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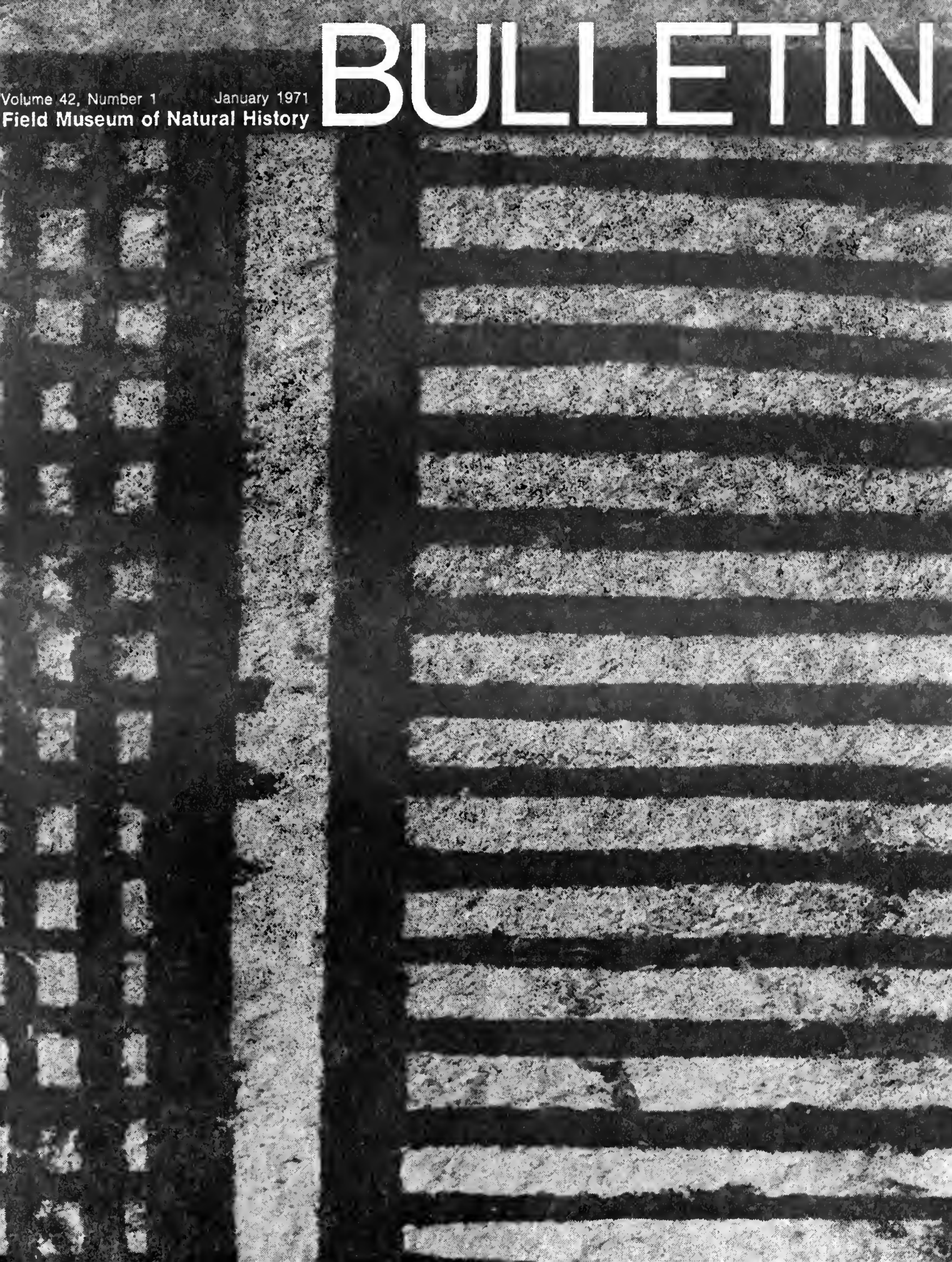
Field Museum of Natural History

BULLETIN



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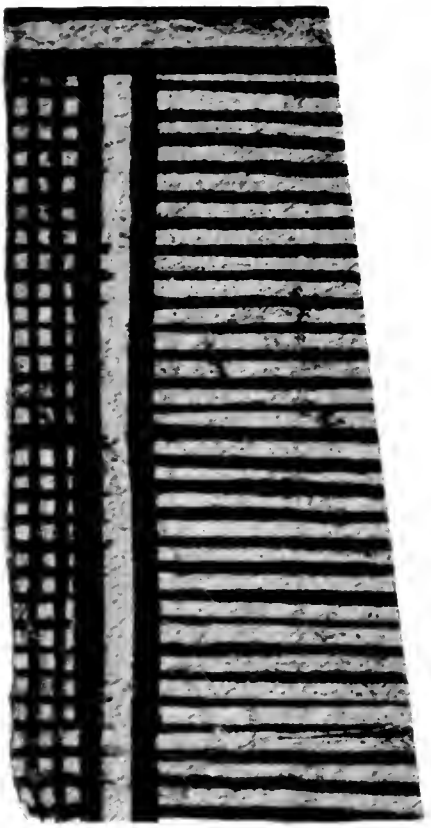

Cover: reproduction of a specimen of tapa cloth from *A Catalogue of the Different Specimens of Cloth Collected in the Three Voyages of Captain Cook, to the Southern Hemisphere.*

Field Museum of Natural History
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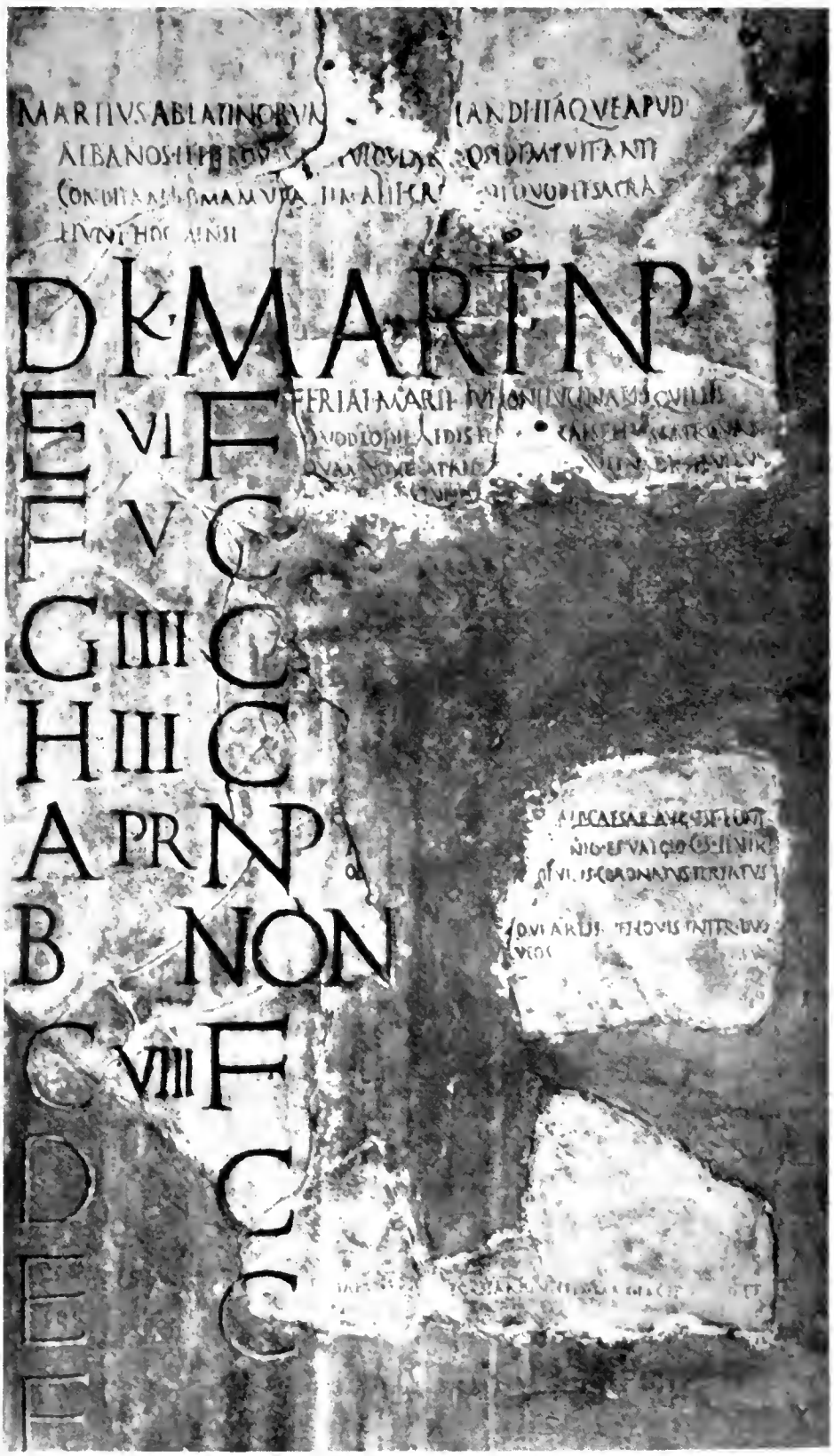
The Primitive Basis of Our Calendar

Van L. Johnson



Why does the year begin on January first? Why are there twelve months in a year and why is the twelfth month December when its very name means "tenth month"? Why does a week have seven days, a day twenty-four hours, an hour sixty minutes? A study of the Roman calendar can lead to answers to questions like these and uncovers the primitive basis of our calendar, an institution that has become a silent dictator of our life's pace in so-called civilized times.

We are still using the Roman calendar except for minor changes made after Caesar's reform in 45 B.C. This is rather remarkable considering the revolutionary changes made in the calendar up to Caesar's time. A study of the origins of our calendar faces the obstacle that the Roman calendar was not published until 304 B.C. and the oldest extant calendar, that of Antium, goes back only to sometime in the early first century B.C. However, evidence for the primitive calendar does exist, for the Roman calendar was basically a list of festivals, anniversaries and annotations which included matter of great antiquity. Also, the Romans, great conservatives especially in their religious concerns, often preserved what they no longer understood and primitive elements persisted—thanks to this conservatism —in most of the great festivals still celebrated in Imperial times. Through a study of these obsolete factors preserved in the written calendars and the later festivals, we are able to reconstruct the earlier history of the calendar and to form some notion about what lies hidden in the prehistoric darkness from which the calendar emerged.

In research of this kind, complete certainty is usually impossible, but I believe that I have found a major clue to the solution of many perplexing problems: namely, an unrecorded four-month year. A study of the nundinal or Roman weekday system first led me to assume the existence in primitive times of this four-month year. Yet its existence can be detected quite simply in our present names for the months: December, our twelfth month, really means "the tenth month," and this count goes back in an orderly way to September, our ninth month, which really means the "seventh month." We know too that August and July, our eighth and seventh months, were originally the "sixth" and "fifth" months (Sextilis and Quintilis) renamed in honor of Augustus and Julius Caesar in their own lifetime. All this implies that the year once began with March, that January and February were added at some time to a ten-month calendar, and that there was an original cluster of four named months—March, April, May and June—to which six numbered months were added to form the ten-month year.

This is a fragment of the calendar of Praeneste for the beginning of March. Fragments of this calendar have been coming to light since the fifteenth century.

It appears that this cluster of four named months was actually an original four-month year. Since three four-month years would just about complete one solar year this was probably the best calendar the Romans possessed and used until Caesar's reform of the calendar in 45 B.C. For most primitive peoples, the sun measures only the day; and the moon, with its distinctive phases is the first measurement of periods beyond that. In addition, primitive people often designate market days (the days when they gathered to exchange goods) with regular intervals between them. The early Romans seem to have followed this pattern and a four-month year may be their attempt to combine a thirty-day lunation with an eight-day market-week. Their market days were called *nundinae* or "ninth days," but this means "eight days" by our mode of reckoning which is not inclusive like the Roman. The meshing of these two time-units—thirty and eight—could be soonest accomplished in four months of thirty days each, i.e., a year or cycle—that is what the Latin word for year, *annus*, seems to mean—of 120 days. This is what anthropologists call a permutation cycle—a term which means that the cycle is completed and begins again every time the two intervals in question coincide: this would have been on March first in the four-month year under discussion. However, the focal point in each month was not the Kalends as the first day, but the Ides or "Divider" which always came sixteen days before the end of the month, because half of thirty on the duodecimal system used by the Romans in computing fractions is not fifteen, but sixteen.

The Ides of March was particularly prominent because March was the first month. In a thirty-day month it must have fallen on the fourteenth day of the month and on the sixth day of a Roman eight-day week. The Ides was celebrated as New Year's Day with great festivities for Anna Perenna, the "Unending Year-Cycle." Festivals like this were known as *feriae*, so that the Ides of March is a ferial day or, as abbreviated in Latin, an F-day. The Ides was also, I think, a nundinal or market-day, for the great fair in honor of Feronia, the market deity, would have fallen on this day in a four-month year. Moreover, all other market days were reckoned progressively from this date, so that all fell on the sixth day of a Roman week and the earliest calendar was probably simply a list of these nundinae. They were also festival or ferial days for the first recognized divinities, so that these days were labeled F. Other days of the week, if they had to be identified, were simply referred to by the remaining letters of the alphabet from A-H.

Days of the month, as opposed to days of the week, were numbered, I believe, by counting up to and down from the Ides: two vestiges of this practice survive in the name "Nones" for the ninth, i.e., the eighth day before the Ides, and in the name of a festival, the Quinquatrus which seems to mean the fifth day after the Ides of March. This practice was abandoned in later calendars when the Nones and the Kalends became reference points in counting, along with the Ides.

Calendar

The primitive calendar was a permanent calendar, of course—something which calendar reformers are again striving for—since a new year began automatically whenever the first day of the week and the first day of the month coincided. The permanent nature of the calendar is nicely illustrated in a phrase which runs through ancient literature on the subject, the *annus vertens* or "turning year." Commentators have seen a reference to the turning heavens and other celestial matters; but at a primitive level, it must have meant something more recognizably physical, and I suspect that it refers to actual four-sided stone calendars with one month on each side. These were no doubt turned, perhaps on a pivot, to face the viewer as the months changed. I would think that we have relics of these in the four-sided rustic month-counters, the *menologia rustica*, which carried a twelve-month calendar with three months on each side. These stones—of Imperial date—have been regarded as seasonal calendars, but that is an odd seasonal arrangement of months for Italy. They are more likely an adaptation of an earlier four-month calendar.

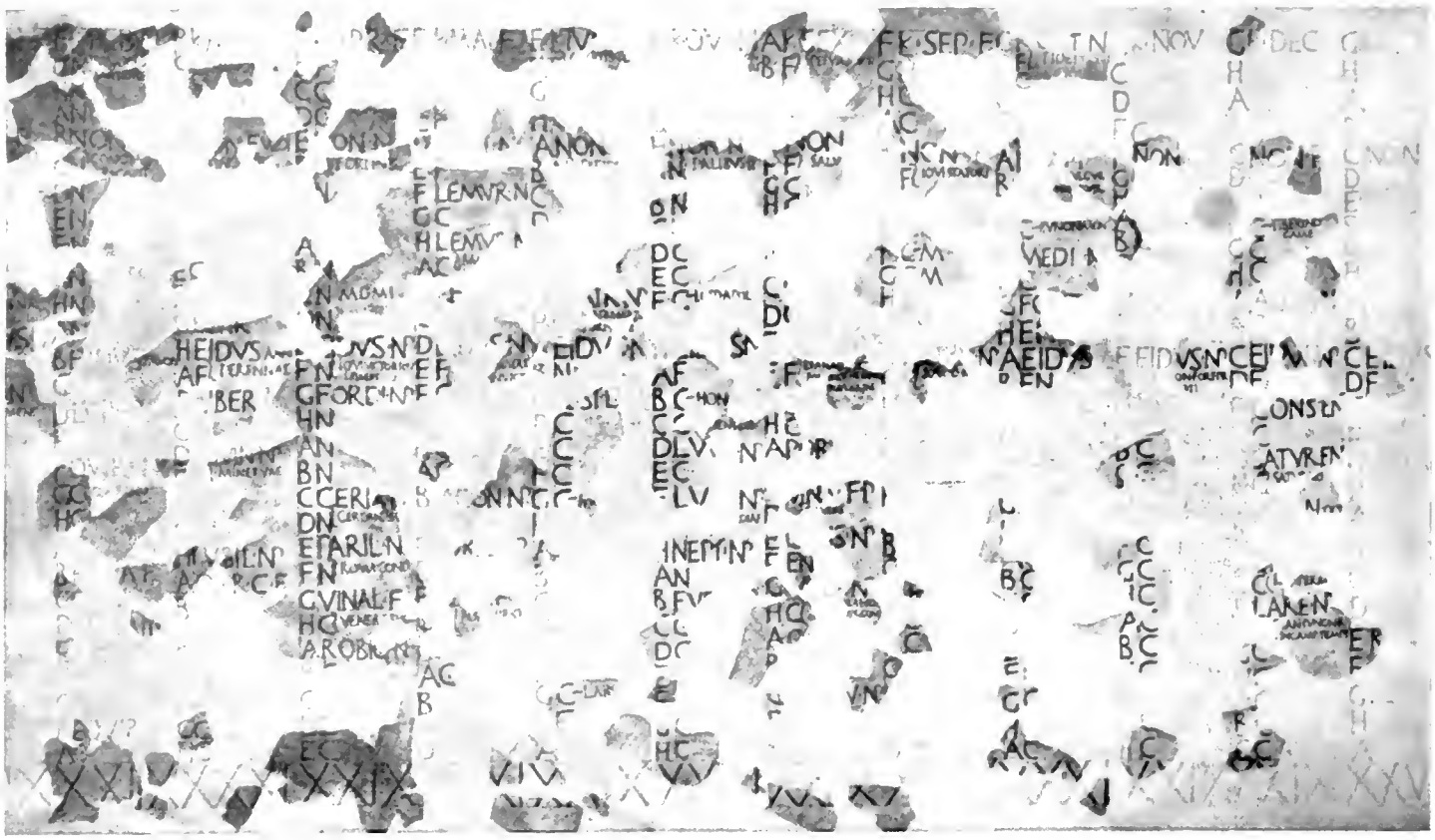
If we analyze this four-month calendar, the units it contained and the rituals it embraced, we can form a clear picture of the community it served and the economy it reflected. The eight-day market-week probably reflects the length of time it took (eight days) to process goat cheese in ancient Italy. The length of the year, 120 days, matches the gestation period of the pig. Two of the primitive month-names, April and May, I would derive from *aper* meaning "boar" and from *maia*, the name of a goddess which I think means "sow." *Maia* is certainly related to *maialis*, the Latin word for a gelding boar, and its derivative *maiale* which is still the Italian word for "pig." The quality of this sow or *maia* was *maiestas*, so after all, "majesty" turns out to be only "pigness." March and June, in my opinion, were not so named in the beginning, for there is no trace of Mars in the festivals of this primitive March; and June, if named for Juno by Latin peoples, would have been called Junonius, not Junius. The first of June was always known not as the Kalends of June but as *Kalendae Fabariae*, the "Kalends of the Bean" and here, I think, we have a vestige of the earlier month-name, Fabarius, the month of the "bean," a staple diet for hogs in early Italy. The month we call March—because the Romans named it Martius later on when the cult of Mars was introduced—may have received its original name, Caprotinus, from a very important festival which later was attached to July and appears there in all the extant Roman calendars as *Nonae Caprotinae*, the Caprotine Nones. In a four-month year this would have been the Nones of what we call March. This illustrates how festivals or parts of festivals were dispersed over an ultimate twelve-month year—an important phenomenon in the study of the calendar. For example, if we identify the Caprotine Nones as originally the Nones of March, it is concurrent with some interesting rites for Vediovis, a god usually described as a youthful Jove to whom a *capra* was sacrificed. *Capra* is the root of *Caprotina* and in developed Latin means "goat," so *Nonae Caprotinae* is usually translated "Nones of the Goat." But we can go even further than this, for *capra* is the cognate of a Greek word *kapros* which means either "sow" or "boar" and accounts perhaps for the name of the island of Capri—irreverent thought! Since both words are also related to Latin *aper* (boar). with a "k" prefix, it is probable that *capra* in Latin originally referred to a sow and not to a she-goat. Therefore the month of Caprotinus is another month named for the pig, and all four months of the primitive contain some reference to this animal or its food.

To the four original months, six months, simply numbered from five to ten—Quintilis, Sextilis, September, October, November and December—were added, tradition says, by Romulus. This new year of ten lunations, or 300 days, corresponding roughly to the gestation period in cattle and in human beings, was augmented by four days to give a multiple of eight for the total number of days in a year, 304, so that the eight-day week would still mesh with months. These four extra days were added, one each, to the months of March, May, July and October which continued throughout Roman history to have their Ides or full moon reckoned on the basis of a 31-day month.

Since the months now varied in their number of days, it was necessary to inaugurate a system of dating which indicated how many days there were in the month at hand. The Nones was made a point of reckoning, and the Kalends was introduced to "call" the Nones. When the Nones took on this new importance for dating, it was necessary to distinguish it carefully from "nundinae" a word which means exactly the same thing as Nones, "ninth days," because there was only one Nones in a month whereas there might be three or four "nundinae" in the same period. Hence the reformer was scrupulous in avoiding a nundinal Nones and later superstition confirmed his effort by suggesting that a nundinal Nones was unlucky. The force of this scruple explains why "Romulus" added a day to alternate months until he got to September; he skipped September and added a day to October because thirty-one days in September would have produced a nundinal Nones.

Numa, the second king of Rome, is credited with instituting the first lunar year by adding fifty days to the calendar of Romulus. To equalize the distribution of 354 days over twelve months, he subtracted one day from each of the thirty-day months, added these to his new fifty days and divided the sum, 56, into two new months of twenty-eight days each: January and February.

Since fifty-six is a multiple of eight, both January 1 and March 1 were A-days (first days of a Roman week)

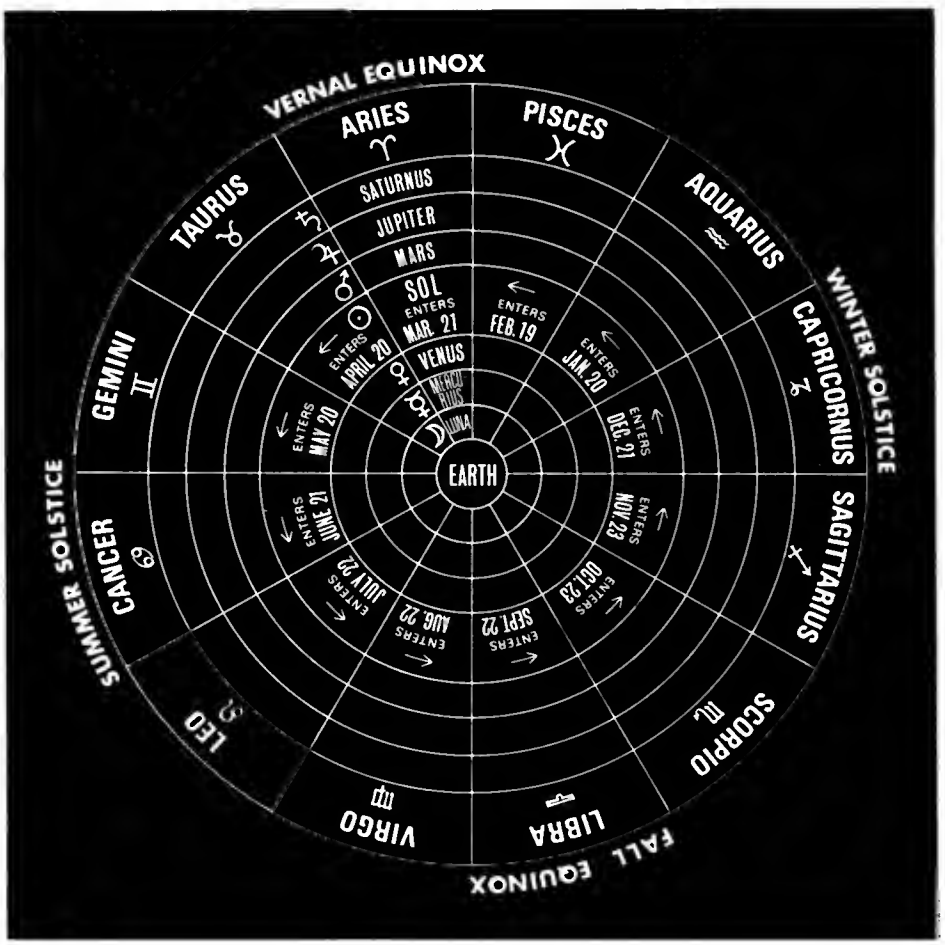


This is the fragmentary calendar of Antium discovered in 1915 by the Italian scholar G. Mancini. This inscription records the oldest extant Roman calendar unearthed to date. The thirteen months is represented by a column with the abbreviations for the name of the month at the top, and includes the intercalary month. The first column of letters under each month indicates the eight days of the Roman week lettered from A to H. The second column of letters abbreviates the legal status of certain days and the abbreviated words indicate the dates of festivals or dedications.

Calendar

in the first year of this reform; but to keep them so, since 354 is not a multiple of eight, it was necessary to add days to one week toward the end of the year. This was accomplished, I believe, by lettering three days, namely December 17-19, all as F-days. This was done by instituting the Saturnalia on December 17 and connecting its ferial functions with those of the Opalia on December 19. Thus a tradition for a three-day Saturnalia developed and we find the real origins of intercalation in this very simple device to make the year end with an H-day (the last day of a Roman week). Meanwhile, the reformer neatly contrived to leave it an open question as to when the year really began. March first was still an A-day, but so was January first.

Reforms, however, can be over-ingenious and that proved to be the case with the calendar of Numa. The intercalation was immediately neglected or misunderstood or even resented (since January first had no sanctity as an A-day) and people went right on lettering December 17-19 in the normal way. This produced a nundinal Nones in January—or would have done so if new measures had not been taken. The same reformer, or a new one whom I label Numa II, found a solution by adding a day to January; thus removing the Nones from its unlucky nundinal position and giving the year 355 days, a number achieved in this simple way and not because of any superstition against even numbers (the ancient explanation). But 355 is not a multiple of eight either, so a new method of intercalation had to be devised. This consisted of adding five days to the calendar between February 23 and 24, all lettered in the normal way, but this time unnumbered. Here we have the origin of two interesting festivals, the *Terminalia* of February 23 and the *Regifugium* of February 24, as well as the origin of intercalating at this point in the calendar. March 1 thus resumed its old sanctity as the one true New Year's Day and remained so for some purposes down to 153 B.C.



During the Republic, intercalation came to be used for a different purpose: to bring the lunar year into accord with the solar year of 365 or 366 days. An intercalary month of twenty-two or twenty-three days, called Mercedonius, was added in alternate years after February 23, the day of the *Terminalia*, and the last five days of February were absorbed as the last five days of Mercedonius, a vestige of Numa's five unnumbered days. This device was so often neglected, however, or corrupted by priestly or political abuses that the calendar had very little relation to the sun's course when Julius Caesar and his learned adviser, Sosigenes, introduced those reforms which are still the basis of our calendar. Caesar first extended the year 46 B.C. to 445 days, thus bringing the old calendar into agreement with astronomical observations; then, on January 1, 45 B.C. he introduced a solar calendar of 365¼ days: the fourth parts were allowed to accumulate and produce a year of 366 days once every four years. To achieve the ten new days of a normal year (365 minus 355), Caesar added two days each to January, August and December, one day each to April, June, September and November; and the extra day for leap years was inserted after February 23 as February 24 repeated, i.e., *bissextilis* the "twice sixth-day" before the first of March. So it is we speak of a bisextile year.

Caesar's calendar was eleven minutes, fourteen seconds too long, so Pope Gregory made a slight adjustment in 1582 A.D., dropping ten excessive days at once and stipulating that leap year be observed in centesimal years

only when they are divisible by 400. These corrections were not accepted in Great Britain and the American colonies until 1752 A.D.

The seven-day planetary week was not common in Rome or the West until the third century of our era although it appears to have existed alongside the Roman eight-day week in a Sabine calendar in the first century after Christ. The planetary week had its origins in the Eastern Mediterranean where Babylonian astrology, the Hebrew Sabbath-week and Egyptian astronomy combined to formulate and confirm it. The nature of the planets was first discovered in Mesopotamia where an intense interest in the heavens gave rise to the pseudo-science of astrology: the sun and moon, however, were included in a list of seven "planets" or "travelers," and the earth was omitted as being the stationary center of a geocentric universe. Saturn, Jupiter, Mars, Venus and Mercury (to use the Latin names still current) were properly located, at least in respect to their relative distances from the earth. Pluto, Neptune and Uranus were, of course, unknown so the seven "planets" were Saturn (the outermost), Jupiter, Mars, Sol, Venus, Mercury, and Luna, in that order. The planets were conceived as moving in spheres or orbits around the earth and passing through twelve constellations or "fixed stars" which made a zodiac or "belt of animals" around the heavens, with the sun's path or ecliptic as the middle line. Since the sun travels through all twelve signs of the zodiac in one year and remains about the same length of time in each, this system evolved something like a solar month which could be related to the equinoxes and the solstices.

But in Egypt the planetary system underwent further development, as the seven planets were meshed with a twenty-four hour day: assigning Saturn to the first hour of the first day, Jupiter to the second hour, Mars to the third, etc., introduces Sol at the first hour of the second day, Luna at the first hour of the third day, and so on until each "planet" has been associated with that day of which it marks the first hour. Thus the seven "planets" name the seven days of the week in this order: Saturn, Sol, Luna, Mars, Mercury, Jupiter and Venus. In this sequence these seven celestial bodies still name, with minor exceptions, the seven days of our week; French preserved the Latin names while German and English translate them into the names of counterparts among Germanic deities.

The day itself appears to owe its twenty-four hour division to an Egyptian arrangement which affects the Graeco-Roman world at an early period, since twelve hours of night and twelve hours of day were customary both in Greece and Rome. The twelve-hour system originated in certain "diagonal" calendars which date back to anywhere from 1800 to 1200 B.C. in Egypt.

The Egyptians had a solar year of 365 days divided into twelve months of thirty days each, plus five epagomenal days. The 360 days of the twelve regular months were divided into thirty-six decades of ten days each, to each decade there was assigned a particular constellation or decan. The heliacal or dawn rising of this constellation marked the last hour of the night for a ten-day period; it was then succeeded as decan by a new constellation, and retired—so to speak —to the next-to-the-last hour of the night, and so on. Only one of these decans can be identified, Sirius, whose heliacal rising in the summer marked the inundation of the Nile. Had day and night been of equal length, 18 decans would have been visible every night: but because of twilight and the short nights of summer when Sirius rises, only twelve were visible over a ten-day period. This twelve hour division of the night was then imposed on the day, perhaps reinforcing a division of the day into ten hours plus one hour of morning twilight and one hour of evening twilight—a division which was known in Egypt as early as 1300 B.C. Our division of the hour into sixty minutes is the result of Hellenistic computations worked out on the sexagesimal system first devised by the Babylonians about 1800 to 1600 B.C. Thus the sixty-minute hour, the twenty-four hour day, the seven-day week, the twelve-month year—all represent centuries of development from a primitive mixture of superstition and acute observation to the system now taken for granted.

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Tapa Cloth

W. Peyton Fawcett

The Museum has received with the greatest pleasure another gift from Mrs. E. W. Fuller of Sussex, a rare and interesting book titled *A Catalogue of the Different Specimens of Cloth Collected in the Three Voyages of Captain Cook, to the Southern Hemisphere.* This volume, from the library of Mrs. Fuller's late husband Captain A. W. F. Fuller, is one of the curiosities of literature and is of great ethnological, artistic, and historical value. It is a most welcome addition to the Library's collections.

The volume was published in the year 1787 in London and is illustrated with actual samples of the tapa or bark cloth collected by Cook and his companions during that great explorer's three voyages. The text is brief, consisting of some observations on the manufacture of bark cloth in Polynesia, and chiefly taken from the journals of Cook, Anderson, and John Reinhold Forster. Appended to this are "the verbal Account of some of the most knowing of the Navigators" and "Some anecdotes that happened to them among the Natives" in the form of notes on the items listed.

Oddly enough the author is not known and his dedication, in vigorous, picturesque, and charming English, is to a person not named:

> Sir, these are only select specimens for a few friends, but if I was capable to give the public a particular account of the manner of manufacturing cloth in every part of the world, I would not hesitate one moment to dedicate it to you, as there is none more ready to feed the hungry and clothe the naked: would to God it was as much in your power as it is in your heart to wipe the tear from every eye, but that is impossible; for while you was teaching Indian nations how to be happy, you was as much wanted at home, where it is our constant wish that Heaven may long preserve you the support of science, and idol of family and friends . . .

Henry Usher Hall, in his description of the copy of this work in the Pennsylvania University Museum ("A Book of Tapa," *The Museum Journal,*

vol. 12, no. 1, 1921), argues very plausibly that this person is Warren Hastings, the first titular Governor of India, whose impeachment was pending at the time the dedication was written.

Another curious feature is the disparity between the number of specimens as given in the list and the actual number of tapa specimens and in their arrangement. Our copy agrees with that in the Pennsylvania University Museum in having 39 items on the list and 43 actual specimens, but the arrangement seems to differ. Hall notes that the Peabody Museum of Salem copy has 56 specimens and a list of 39. The copy described by Dr. W. T. Brigham in his book on tapa making *Ka Hana Kapa (Memoirs of the Bernice P. Bishop Museum,* 3, Honolulu, 1911) apparently has only 39 actual specimens, but again the arrangement is different. Captain Fuller had compared his copy with others and noted that "The printed descriptions are totally unreliable and have no relation to the specimens." I should like to remark in passing that Captain Fuller was a man who knew his books and collections intimately and who kept copious and meaningful notes on the provenance, history, peculiarities, and other features of his materials. I have had the pleasure of cataloguing a number of his books and have much admired the fullness and depth of his researches. The present volume is no exception and is enriched with a number of valuable notes.

The difficulties in identifying particular specimens as they stand with the numbers of the list, which is not in any real sense descriptive, are very great; the actual specimens are unnumbered. As Hall points out, "The original compiler's chief concern, apart from that in the methods of manufacture, seems to be with the human interest evoked through contact by the proxy, so to speak, of their intimate belongings with the simple people of the South Seas. It is with a kind of pleased surprise that he finds these people capable of emotions quite other than fierce." A good example of this is the description of cloth number 34 of the list:

> From Otaheite [Tahiti], wore as garments by the ladies. A number of the natives being on board of the Resolution, one of the chiefs took a particular liking to an old blunt iron, which lay upon one of the officer's chests, and taking hold of a boy about nine years of age, offered him in exchange, pointing to the iron. The gentleman, although he knew he could not keep the youth, yet willing to see if he would willingly stay; or if any of the rest would claim him, took the child and gave the savage the iron; upon which a woman, who appeared rather young for the mother, sprung from the other side of the ship, and with the highest emotions of grief seemed to bewail the loss of the infant: but the lieutenant, with a true British spirit, took him by the hand and presented him to her, upon which, after putting her hands twice upon her head, she unbound the roll of cloth which was round her body, and from which this specimen was cut, and having spread it before him, seized the boy, and jumping into the sea both swam ashore, nor could he ever learn whether she was the mother, sister, or relations, and this he lamented the more, as such affection was very seldom seen among those people.

Specimen number 34 in our volume is very thin and of a dark ivory color. Number 34 in the Brigham copy is described as "A thick coarse, ribbed cloth painted in triangular patterns of orange, red, brown, with black dividing lines. So far as the diminutive specimen shows the design, it was gaudy rather than artistic." Hall believes that number 37 of the Pennsylvania University Museum copy is the same as Brigham's 34. From the plate in Hall's article it appears that our number 11 is the same.

Of the accounts of the manufacture of bark cloth three are well known and the one from an anonymous navigator is rather too long for quotation. Basically, the manufacturing process, similar to making felt, consists of stripping off the bast and soaking, then beating it to cause the fibers to interlace and achieve proper thickness.

The uses to which this cloth was put were many and varied. Its principal use was for clothing, chiefly in the form of loin cloths for men and women, breech cloths for the men, and mantles and cloaks for both sexes. It was also an important medium of exchange and an element of wealth. As such it was presented to distinguished visitors as a mark of favor. It also had many uses connected with religious and ceremonial occasions.

The Museum owns other pieces of tapa cloth from the Fuller collection, including one lot of great historical significance. Captain Fuller, speaking of it in 1958, said:

> This is a little collection of seven pieces . . . from I don't know [where]. Some look Hawaiian, others look Tahiti[an]. This is the oldest piece in the Fuller collection; it was a collection made by my great or my great-great grandfather on my father's side, Richard Fuller. It was a little lot kept in a microscope box. We used to play with these pieces when young. There were a great deal more then. They got lost and smaller as a result. A wonder any remain. It is inscribed by my grandfather, Richard Fuller, Jr. of Chichester . . . 'O-Tahiti, tapa cloth, made of the bark of trees brought to England by Captain Cook.' That being so, it must have been a gift to one of my relatives, great grandfather, etc., or one of my great uncles—one was a wealthy old chap, and helped to finance Cook, it is not generally known.

It is fitting that, through the generosity of Mrs. Fuller, these specimens and the tapa cloth volume are together again.

W. Peyton Fawcett is Head Librarian at Field Museum.

Space Biology and the Murchison Meteorite

Dr. Edward J. Olsen

Over the past year Field Museum has acquired over 60% of a new meteorite which fell on September 28, 1969 near the small town of Murchison, Australia, about 60 miles north of the city of Melbourne. From the very first it was clear that *Murchison* was an extraordinary meteorite. Initial research work, principally at Field Museum and Argonne National Laboratory revealed it to be what is called a Type II carbonaceous chondrite, of which only fourteen exist out of the almost 2000 known meteorites. These carbonaceous meteorites are unique in that they contain about 13% water (combined in some of the minerals that compose them), and 2% to 2.5% carbon, a small portion of which is combined in a large number of different organic compounds. Because of the presence of these organic compounds this group of meteorites has excited a great deal of research activity especially over the past 20 years when instrumentation has been developed that permits extremely sensitive examination of them.

It has been known for almost a century that numerous organic compounds can be produced without the intervention of any form of living matter. Many of them can be fairly easily synthesized in the laboratory. For some of them there is absolutely no difference between the synthesized compounds and the same compounds that are made biologically. For others, however, there are small, but significant differences. The most interesting of these is the group of compounds called amino acids. Amino acids consist of chains of carbon, hydrogen, oxygen, and nitrogen atoms. Different internal arrangements constitute the different acids of the group. An amino acid chain has an interesting property. Because of the way carbon atoms link to other atoms of carbon, hydrogen, etc., an amino acid chain has a twist to it, somewhat like a spiral staircase. The spiral can twist either clockwise (which is called *d*, for dextral), or counter clockwise (which is called *l*, for levorotatory).

Which way a given amino acid chain twists is immaterial. It takes just as much chemical energy to form one way as the other. Thus, when a chemist is synthesizing some amino acid in the laboratory the chances are 50:50 that any given molecule will form as a d-type (or as an l-type). This is exactly how it turns out. With a device called a polariscope this can be measured with great accuracy and, as predicted, a laboratory-synthesized amino acid shows that half the molecules form one way (d), and half form the other way (l). When, however, the same amino acid is formed by a living organism the organism imposes a pattern upon it in such a way that all the molecules twist in only one way. Most organisms produce entirely l-type amino acids, though some of them produce d-type acids. No organism produces half l-type and half d-type.

In the mid 1950's Dr. Stanley L. Miller performed an experiment based on an idea conceived by Prof. Harold C. Urey, a Nobel Prize laureate in chemistry. Both were at the University of Chicago at the time. It is known that the earliest atmosphere of gases surrounding any planet, including the young Earth, four-and-one-half-billion years ago, consisted of the gases methane, ammonia, hydrogen, and water (as opposed to our present atmosphere of

A piece of the Murchison meteorite fall. This particular piece is about seven inches long and shows the black fusion crust around the outside. Part of this crust is flaked away revealing white mineral fragments scattered in a black matrix. The matrix contains organic compounds in small amounts. Argonne National Laboratory Photo.

mainly nitrogen and oxygen). Urey reasoned that simple electrical discharge (lightning) in such a primitive atmosphere could produce simple organic compounds that might be progenitor-molecules for living forms. Miller set up a chamber that contained these gases and wired it to produce discharges of appropriate energies. The analysis of the results proved to be vastly better than expected. In addition to some simple organic compounds, nine different amino acids were formed and identified, and fourteen others were detected but not specifically identified. Because these were produced by a strictly physical, non-biological process, these acids showed the characteristic 50% l-type, 50% d-type distribution. Thus, it was clear that some quite significant organic compounds could be formed by a very simple process. When several amino acids combine they can form combinations called proteins. The simplest living thing of which we know is a type of self-reproducing protein molecule called a virus. Thus, amino acid formation is only a step away from possible simple life forms.

After this experiment there were grounds to carefully examine the carbonaceous meteorites. They show little sign of having undergone any serious change since they were formed in the solar system 4.5 billion years ago. It is possible they might contain remnant amino acids, formed by a Urey-Miller process, among the organic compounds in them.

A search of this kind is not easy because the chance of contamination by terrestrial amino acids is great. Amino acids are present on our hands and skin, and the air is rich with bacteria and viruses that contain them. Because of this the first finds of amino acids, in the 1950's, proved to be false alarms due to contamination. The search has gone on intermittently ever since among the small number of carbonaceaus chondrites, always with negative or equivocal results. The newest of these, *Murchison*, has been the object of this search since it fell late in 1969.

In early December 1970 national attention (*Time Magazine, New York Times, National Observer, Chicago Tribune,* etc.) focused on the findings of Dr. Cyril Ponnamperuma, who is a researcher at the NASA establishment at Moffet Field, California. He reported isolating seventeen different amino acids in minute amounts from the *Murchison* meteorite. He went on to report that these showed just about a 50:50 split between l- and d-types. This means, of course, they are the products of a non-biological process—a purely physical process. Were these due to contamination it would be almost impossible to accidentally obtain such a 50:50 distribution. Contamination by humans, or bacteria, etc., would create a huge preponderance of l-type chains. This, along with other lines of evidence, seems to rule out contamination as a factor.

The consequences are clear. A simple process, such as that of the Urey-Miller experiment, operating in a primitive atmosphere at the very start of the solar system is capable of producing the basic building blocks of life. How long it took for such amino acids to link into proteins and more complex forms no one yet knows. Perhaps more important is the fact that the initial step, formation of amino acids, is so relatively simple. It is, what is called, an event of high probability. This means that life may be vastly more prevalent in the universe than we ever imagined.

Dr. Edward J. Olsen is Curator of Mineralogy in Field Museum's Department of Geology.

Portrait of a Naturalist-Explorer

Joyce Zibro

"I can think of a lot of easier ways to slide through my final years," says Field Museum's Curator of Birds, Dr. Emmet R. Blake. "But somewhere along the line, perhaps while being weaned back in South Carolina, I became infected with that dread virus known as the Protestant Ethic which holds that everyone should strive to 'amount to something' and to justify his existence by some work of value to posterity."

The work of value which Dr. Blake is preparing for posterity is the *Manual of Neotropical Birds,* a monumental undertaking which will provide for the first time and under one cover, taxonomic information, descriptions, appropriate keys and the distribution of more than 3,200 species and over 8,500 races or subspecies of Central and South American birds.

The natural culmination of a long professional career that has combined to an unusual degree both laboratory research and field studies, Blake's *Manual* will provide a source book for the professional biologist in diverse specialties. Perhaps its greatest potential applied value is in the field of tropical medical research. The virologist and parasitologist, especially, will find in it a convenient means of identifying host species of medical interest.

"The bird fauna of the Neotropical region," says Blake, "far exceeds that of any other zoogeographical entity and accounts for more than one-third of the world's species. The *Manual,* in effect, will be an elaborated synopsis of this avifauna in several volumes."

Blake began work on the *Manual* in late 1965 under a grant from the National Science Foundation. The first volume, now near completion, probably will be published in 1971. Work on the *Manual* is being continued under a recent grant from the Irene Heinz Given and John La Porte Given Foundation. The final work, consisting of several volumes, is scheduled for completion in 1984.

"It's hard to say where it all began," says Blake, looking back over what is recognized as an outstanding career in museum ornithology. "I've always been interested in birds and other animals and especially enjoy studying them in their natural habitats. Even as a young boy I knew what I wanted to do and prepared myself the best I could in every way I knew. But the rest was pure luck, the breaks. Somehow I just happened to be in the right places at the right times more often than not."

The youngest of a large family of modest means in Abbeville, South Carolina, Blake's enthusiasm for biology has been described by a boyhood friend as "a case of the fixed idea." Turned journalist, the friend, Preston Grady, wrote of Blake in the Greenwood *Index-Journal* of August 16, 1932:

> As a small boy he compiled notes and sketches of his observations which he still proudly exhibits. He held an intense interest in natural history studies and wild life from his earliest youth, and spent most of his boyhood afield, preferably alone. He usually had a menagerie of local wild pets . . . At 15, he entered Presbyterian College, Clinton, and during the next four years flunked at one time or another most courses given there except biology. Biology and kindred subjects were so much pie . . . Much of his time was spent afield, carrying taxidermy to some degree of perfection and becoming locally famous as the catcher of snakes and birds.

Graduating from Presbyterian College at 19, Blake, with $2.65 in his pocket, hitchhiked to Pittsburgh, where he hoped to get a job and work his way through graduate studies in order to "muscle into museum work." Having won the ROTC light heavyweight boxing championship of eight states in college, Blake was able to tie down a part-time job as boxing and swimming instructor for the local YMCA. Concurrently he worked in a settlement house. These, combined with an eight-hour night job pumping gas supported him in graduate school at the University of Pittsburgh. "It was life with a big 'L'," says Blake, "and I had a ball. With all those jobs money simply poured in. It totalled almost $150. A month, that is," he added with a wry smile.

One of "the breaks" came in 1930 and Blake interrupted his studies to assist experienced South American explorer and professional ornithologist, Ernest G. Holt, on a yearlong expedition for the National Geographic Society up the Amazon and into the unexplored jungles and mountains of the Brazil-Venezuela boundary.

Back in the States and nearly penniless again, Blake for a time became a private detective, pick and shovel construction worker and professional prize fighter. And back at the University of Pittsburgh, at age 22, Blake was

promoted to graduate instructor in zoology and continued his studies.

"In December of 1931," recalls Blake, "came a call from Field Museum of Natural History asking if I would accompany and supervise a hunting trip to the Orinoco River and remain in Venezuela to do some intensive collecting for the Museum." Sailing for South America aboard the sponsor's yacht, Blake supervised jaguar hunting in the Orinoco delta region for several weeks before taking on the real work of the expedition—alone. Penetrating the Venezuelan coastal range from the port of Cumana, Blake succeeded in reaching the 9,000-foot summit of Mount Turumiquire where in a period of 35 days, working 18 to 20 hours each day, he collected 803 birds, 96 reptiles and 37 mammals, perhaps a record collecting performance for one man. The collection included several forms new to science, including a lizard, *Anadia blakei,* named for the collector.

In 1932 a headline in Blake's hometown newspaper summed up his career thus far: "At 23, Emmet Blake of Greenwood Is a Veteran Scientific Explorer."

Having thus prepared himself "as best I could in every way I knew," Blake was offered and accepted a position as Assistant in the Division of Birds at Field Museum in July 1935. "I had been following the activities of Field Museum staff scientists ever since I was able to read," says Blake. "It is one of *the* really great natural history museums and, in a way, perhaps the goal toward which I had been moving all my life."

Blake interrupted his museum career in 1942 to serve with the U.S. Army Counter Intelligence Corps for more than three years in North Africa and Europe. Returning to the United States

Holding a Two-toed Sloth, Dr. Blake had this photo taken in Orinoco Delta, Venezuela while on the Mandel-Field Museum Venezuela Expedition in 1932.

with the rank of captain and several medals, including the Purple Heart, he resumed his work at the Museum and was promoted to Assistant Curator of Birds in 1947. He has served as Curator of Birds since 1955.

Referred to by a colleague as "one of the hardiest field men ever," Blake has participated in eight tropical expeditions to collect specimens and has seen the Museum's collection of birds increase from 75,000 in 1935 to well over 300,000, making the Field Museum collection one of the largest and certainly among the most important research collections in the world.

"It's hard to select what might have been the most exciting expedition I've been on," says Blake. "The West Indies, Mexico, Guatemala, British Honduras, Venezuela, Colombia, the Guianas, Brazil, Peru, they were all wonderful experiences. If you have to pin me down to one trip I guess it would be the Sewell Avery Zoological Expedition of Field Museum to the Acarai Mountains in southern Guyana (formerly British Guiana) in 1939. Schomburgk, the German naturalist, had preceded me by a century but at the time of my visit the Brazilian frontier of the Guianas was still uninhabited, even by Indians, and virtually unknown to biologists. I remember it as a region of jumbled mountains and turbulent streams blanketed by a trackless forest; a 'lost world' if there ever was one. Access to that remote area was possible only by canoe or small boat, first by ascending the treacherous Courantyne River, which forms the boundary between Surinam and Guyana, and then its tributary, the New River.

"I arrived at Georgetown, capital of Guyana, on August 12 with six hundred pounds of carefully selected collecting and field equipment," says Blake. "A small, chartered hydroplane flew a native taxidermist and me into the interior. After a flight of several hours we were deposited on the Courantyne River just above King Frederick William IV Falls, and so avoided weeks of dangerous river travel. At the falls were Richard Baldwin, an experienced riverman who was to serve as assistant for the expedition, twelve Indian and Negro boatmen and the expedition's 32-foot boat, the *Oronoque.* It was powered by an outboard motor supplemented by Indian paddlers, and was capable of surviving all but the worst rapids.

"All of our heavier supplies and equipment had to be relayed up the river, through and often around innumerable rapids, to the head of navigation on Itabu Creek where a base camp was established. Traveling light, we then pushed on for days in dugout canoes until they, also, had to be abandoned. Finally the long, long

This photo of Dr. Blake holding a Margay Cat was taken in 1932 at Mt. Turumiquire, Venezuela during the Mandel-Field Expedition.

trek overland with heavy packs until we reached our objective, the crest of the Acarais where Guyana and Brazil meet. A crude camp was rapidly thrown up and intensive collecting, almost around the clock, began some five weeks after joining the boat crew.

"With three collecting guns in use from dawn until dark, extensive trap lines set for small mammals each night, and several men scouring the forests for specimens of all kinds, the collections grew rapidly. More than 2,000 specimens of birds, mammals, reptiles and fish, not to mention insects, were collected in the space of a single frantic month. We reluctantly broke camp in mid-October and raced for the coast. To have remained in the mountains longer would have left us stranded by the shrinking streams of the dry season.

"Rivers had dropped about fifteen feet during our month in the mountains, and stretches of water which had been relatively placid during our ascent were now seething rapids, often with whirlpools. Many channels which had been difficult before were potential death traps that we approached with dread. Disaster was an imminent possibility as our dugouts were run or 'streaked' through interminable rapids. Any serious accident could be fatal. In the Guyana hinterland you can't just walk out; you move by boat or not at all. We abandoned the dugouts above King Frederick William IV Falls and thereafter were dependent on the *Orinoque* for the final dash home.

"After caulking, the *Orinoque* was again launched and we had visions of reaching civilization within a week or so. But while running rapids only

hours after pushing off we struck a submerged rock and were capsized in mid-river. Suddenly it was every man for himself. I found myself under the overturned boat struggling frantically to avoid being enveloped in a tarpaulin that had been used to cover the cargo. It was a close call, almost as bad as that little affair at Anzio Beachhead . . . but that's another story.

"Well, to make a long story short, all of us managed to reach an island in mid-river, but without food, equipment, or even clothes. A few things were salvaged from pot-holes later, including some of the specimens. I sent some of the men to the Surinam shore and they managed to make their way back to King Frederick William IV Falls, a ten-day trek, to retrieve several dugouts that we had abandoned. Meanwhile, the rest of us scrounged for food, alternately baked under the tropical sun or froze at night, slapped mosquitos, dried remnants of the collection and painstakingly fabricated a couple of serviceable canoes from the salvaged tarpaulin and the bark of a 'purpleheart' tree.

"With the return of our 'rescuers' from up-river we formed quite a flotilla. Its arrival at La Tropica, a Surinam police outpost and farthest interior point of civilization on the Courentyne, created quite a sensation. In fact, it was a near disaster. We showed up unannounced at about 2 a.m., were mistaken for attacking escapees from Devil's Island, and were very nearly shot before identifications could be established. All in all, it was *quite* an experience. Wouldn't care for a repeat performance every day before breakfast, but in hindsight I wouldn't swap the memory for—well, you name it."

Letters written to a museum colleague by Blake when on an expedition to Peru in 1958 give an insight into some of the lighter episodes which make up a part of any natural history expedition and reveal Blake as a man of wit and humor. He gives us this account of his reception at Hacienda Villacarmen on the banks of the Peña Peña River in Amazonian Peru:

"This being the height of the dry season there were several all-day deluges that gave me a 'breather'—and also the two-day celebration in honor of Saint Carmen, patron Saint of the Hacienda. For the Indians it lasted 56 *continuous* hours of dancing and drinking raw cane alcohol. The rest of us—I couldn't avoid becoming involved—settled for a single night of dancing and weak, but seemingly

In 1958, Dr. Blake was on the Boardman Conover-Field Museum Peruvian Expedition. This photo was taken in Rio Madre de Dios.

inexhaustible beer. Our party included visitors from neighboring haciendas and apparently all leading citizens of a nearby village who either owned or could borrow shoes. By secretly fortifying myself with half a cup of cooking oil 'El Doctor Americano' responded to each and every 'Salude' and lasted the full stretch to 4 a.m. My probably elephantine endeavors in the realm of the tango, samba and mambo were much admired and produced roars of 'Ole.' In brief, I think I succeeded in maintaining the honor of the Museum and integrity of the U.S.

"While at Villacarmen," Blake continues, "there was one bit of excitement that did scare hell out of me. An Indian was brought in who had been bitten by a snake believed to be invariably deadly. He had already slashed the wound and was wearing a vine ligature. 'El Doctor' was hurriedly summoned to take over and that poor devil hadn't previously taken the trouble even to read the complicated directions with his anti-venom equipment. I was really on the spot, however, and with an audience of 20-30, had to go through with it. I soon had the victim's leg so loaded with suction cups that it looked like a lemon tree and was about to give him an injection when it dawned on me that the leg wasn't even beginning to swell. I sent for the snake. It was brought in, headless, but to me quite obviously only an eight foot boa. The women began to weep, there was quiet discussion of a burial detail—they don't waste time in these latitudes—and even the victim began to look thoughtful. They still insisted it was the deadliest of all snakes; the only explanation I have is that possibly they had confused it with a bushmaster. OK. They had their way, but I decided to have myself a ball with some pseudo-medical mumbo-jumbo and reap the rewards. Old Doc Blake swung into action by keeping the suction cups going for another half hour while he took the patient's pulse, listened to his heart, dilated his pupils and took his temperature every five minutes. This last inspiration gave me a wonderful opportunity to show varying degrees of consternation. Finally, I announced the man was going to recover, but *must* have a week's complete bed rest wrapped in blankets, five bottles of beer every day (dilutes the venom, enriches the blood and tones up the system), and no sex for a month. I don't know about the patient's subsequent love life but I do know he followed the other directions because I visited him every day to check his pulse and help him with his beer!"

In still another letter from Peru, Blake tells about his expedition cuisine. "I came out (from Manú) in a magnificent 40-foot cedar dugout as the 'paying guest' of a man named Trencoso, an older brother of my hunter. The trip took six days (Manú to Pilcopata) and it rained most of the time. We always broke camp early, were on the river by 5:30 or 6:00 and didn't stop until nightfall. Meals were simple: coffee—sometimes with cold monkey and rice soup for breakfast, crackers—sometimes with sardines or smoked fish for lunch, and coffee with hot monkey and rice soup for supper. The soup was very good and usually one could chew on the hunk of meat all the next day . . . As the paying guest I rated the best and first of everything. My plate was the top of the stew pan and I usually got the one spoon for my soup instead of the one fork. Palm leaves served as plates when the

utensils were in use otherwise. It's remarkable how easily one can accept these conditions as *the* way of life, and really enjoy them. Although wet, hungry and bug-bitten the whole way I had a hell of a good time."

Again writing from Peru, Blake shares some of his leisure-time thoughts with his colleague at the Museum. "Almost any night while listening to my men snoring," says Blake, "I could lie in my hammock, close my eyes, and in a moment go back 40 years and 3000 miles to the Greenwood of my youth and see once more (for free!) the circus parade as it formed in the vacant lot next to shanty town beyond the Seaboard Airline Tracks. Here it comes now, up Maxwell Avenue, past the Bijou Theatre and water tank to make its turn for the Fair Grounds at Ellis's Funeral Parlor. First comes a calliope, followed by the elephants . . .

"But expeditions are only a part, albeit an essential and exciting part, of museum work," says Blake. "On returning from any expedition, specimens, often in the thousands, must be identified and catalogued, the new forms described and named, and the entire collection studied critically as steps in the preparation of the final technical report." Blake sums his business up this way: "In this manner, little by little, slowly and sometimes painfully, we learn more about the world around us and the myriad creatures that inhabit it."

At Field Museum in 1971 Dr. Blake is doing research and working on the Manual of Neotropical Birds.

Out of Blake's explorations and laboratory research have come over one hundred articles and books, both technical and popular, on birds. His best-known book, *Birds of Mexico, A Guide for Field Identification* is now in its sixth printing and is recognized as an authoritative work on the rich and varied bird fauna of that country. Written primarily for the bird watcher, its 650 pages treat all of the 967 species that have been recorded from the Mexican mainland, the adjacent waters and associated islands.

In his personal life Blake, like many of his museum colleagues, is still very much the outdoorsman and naturalist-explorer. Vacations usually are spent camping and on wilderness canoe trips which over the past twenty years his wife and two daughters have also shared and enjoyed. Mrs. Blake recalls a wonderful honeymoon that included a "pack-back" camping trip along the Appalachian Trail in the Great Smoky Mountains.

"My ambition now," says Blake, ornithologist, explorer, researcher, writer, one-time spy-catcher and boxer, "is to live long enough to become a garrulous old man with scads of boring stories. Sometimes I suspect that goal might be nearer than I realize."

Joyce Zibro is Editor of the Field Museum Bulletin *and Public Relations Manager.*

NEW BOOKS

The Year of the Whale

By Victor B. Scheffer. Decorations by Leonard Everett Fisher
New York, Charles Scribner's Sons (c1969). $6.95.

This intriguing volume is the story of twelve months in the life of a young sperm whale and is, as the author points out, "fiction based upon fact." The story of "Little Calf" is interspersed with information about the study of whales, about whaling, past and present, and about conservation and other related matters. This information is printed in different type from that used for the story. The reader follows Little Call month by month from his birth in the northeastern Pacific and in the process learns much about the life history of the whale and about how men feel about whales, what they do to whales, and what whales do to men.

The author is an authority on the biology of marine mammals and is a biologist with the United States Fish and Wildlife Service. His book is extremely well written and documented and is provided with "a special kind of bibliography, confined to some classic works in the literature of whales and whaling." The volume is attractively illustrated and the printing and binding are very nicely done. In every way, an excellent work.

The Bog People; Iron-Age Man Preserved

(By) P. V. Glob. Translated from the Danish by Rupert Bruce-Mitford
Ithaca, Cornell University Press (1969). $7.50.

This fascinating and profusely illustrated volume had its beginning in 1950 when two men, cutting peat in a Danish bog, came upon the body of a man with a noose around his neck. Believing him to be a recent murder victim they called in the police who in turn called in two representatives of the local museum. These gentlemen consulted the author, an eminent archeologist and now Director General of Museums and Antiquities in Denmark, who established that the body was that of an Iron-Age man who had been flung into the bog 2,000 years ago and preserved through the tanning action of the water.

In the last 200 years about 700 such bodies have been found in bogs all over northwestern Europe, most showing signs of violent death. Prof. Glob became interested in why so many people—men, women, and children—had been slain and cast in the bog and the present volume is the fruit of his researches.

Drawing on archeological data and classical written sources, the author constructs a picture of the way of life, culture, and religion of these people and concludes that the bodies in the bogs were victims of ritual murder and sacrifice to Nerthus, the goddess of fertility.

Professor Glob's book is most interesting and readable, though some of the photographs are not for the tender-minded.

Seeds of Change; the Green Revolution and Development in the 1970's

By Lester R. Brown
Foreword by Eugene R. Black
New York (etc.), Published for the Overseas Development Council by Praeger Publishers (1970). $6.95.

In the late 1950's, Rockefeller Foundation scientists in Mexico succeeded in developing a new variety of wheat that yielded twice as much grain as traditional varieties. A few years later a similarly fruitful rice was developed in the Philippines. Within less than a decade these and other new varieties of wheat and rice had been refined so that they could be grown successfully in a wide range of climatic and soil conditions, particularly in the impoverished tropical areas of the world. Their success has been phenomenal. Between 1965 and 1969, for instance, land planted with these seeds in Asia expanded from 200 acres to 34 million acres, about one-tenth of the region's total grain acreage. Cereal production is increasing spectacularly in Pakistan, India, Ceylon, and the Philippines, and other countries are quickly beginning to capitalize on the new grains.

This timely and useful book is designed to help us understand the significance to the agricultural revolution the development of these "miracle" strains has brought about, and to bring to our attention its implications for the future. The author points out that "The breakthrough in cereal production is meaningful because it represents at least the beginning of a solution to the problem of hunger, which until recently was regarded as nearly insoluble" but notes that "As the new seeds and the associated new technologies spread, they introduce wide and sweeping changes, creating a wave of expectations throughout society and placing great pressure on the existing social order and political situation." The "second generation" problems produced by the new technologies present us with a number of choices and the wisdom of our choices will determine, the author argues, whether the revolution will fulfill its promise of ensuring a better life for those who inhabit the rural areas of poor countries or whether it "will aggravate the job shortage and accelerate the exodus from the countryside to the already overcrowded cities." These choices, he feels, are political in nature rather than agricultural or scientific, and consequently addresses his book to all those "whose opinions and actions may affect future plans and political decisions": concerned laymen, academicians, and humanitarians as well.

The author is a senior fellow with the Overseas Development Council and served, between 1964 and 1968, as special adviser to the Secretary of Agriculture on foreign agricultural policy. His book is concise and well written. I recommend it highly.

by W. Payton Fawcett, head librarian, Field Museum.

LETTERS

To the editor:

In your October, 1970 Bulletin, you have devoted space to an article on the population crisis, by Dr. Paul Ehrlich.

I would not deny that there may be a population crisis in parts of the world, but I do question whether there is one in our United States. I certainly would not deny that there is a pollution crisis. In either crisis, population or pollution, I have serious doubts if Dr. Ehrlich has the voice to be heard. He seems more a propagandist than a scientist. Your *Bulletin* has dropped in its glory by your fostering of his thesis; that we must change our system of government to some form of dictatorship, change our free market philosophy to a socialist economy, give up our high standard of living in favor of something like that which existed in the United States around 1840.

Ehrlich did not paint such a picture in so many words, but is this not where his paradoxical solutions take us?

The United States now has two hundred million people and any of the two hundred million who will work can eat better than the few thousand Indians who lived in the same area in the year 1500. We eat so well, in fact, that our Government is paying farmers to remove land from production and otherwise limiting agricultural production.

Ehrlich decries the ghetto. Who makes the ghetto but the folks who live there? New York is a dirty city, but it is New Yorkers who make it dirty. Surely if they did not choose to live in such filth they'd clean it up. It is not the number of people but the kind of people living in New York that make their city a slum area. To clean it up they must change their living habits and not necessarily their sex habits.

In his solutions, Ehrlich turns to government and to politics. Where in history has government involved itself in a social problem where the end result has not been more chaotic than was the original problem?

My wife and I are the only inhabitants in an area of about 75 square miles. As far as I know, the entire area is clean. Each year the government licenses certain citizens to come into the area to hunt wildlife. Beside killing off the wild life, the area looks much like a garbage dump after the hunters leave. It is not the number of hunters that create the filth, but it is the kind of people they are.

Ehrlich is for a decrease in our population, and he is equally against the use of DDT. But he's against DDT because it is decreasing our population. I do not believe I like his system of population control a bit better than DDT. In fact, I don't like it at all.

Let us forget Ehrlich, and take some other route.

Robert B. Ayres
Sedona, Arizona

To the editor:

With its excellent combination of scientific and public relations facilities, the Field Museum is in a unique position to inform the public about the great ecological problems facing us—problems more urgent than any other, except the threat of nuclear war. The article by Paul Ehrlich in the October issue of the *Bulletin* was most informative, and at the same time a challenge to us all to face up to the difficulty of protecting our environment from the processes of deterioration which threaten to become irreversible.

I hope there will be many more articles of this sort in the future, and that the Museum will stage some exhibits which will pass on to all visitors to the Museum some of the sense of importance of ecological problems which was so well communicated by Dr. Ehrlich.

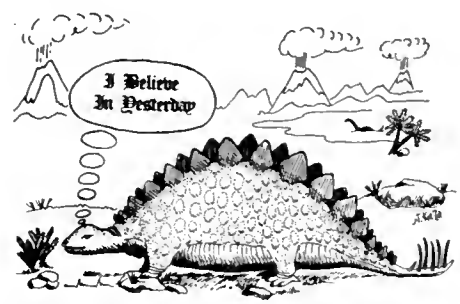
With best wishes for the continued success of the Field Museum.

Alan Garrett
Winnetka

To the editor:

Let me express my admiration and congratulations on the new *Bulletin* format. Enclosed are a few items I thought might properly belong in your magazine. There is, after all, a world of humor which is unique to the world of natural history.

James G. Kazanis
River Forest



To the editor:

Congratulations on the *Bulletin's* changes in content and format. There is no reason I can think of why a museum publication should be either dry or stuffy; and it is a pleasure to see that this feeling is shared by the editorial and design staffs for the *Bulletin*. In an age where so much is communicated, it becomes almost a matter of public trust that content be relevant and communication be fluent. The fresh approach of the *Bulletin* conveys the feeling that the museum knows about this and cares.

Charles L. Owen
Associate Professor
Institute of Design, IIT

Please address all letters to the editor to

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The editors reserve the right to edit letters for length.

FIELD BRIEFS

New Assistant Curator of Insects

Dr. John Kethley has joined the scientific staff of Field Museum as Assistant Curator of Insects. Dr. Kethley received his BS degree in 1964, and his PhD in Entomology in 1969 from the University of Georgia. He spent the past year at Ohio State University on a post-doctoral fellowship from the National Institutes of Health.

Dr. Kethley is particularly interested in mites, especially the classification and population dynamics of the family *Syringophilidae*. These are little-known mites that live only inside the quills of bird feathers. He has written several scientific papers on this subject and on other aspects of biology.

$500,000 Standard Oil Gift

Field Museum of Natural History recently received a capital contribution of $500,000 from Standard Oil (Indiana) Foundation. Announcement of the gift, which represents the largest corporate foundation contribution to Field Museum in the Museum's 77-year history, was made at a recent luncheon at the Museum attended by Robert C. Gunness, president of Standard Oil (Indiana) Foundation; Blaine J. Yarrington, president of American Oil Foundation and a trustee of Field Museum; John H. Lind, executive director of Standard Oil (Indiana) Foundation; E. Leland Webber, director of Field Museum and Museum President Remick McDowell.

In making the presentation, Gunness said, "Standard Oil Foundation is pleased to be able to support the famed Field Museum. People everywhere are reconsidering the extent of their dependence on the natural world and in the process of seeking a broader understanding of man and his relation to his environment. The Field Museum has a vital role in discovering new information essential to that understanding through its scientific programs and an equally important role in transmitting that information to the community through its educational programs. We are perhaps rediscovering the significance of the Field Museum to our community and we look to it for continuing leadership as we seek a better appreciation of man and his environment."

"The contribution, to become available to the Museum over a five-year period," said McDowell, "will help the Museum to embark upon a long postponed program of capital repairs and improvement. During the thirty-year period from 1940 through 1969 some $3,081,000 was expended for major repairs," said McDowell. "Of this amount, $1,470,000 went for building improvement and $1,611,000 for equipment and repairs. However, architectural estimates show that over twenty million dollars could have been effectively spent for these purposes if funds had been available. In appraising the Museum's capital requirements for the next five years some $25 million dollars will be needed."

Completed in 1920, the present Museum building with the terrace and surrounding grounds occupies an area of thirteen acres, the building itself measuring 706 feet long and 438 feet wide and 105 feet high. The building houses over 10,000,000 specimens which make up the Museum's world famous research collection and contains ten acres of space devoted to exhibition purposes.

"Soaring operating costs over the past several years," said McDowell, "have made it impossible to make any but the most minimal of repairs or improvements to the physical facilities of the building."

"We are extremely grateful to Standard Oil (Indiana) Foundation for this very important gift," said McDowell. "The millions of people who will visit the Museum in coming years, including the annual visitation of approximately 400,000 school children in organized study groups, stand to benefit from the improved facilities which the Foundation's generous contribution will help us to provide."

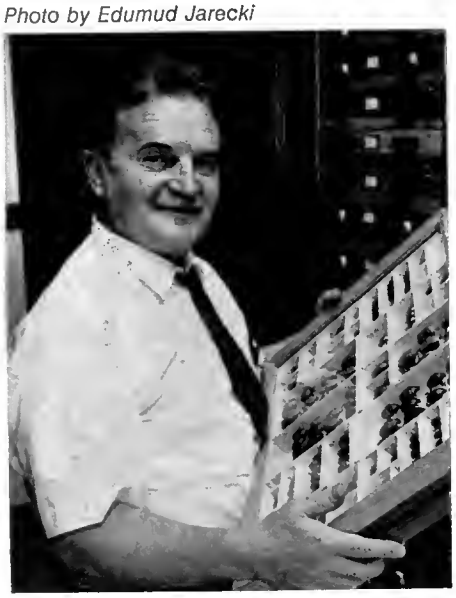
Blaine J. Yarrington, president of American Oil Foundation and a trustee of Field Museum (left to right), Remick McDowell, Museum president, E. Leland Webber, director of the Museum, and Robert C. Gunness, president of Standard Oil (Indiana) Foundation, are shown at a recent luncheon where a capital contribution of $500,000 was made to the Museum from Standard Oil (Indiana) Foundation. The gift is the largest corporate foundation contribution to the Museum in its 77 year history.

FIELD BRIEFS

Henry Dybas New Head of Insects

Henry Stanley Dybas has been appointed Head of the Division of Insects in Field Museum's Department of Zoology. A native Chicagoan, Mr. Dybas joined the Museum staff in 1941 as Assistant in the Division of Insects. He was named Assistant Curator of Insects in 1947 and has served as Associate Curator of Insects since 1950. A specialist in the systematics of the smallest known beetles, the featherwing beetles (*Ptiliidae*), and the population, ecology and evolution of the 17-year and 13-year periodical cicadas, Mr. Dybas has

Photo by Edumud Jarecki



Henry S. Dybas

carried out field work in the United States, Mexico, Panama, Colombia and Micronesia and authored numerous scientific papers and popular articles on insects.

Speaking of the relevance of studying such tiny insects as the featherwing beetle (a dozen or so small featherwing beetles could be placed on the head of a pin), Mr. Dybas said: "They are important in their own right because of their activities and because of their complex relations with other forms of life in our fields and forests. And because they are faced with extreme problems as a result of their small size, their study can provide insights into problems of general biological interest."

In addition to his work at the Museum, Mr. Dybas is Research Associate in the Department of Biological Sciences at Northwestern University and Lecturer in the Committee on Evolutionary Biology, University of Chicago. He is a member of the Entomological Society of America, the American Mosquito Control Association, the Ecological Society of America, the Society for the Study of Evolution and other professional organizations.

Given Foundation Grant

Field Museum has received a $35,000 grant from the Irene Heinz Given and John LaPorte Given Foundation, Inc. The grant will be used as a subsidy in the completion and publication of the *Manual of Neotropical Birds,* which Dr. Emmet R. Blake, curator of birds, is currently working on.

The *Manual* is a long-range project which started through a grant from the National Science Foundation in late 1965. The final work will consist of several volumes, and is scheduled for completion in 1984. A residue of National Science Foundation funds will see Dr. Blake's work through the first volume, exclusive of its publication. The Given Foundation grant will ensure the continuity of work on the second volume.

Museum Receives NSF Grant

The Museum has received a grant in the amount of $18,600 from the National Science Foundation for continuing research entitled, "Herpetology of Seasonal and Aseasonal Tropical Forests," under the direction of Dr. Robert F. Inger, chairman of scientific programs. The grant, which is to run until approximately January 31, 1972, will permit Dr. Inger to complete research underway since July 1968, on the organization of animal communities, particularly reptiles and amphibians, in tropical forests. "The research when completed," said Dr. Inger, "will permit us to estimate the amount and pattern of genetic variation in different kinds of animal populations in terms of different types of distribution patterns. Our ultimate aim is to determine how ecology affects genetics and in effect, how the organization of natural communities affects evolution.

The project is being carried out in conjunction with Dr. Harold Voris at Dickerson College, Carlisle, Pennsylvania. Dr. Voris's prime concern will be the analysis of blood proteins to determine genetic constitution.

Field work on the project has been carried out in Malaya, Borneo, and Thailand. These areas in Southeast Asia were selected, said Dr. Inger, because they contain an abundance of different kinds of environments. Dr. Inger will return to Malaya for additional field work in July, accompanied by Dr. Voris.

Field Museum's geology preparator John Harris demonstrates the technique of model-making to Museum visitors. Shown with him are Hisatoyo Ishida (left) and Jo Okada (third from left), of the Agency for Cultural Affairs, Ministry of Education, Tokyo. At the right is Masataka Uehara of the office of the Consulate General of Japan in Chicago. They met with various staff members to learn about the Museum activities for the purpose of establishing a natural history museum in Japan.

CALENDAR

Hours
9 a.m. to 4 p.m., Monday-Thursday
9 a.m. to 9 p.m., Friday
9 a.m. to 5 p.m., Saturday and Sunday
The Museum Library is open
9 a.m. to 4 p.m.
Monday through Friday

Through January 15
Corn Blight, an exhibit of current interest. The effects of a virulent new strain of Southern Corn Leaf Blight disease, responsible for a predicted 18% decrease in the nation's corn crop, are shown. South Lounge.

Begins January 16
Catalogue of the Different Specimens of Cloth Collected in the Three Voyages of Captain Cook, to the Southern Hemisphere, London, Alexander Shaw, 1787, on display in the South Lounge. The rare copy consists of actual tapa cloth specimens collected during Captain Cook's voyages to the South Seas (1768-1780). The volume is the gift of Mrs. A. W. F. Fuller. Through March 21.

"Life in Other Worlds?" an exhibit of the *Murchison* meteorite, a Type II carbonaceous chondrite, of which only fourteen exist out of the almost 2,000 known meteorites. Recently, amino acids, possibly building blocks of life, have been reported in this meteorite. Through March 21. South Lounge.

January 17
Free concert by the Metropolitan Youth Symphony Orchestra. 2:30 p.m., James Simpson Theatre.

January 31
Free Wildlife Film, "Everglades Safari," offered by the Illinois Audubon Society. 2:30 p.m., James Simpson Theatre.

Begins February 7
26th Chicago International Exhibition of Nature Photography featuring award-winning photographic prints, sponsored by the Nature Camera Club of Chicago and Field Museum. South Lounge. Through February 28.

February 7
A showing of prize-winning transparencies from the 26th Chicago International Exhibition of Nature Photography, 2:30 p.m., James Simpson Theatre.

Through February 7
A Child Goes Forth, an exhibit of toys and games, looks beyond the superficial nature of playthings and into the influence they may have upon a child's cultural development. Hall 9.

Continuing
"Exploring Indian Country," Winter Journey for Children. The self-guided tour enables youngsters to see American Indians of three environments as the early explorers saw them. All boys and girls who can read and write may participate in the free program. Journey sheets are available at Museum entrances. Through February 28.

John James Audubon's elephant folio, "The Birds of America," on display in the North Lounge. A different plate from the rare, first-edition set is featured each day.

75th Anniversary Exhibit: A Sense of Wonder, A Sense of History, A Sense of Discovery, continues indefinitely. Exciting display techniques offer a new experience to museum-goers. Hall 3.

Meetings

January 12, 7:45 p.m., Nature Camera Club of Chicago

January 12, 8 p.m., Chicagoland Glider Council

January 13, 7 p.m., Chicago Ornithological Society

January 13, 7:30 p.m., Windy City Grotto—National Speleological Society

January 14, 8 p.m., Chicago Mountaineering Club

January 19, 7:30 p.m., Chicago Area Camera Clubs Association

February 9, 7:45 p.m., Nature Camera Club of Chicago

February 9, 8 p.m., Chicagoland Glider Council

February 10, 7 p.m., Chicago Ornithological Society

February 10, 7:30 p.m., Windy City Grotto—National Speleological Society

MRS. JOHN STEPHENS
757 NORTH PARK BOULEVARD
GLEN ELLYN, ILLINOIS 60137

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BULLETIN

Volume 42, Number 2
February 1971

Cover: Two red marine algae from the Monterey Peninsula, California. The lacy *Microcladia coulteri* is growing on *Gigartina harveyana*. Illustration by Richard Roesener.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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Canning a legend

Patricia M. Williams

An American World War II song confidently proclaimed "We did it before and we can do it again!" With dubious distinction, man can now sing the same song about the elimination of the wild horse from North America.

Some 50 million years ago in what is now the western United States the tiny, four-toed *Eohippus* was busily beginning that process of evolution that resulted in today's large, single-toed horse, *Equus caballus*. Abundant fossil remains of the horse have been unearthed from several areas in the west, especially in Texas and Wyoming.

Ten thousand years ago Pleistocene man entered and crossed North America. Two thousand years later the horse was extinct on this continent. The theory most widely supported by the scientific community contends that man in his search for food killed off the horse. Others suggest that man in combination with a virulent epidemic did the job. Whatever the cause, there were no horses on the North American continent when Columbus arrived in 1492.

The horse was brought back to continental North America in 1519 by the Spanish conquistador, Hernando Cortés. Cortés departed leaving behind only one colt. Next, according to legend, DeSoto's men set free "six great horses of Spain" and these horses are said to have sired the great wild race that replaced their kin which were lost to America thousands of years earlier. In his poem "The Distant Runners" Mark Van Doren celebrates this event with the lines, "Four and twenty Spanish hooves/Fling off their iron and cut the green,/Leaving circles new and clean/While overhead the wing-tips whirred."

At about this time Coronado and his men were also riding horseback across the continent. The conquistadors treated the Plains Indians cruelly and, in return, the Indians often stole the explorers' horses. Early settlers and traders in the Santa Fe area brought more horses which, in turn, were stolen or escaped. It may be romantic to believe that our bands of wild horses derived from those of DeSoto, Coronado and other explorers. In fact, they did not. As George Gaylord Simpson states in his book *Horses*, "The feral herds—the 'wild horses' of western history—arose from horses that escaped from the missions, ranches and Indians, and not from those ridden by the explorers."

Clearly then, our American wild horse is not technically a wild animal. A truly wild animal is one whose ancestors have always been wild. As our "wild" horses are all derived from imported domesticated stock, they are properly called feral horses, but through common use "wild" has become accepted.

Most of the early wild horses were descendants of an old Andalusian breed. These Andalusian horses, according to Simpson, "were jennets or jinetas, descended in part from older, even prehistoric Spanish races but with a predominant Barb element brought in by the Arab conquerers from North Africa.'

The classic Andalusian was rather small, generally built close to the ground with a wide chest, a muscular rather short neck, and a low-set tail. It displayed the whole range of equine colors, including spotting.

After years of fending for themselves, the modern offspring of the proud Andalusian retain the almost incredible stamina and endurance of that breed but have lost many of the physical characteristics. They are still generally small, but too often border on the runty. Their scant and limited diet of grasses has contributed to their small stature and sometimes scrawny appearance of today's wild horse. Cross-breeding, whether uncontrolled or through attempts to improve the wild horse, has resulted in the disappearance of the classic form of the Spanish horse. Nevertheless, the wild horse still retains the wide assortment of colors while the spotted or patterned form was particularly cherished by some Indian tribes.

The mustangs or *mestenos* were originally the horses of the wild herds that belonged to no one. Eventually, the term mustang included the cowponies taken from these herds. Indian ponies usually contained much mustang blood and a little of any and every other kind of horse as well. Today's cowponies have been extensively crossed with other breeds and the original mustang is all but gone here in America.

But in 1680 large bands of mustangs were racing across the plains. By 1900 their numbers had swelled to an estimated two million horses, ranging throughout the grasslands from west of the Mississippi to the Rockies, past the Continental Divide and through the deserts to the Pacific Coast. Today, following years of merciless depredation, there are fewer than 17,000 "wild" horses on public lands in the United States. If these horses were simply being eliminated by the forces of nature, man's responsibility would be less grave. Over the years, however, the white man has had a variety of reasons for eliminating herds of wild horses. Little-known casualties of World War I, thousands of horses were sold to the allies to aid in the war effort. To break the Indian's will, their precious herds of horses were decimated. Cattlemen, anxious to preserve the grazing land for their own livestock, actively persecuted the wild horses. Hope Ryden, in her book *America's Last Wild Horses*, writes that between 1900 and 1926 the wild horse population on public lands declined from two million to one million.

Today wild horses are being slaughtered for dog food. Not only swaybacked nags, weary after years of pulling a plow or wagon, but young,

strong, free horses are being hounded to exhaustion by siren-howling planes. Low-flying horse-hunters dive over the panic-stricken herd blasting it with buckshot to keep it moving in the desired direction. Some horses drop dead from exhaustion, their lungs bursting from the strain, but others are driven madly on into the corral where, filled with fear, they often fight, pile up and trample each other to death.

Those who survive the hideous chase are packed into trucks for cross-country shipment to the meat cannery. In her book, Hope Ryden states:

> Once the truck was loaded, the door was not opened again during the long haul to the packing plant and the horses were neither watered nor offered food. A transportation regulation known as "killer-rate" exempts truckers carrying livestock to market from a law which requires that in transit animals must be fed and watered at regular intervals. It is argued that animals en route to a packing plant are condemned cargo anyway, and the transporter need not spend time and money maintaining their physical well-being. Yet, though "killer-rate" unfortunately applies to all livestock, domestic animals do not suffer the kind of maltreatment inflicted on the wild horse during its ride to slaughter.

The truck leaves in its wake unweaned colts doomed to starvation, stallions blinded with buckshot, and wretched animals whose hoofs were worn down to bloody stumps during the deadly race. And this just to fill Rover's dinner bowl.

This dog-eat-horse policy is not without its supporters, obviously. Although not all agree with the methods by which the horses are exterminated, many people feel that if economic gain cannot be derived from them, then the horses have no right to exist. Mr. Chester (Chug) Utter, an airplane pilot and mustanger, claims to have captured 40,000 horses over 14 years for the Bureau of Land Management, which sold the animals at auction. Mr. Utter advocates wild horse preserves established on government land and says, "You need every spear of grass for deer, antelope and cattle. I don't have any ax to grind either way. But I'd much rather have wild game than a bunch of horses you can't do nothing with" (*New York Times*, Nov. 15, 1970, p. 62. "A Devoted Few Strive to Save Wild Horses").

Even Dr. C. Wayne Cook, head of Range Science Department of Colorado State University and chairman, Advisory Committee to the Department of the Interior on the Wild Horse Range in the Pryor Mountains, cautions that there should be some control over the numbers of wild horses lest they multiply too quickly and become too competitive for grazing lands. But Dr. Cook appreciates the emotional and historical factors too, in the movement to preserve the wild horses.

Historically, the wild horse played a major role in the development of the west and was a positive aid to expeditions such as that of Lewis and Clark. It helped the early trappers, pioneers, ranchers and the fledgling cattle industry. The wild horse was an integral part of the culture of American Indians and was incorporated into their myths and ceremonies.

The unquestionable emotional appeal of the wild horse was perfectly expressed by Matt Field's description of one he encountered along the Santa Fe trail in 1839, as related in *America's Last Wild Horses* (pp. 125-128):

> " 'Twas a beautiful animal . . . a sorrel, with a jet black mane and tail. We could see the muscles quiver in his glossy limbs as he moved; and when half playfully and half in fright, he tossed his flowing mane in the air, and flourished his long silky tail, our admiration knew no bounds and we longed . . . hopelessly, vexatiously longed to possess him.
>
> Of all the brute creation the horse is the most admired by men. Combining beauty with usefulness, all countries and all ages yield it their admiration. But, though the finest specimen of its kind, a domestic horse will ever lack that magic and indescribable charm that beams like a halo around the simple name of freedom. The wild horse roving the prairie wilderness knows no master . . . has never felt the whip . . . never clasped in its teeth the bit to curb its native freedom, but gambols, unmolested over its grassy home where Nature has given it a bountiful supply of provender . . . We might have shot him from where we stood, but had we been starving, we would scarcely have done it. He was *free*, and we loved him for the very possession of that liberty we longed to take from him . . . but we could not kill him."

Philip Hershkovitz, research curator of mammals in Field Museum's Department of Zoology, believes that "few things in man's world equal the beauty of a racing herd of wild horses." As a taxonomist, he also points out that, "By destroying the horse we will have extirpated from the American continent an entire family of its wild fauna—for the second and last time." Hershkovitz went on to observe that while many dog lovers may protest cruelty to animals they unwittingly condone it by purchase of the product of a base and ruthless policy of extermination.

For whatever reason, emotional, historical, or scientific, many are joining the growing movement to protect the last of the once numerous bands of wild horses. Mrs. Velma (Wild Horse Annie) Johnston, president, International Society for the Protection of Mustangs and Burros, is one of the prime forces in this movement and it was largely through her efforts that "The Wild Horse Annie Bill" (Public Law 86-234) was passed in September 1959. This bill prohibits the pursuit of unbranded horses or burros by aircraft on public domain. Like so many of the laws and regulations affecting the wild horse, this one, too, has a loophole. According to Mrs. Johnston, hunters get around this law by putting a branded mare into the wild horse herd and then gather up the whole group a year later. Obviously, then, further legislation is needed.

A bill introduced by U.S. Senator Hansen of Wyoming would have given the Department of the Interior custody over the wild horses. Although the bill died in committee last year, Mrs. Johnston and her associates still hope to secure federal protection for the wild horse and get another bill introduced this year.

There are now two wild horse preserves on federal land controlled by the Bureau of Land Management. One, in the Pryor Mountains of Wyoming, was the result of the efforts of a group of concerned citizens dedicated to saving a herd of 200 wild horses. The other federal preserve is less than ideally situated on the Nellis Air Force bombing and gunnery range and the Nevada test site of the Atomic Energy Commission.

Twenty years ago, Simpson noted that herds of wild horses were relentlessly hunted and diminished. He commented on the loss of the historic mustang and noted that in the Argentine a breeding stock of ponies similar to our mustangs had been gathered from remote parts of the country and preserved in "an admirable, increasingly valued registered breed, the Criollo." His point was, of course, that a similar project could be undertaken here.

Although they do not all agree on goals, there are groups here in the United States interested in the wild horses, such as the American Mustang Association, the National Mustang Association and the Spanish Mustang Registry. The first seeks to improve the wild horse by breeding for purposes of competition and marketing; the second is concerned with the sport of "mustanging"—running and capturing wild horses for personal and recreational purposes, as well as educating the public on the conservation needs of the wild horse. The third group, the Spanish Mustang Registry, is out for blood—pure Spanish blood.

Fifty years ago Robert and Ferdinand Brislawn began to search the wild bands for pure-blooded Spanish horses to form the foundation of what would become the Spanish Mustang Registry. The non-profit association was formally established in 1958 to perpetuate the mustang and establish a permanent reserve for the animals. Eighty-year-old Robert "Wyoming Kid" Brislawn explains, "We are trying to restore a breed, not create one." For this reason, the Spanish Mustang Registry cannot be looked to as the salvation of all wild horses. In the past 50 years only about 200 horses have qualified for the registry and today few roam the 3,000 acre Brislawn Ranch.

Photos from Hope Ryden's *America's Last Wild Horses.*

As bills are discussed by committees, the grim hunt for dog food relentlessly goes on. Thousands of years ago, driven by hunger, primitive man used his simple tools to kill the wild horses. Today, sated with an abundance of artificially sweetened, seasoned, colored and preserved foods, we use our sophisticated, motorized skills to kill the legendary wild horse for dog food.

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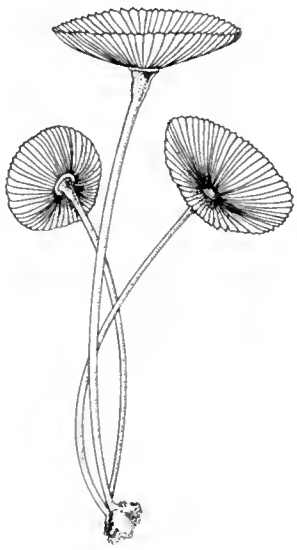
Patricia M. Williams is Managing Editor of Scientific Publications at Field Museum.

Algae Are Man's Best Friends

Dr. Matthew H. Nitecki



Acetabularia crenulata. One of the most beautiful algae, often referred to as mermaid's wineglass or mermaid's parasol. The disc at the top of the plant indeed looks like a shallow cup or inverted parasol. Because it grows easily in captivity, it is a much-studied alga. The recent studies are particularly concerned with the role and function and interrelation of cell nucleus and the protoplasm.

Illustrations by Richard Roesener

If an extraterrestrial giant could come to the earth and stand over the greater Chicago area, he would notice many unusual things. When the sun first falls upon the earth the biomass begins flowing towards the center of the megalopolis, and when the sun goes down the same biomass leaves the city to disperse itself into the periphery. The giant would postulate his first law—that *the solar energy controls the movements of the biomass.* If he could pick up a car in his colossal fingers the occupant would either jump out, try to hide, scream, panic, freeze, or simply die of fright. If, nevertheless, the giant would succeed in holding up the driver, he no doubt would squeeze all life out of the poor man and he would postulate his second law—that *life is a fragile thing and very difficult to study.* He may further add that life manifests unpredictable behavior and movements. The giant, while examining and testing the physical environment, would formulate his third law—that *the biomass releases great wastes into the atmosphere and into the water* in the complicated process of manufacture of seemingly strange objects, and in production of heat and locomotion.

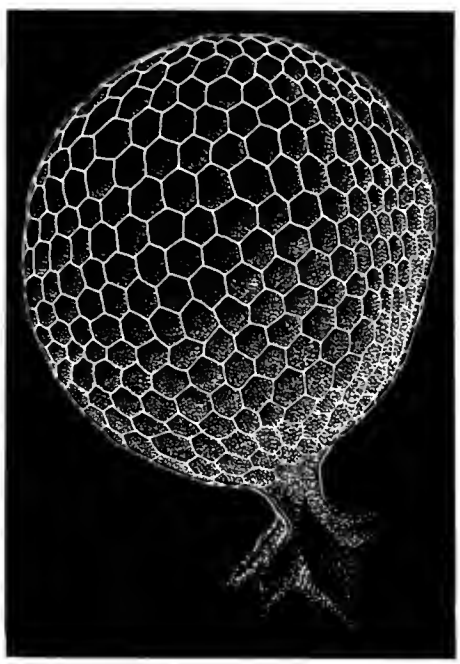
If our giant strides away in his seven-league boots to follow the sun west, he may step over some forest and wonder over its tranquillity and the purity of the air above it. He will notice that oxygen is produced by plants during the day and little waste is manufactured. He may pick up the tree from its bed and meditate over it under the scrutiny of his instruments. He will neither be shot at, nor screamed at, and he will, therefore, modify his second law by adding that plants are more stable and less neurotic than animals. When examining the air around him, and measuring the production of sugar and carbohydrates, he will postulate a fourth law—that *plants provide all the food and all the oxygen,* and that animals simply eat and burn it. He may consider animals

degenerate organisms unable to produce their own foodstuffs and dependent upon plants to do it for them. He may even think of man as a capricious parasite of the earth. He will see plants as benefactors that alter the simple inert matter into the complexity and dynamism of life. Our other-world giant may go further to the great ocean where he will find out that most of this activity of food and oxygen production and cleaning the air of carbon dioxide is conducted in the sea by "simple" organisms called algae. And so he will put forward his fifth law —that *algae, indeed, produce most that is needed for life on the earth.*

Our giant will marvel at the efficiency of algae and will discover that the well-known photosynthetic equation

$$CO_2 + H_2O \xrightarrow[\text{green plants}]{\text{light}} CH_2O + O_2\uparrow$$

means that one molecule of carbon dioxide combines with one molecule of water in the presence of light within the pigment of green plants to produce carbohydrates and oxygen. In a more sophisticated way he can say that in the process of photosynthesis the atoms of hydrogen from water are used to transfer carbon dioxide into carbohydrates and at the same time the free oxygen from the dissociated water is released. Our Gargantuan, just like Professor Eugene I. Rabinowitch of the University of Illinois, will calculate that each year plants of the earth combine about 150 billion tons of carbon with 25 billion tons of hydrogen, and set free 400 billion tons of oxygen! Throughout the last three billion years, plants have been continuously dying and organic matter has been continuously decomposing. The only process known that steadily reverses the results of decomposition and provides for the continuity of life on earth is photosynthesis. In the process of photosynthesis, plants harness solar energy and produce organic matter which, after being used by animals, is dissipated and is mostly lost as heat into the interplanetary space. Our colossus will be astonished to realize that when photosynthesis ceases, life stops and the atmosphere will lose all its free oxygen.



Cyclocrinites dactioloides. This marine calcareous green alga of Silurian age was for a long time considered a problematic sponge. Its fossil remains are commonly found among 450-million-year-old coral reefs in Illinois and Iowa.

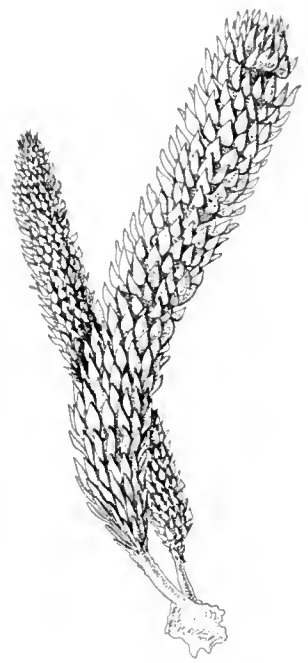
In the past there has been a vigorous discussion in scientific literature of what constitutes the plant kingdom and of what constitutes the animal kingdom. The differences between these two groups disappear when "lower" forms of life are examined. While our Titan can tell the difference between a dog and a rosebush, the placement of certain microscopic flagellate organisms within a kingdom will be more difficult for him. In order to resolve this problem of placing plant-animal-like creatures in classificatory schemes that would indicate their relationship he would expand the two kingdoms into three. In time, this system too would become inadequate, and soon four and even five kingdoms would have to be recognized. The five kingdoms concept of organisms has been suggested by Professor R. H. Whittaker of Cornell University to consist of Monera (for example, blue-green algae and bacteria), Protista, (unicellular forms such as euglenoids, golden algae and protozoans), Plantae ("conventional" plants such as red and green algae and vascular plants), Fungi (absorptive organisms such as fungi and slime molds), and Animalia (the animals).

The system of five kingdoms of living things appears to be gaining some acceptance and seems to serve best our present knowledge of the living world. Within our five kingdom classification algae are assigned to three of these kingdoms: Monera, Protista and Plantae. The word *alga* is subject to change as our understanding of the interrelationship between various groups of algae changes. It is now believed that the algae represent a great variety of organisms of diversified evolutionary

origin and not of a single common lineage. Algologists use the word *alga* to indicate several groups of organisms having similar reproductive mechanisms.

The problem or problems of classification of algae are very technical, particularly since algae constitute a loosely-knit group. The main characters used in their classification are biochemical: algae are separated on the basis of their pigments, the nature of their cell wall, the products of their photosynthesis, and the nature of their flagella.

Algae lack true leaves, stems, or roots, and for this reason have been considered "primitive." This concept is, however, now losing support. Algae represent a great diversity of forms. Some are microscopic; others, as Pacific kelp, may reach a length of 150 feet. Reports of kelp 600 feet long from Brazil need confirmation. Certain algae are single cells that may be filamentous or branching. There are those that are membranous, or some may even be tubular. Although some species are terrestrial, most are aquatic and are found in all waters, seas, lakes, streams and ponds. They can float as plankton or they can exist attached to substrate or to other plants or animals. Some algae inhabit the soil, others live on bark of trees or even on rocks, and recently algae have been collected from the atmospheric currents. There are even those that thrive on snow or within other organisms, or as lichens, the composite organisms consisting of fungi living together with algae. Even two species of sloths in Central America may be distinguished by the different species of algae that grow on their hair.



Halicoryne wrightii, "sea-club alga." A marine green alga from Dutch East Indies and from the Philippines. The genus is known throughout the warm, tropical seas and four species are found in the Caribbean. The body of the plant is covered with a thin layer of carbonates.

Algae that precipitate calcium and carbonate ions from the sea water build hard, limy coverings. These algae are extremely important as rock-building organisms and are responsible for the formations of many limestones throughout geologic history, especially reef deposits. In addition to forming their own masses they also act as the cement that binds together the skeletons of invertebrate animals. It is no surprise, therefore, that these plants have left an extensive fossil record and are extensively studied by paleontologists.

Algae as a group provide the earliest evidence of life on earth, and are the most ancient group of living things known. The oldest algae-like fossils are about three billion years old! Since they represent the first documented life on earth they are from the evolutionary viewpoint extremely important.

If only our giant could search the outcrops of rocks and find the places where remnants of past life are preserved, then he would rejoice in the discovery of the past history of our planet and the life which existed on it. But, by a singular paradox, the processes which gave us the lands also turned the sediments into rocks, changed their composition and made them into marbles and schist, hiding the records from the seeker, and altering the organic remains into their byproducts. Thus, all but scanty evidence was destroyed.

And yet, when we look, when we carefully comb the rocks, we find shapes that are varied, some recognizable, some with strange forms that do not exist any more. Some of these finds are fossils of a common nature, abundant, obtainable by the "bushel," others are rare. Some are so delicate that they require special treatment; some are so preserved that they need the strength of machines and endless hours to prepare for

study. Among many fossils some become more important—because they explain more, they possess some characteristics absent in other specimens—and hence instantly become more interesting and meaningful. The fossil, in brief, reflects the image of life as it once was.

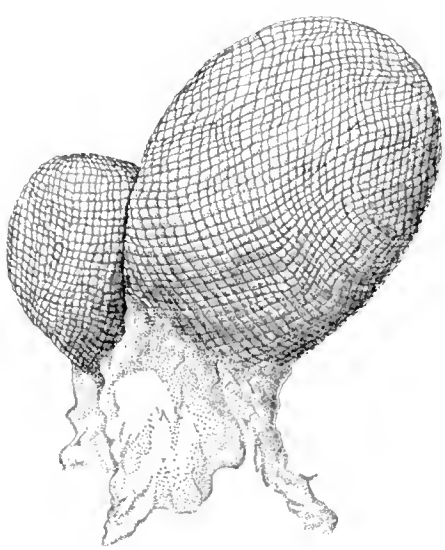
Algae in the 19th century, and among many persons even today, have been considered less vital than most other plants and animals, and are usually deprecated as seaweed, pond scum, and kelp. But algae as a group are important, as we have seen, not only because they represent the first documented life on earth but also because they produce most of the food and oxygen necessary for life on earth. In addition, algae are becoming economically important and great quantities of them are used for human consumption particularly in Japan. They may possibly become a future source of food for the ever-growing and hungry human population. They are already used as a source of potassium and iodine, and for treatment of sewage in certain localities.

Neomeris van-bosseae. When examined in the Museum dry collection, this alga does not look like a plant at all because its attractive white outer calcareous cortex resembles an animal's exterior skeleton. Under this hard covering are whorls of white branches that expand at their ends.

On his long way home, our extraterrestrial visitor will hold in his possession a few vials of small, barely green, calcareous, tubular, whorled algae from the tropical seas of the earth. And he'll wonder over these strange benefactors of apparent simplicity and beauty that together with untold numbers of other algae since time immemorial have endlessly and continuously provided the source of food and oxygen to the inhabitants of the earth.

He will learn now that nature manifests beauty of the highest degree in a multitude of forms—beauty of structure and shape. And he'll pause over this for awhile. Life is a short business when dealing with an individual organism. It is somewhat longer when dealing with taxonomic units like species and genera. Man has existed for time long enough to have a geologic past—but yet, life is still a very fragile thing. Life is difficult to study, because the process of study itself may modify or kill the organism. But life on the geological scale is different; the organisms are gone, but hard skeletal parts remain. Sometimes unaltered, but in most cases replaced, recrystalized—but yet often retaining most of the original details, even the color pattern may be preserved. How many of us have stopped to think that we are dealing with life when studying fossils? Here the wonder is that we have in front of us the record of life, represented by fragments, from which we choose to reconstruct the whole of the evolutionary path of organic history. The past is nebulous and we are penetrating it. What else can give greater joy than to unveil the unkown?

Dr. Matthew H. Nitecki is Associate Curator of Fossil Invertebrates in Field Museum's Department of Geology.



Calathella anstedi. A half-billion-year-old (Lower Ordovician) green calcareous alga from Newfoundland. This fossil is one of the oldest "higher" forms of algae found. Its outer structure is very complicated and advanced, and the alga can be easily placed in a class of well-known living green algae.

SCANDINAVIA:
lands of fjords and the midnight sun

Phil Clark

Most persons, in quest of natural history novelty and nuance, think of exotic lands in southern hemispheres, with their gaudy flowering trees and brightly plumed birds.

But I found a refreshing view of flora, and fauna, and peoples during a month's visit to Scandinavia, where I programmed a natural history tour for next June. It sharpened my joy in our own northern American flora and avifauna; there was so much subtle contrast in the two basically similar ecological systems.

Other sharper contrasts were stimulating too. The great Scandinavian spruce-pine forests and the birch-beech-poplar woodlands still stand, even though they have been a judiciously used source of wealth for generations. Rivers are relatively unpolluted and buildings, from medieval to Victorian, stand well kept in mellow, unsooted harmony with handsomely modern architecture on clean city streets.

The most exciting fjord I saw was the greatest of them all: Norway's Sognefjord. At first the scenery was similar to that from Stavanger to Bergen

Thirteenth century Norwegian stave church in Oslo's Folkmuseum.

—little rocky islets from which clouds of Lesser Black Back, Herring and Black Headed Gulls rose to meet us over dark seas. Liver-colored *Calluna* heather hugged the wet, black rocks. And at one islet I glimpsed a pair of Golden-eyed Ducks, spending the summer, plump and happy.

As our ship neared the Sognefjord straits, the islands grew larger and finally we steamed through a great rocky gateway, its sides fleshed with deep green spruce and white-boled *Betula pendula*. Finally, near the fjord's inland end, a day's voyage from Bergen, I spent the night at a small inn in a village which clustered at the foot of towering, spruce-green cliffs, a nest of white-painted, green-trimmed houses.

Wandering by foot and by bus the next two days brought many a thrill, as plant communities changed from flowery meadows edged with birch, mountain ash, willow and pine in the valleys, to forests of spire-tall Norway spruce on the mountain sides and to ground-hugging silvery-leaved willows and dark junipers, dwarfed both by mountain winds and by inherent traits. These fringed the bald, gray tundra, where glacial snows gleamed in cold ovals and dark lakes gushed into streams that tumbled, foaming over rocky cliffs and down to the fjord, miles below.

In Oslo, the folk museum made me feel that I had known this well-kept land for generations. Here I walked through a spruce-birch forest from one village to another, each typical of an era and an area—and all the buildings, planks, tiles and all, brought from sites throughout Norway.

The idea of the midnight sun moved me as little as some remote solar eclipse . . . until I experienced its surprising nocturnal light. This was in a ship on cold Lake Inari, far north of the Arctic Circle in northern Finland. Here was a different and an exciting world of the mysterious Lapps and their

Gustav Vigeland nudes in Oslo's Frogner Park.

great herds of reindeer wandering free over vast miles of gray tundra.

Comprehensive exhibits at Helsinki's National Museum added the knowledge-dimension that only actual objects can, to my understanding of the prehistory, history and art of a creative people, the Finns. Their origins shrouded in a mystery lighted only by linguistic connections with the Magyars and the Esthonians, the Finns came early to this northern land, then peopled only by the primitive Lapps, from Esthonia across the Bay.

Feeling for design is everywhere evident in Helsinki's architecture, from its classical central square to the romantic buildings of the early part of this century and climaxing in the magnificent garden suburbs which cluster on Helsinki's outskirts: in particular, elegantly simple and functionally practical Tapeola.

But in prosperous, sensibly-ordered Sweden is what I believe the most beautiful temperate world city: Stockholm, spreading from Baltic islands to mainland. Its copper-green, spike-spired churches, its medieval and revival castles, its elaborate public buildings of the last century and its architecture of the twenties—clean-lined yet resonant of the national past: all these exist in lovely harmony with glass and steel modern buildings. And they front on mostly broad, clean avenues, frequently interrupted by parks and squares—flowery, green, rich in sculpture and furnished with inviting benches and outdoor restaurants.

All this architectural harmony and beauty is no accident, for new construction or demolition of old buildings in Stockholm must first be approved by a committee charged with protecting and increasing the city's beauty.

For the artist and the garden lover, Stockholm offers an unusual joy in Milles' Garden, on the rocky cliffside of the Island of Lidingö.

On the Swedish island of Gotland, I found something of interest for every natural history taste. At the wildflower preserve of Allekvia, midst pines and flowery meadow, grow several species of terrestrial orchids including *Orchis sambucina, Habenaria bifolia* and *Cypripedium calceolus*—closely related

to our large yellow moccasin. Bronze age man, about 1000 BC, in forested glades and near the sea, built great rock outlines of ships over burials—magic vessels to bear the departed to Aasgaard. On Stora Karlsö island off Gotland, New Stone Age man, 2500 BC, left cave dwellings. On the same island, I found many sea birds, including colonies of guillemots, shags and razorbills. Gotland's principal city, Visby, has some handsome medieval ruins.

Visby, capital of the Swedish island of Gotland.

Few Gothic cathedrals equal the majesty of Uppsala's great Cathedral, where the bones of St. Erik the King, martyred in Uppsala in 1160, lie in a golden box in the high altar. The 13th century Cathedral stands over what was probably the greatest religious center of pagan Scandinavia, when the one-eyed god, Odin, reigned supreme (he traded the eye for the gift of wisdom).

This university city also is a place of almost reverent inspiration for botanists. It is here where Carl von Linne (founder of the Linnaean system of nomenclature and classification) lived and carried out his studies, using a botanic garden which has been carefully kept as he knew it. In nearby Hammarby, Linnaeus' gracious country home and woodland is maintained. The botanic gardens of Uppsala, given by Gustav III to the University in 1786, are today immaculately kept and artistically designed.

Further south, just across from Denmark, is Helsingborg. Nearby are some of the most beautifully designed gardens in Europe: Norrviken Gardens at Bastad. The gardens' creator, Rudolf Abelin, was a landscape architect and at the turn of the century he began developing these varied gardens for his own pleasure. All undisguisedly Swedish, they nonetheless convey the moods of Japanese, Cloister, Baroque, Renaissance and Romantic gardens. The exotic moods are there, but they link to the Swedish setting of sea and rolling hills. Another masterful garden, this is Helsingborg itself, is the royal garden of Sofiero, where sprightly, 87-year-old King Gustav VI Adolf often indulges in his gardening hobby (he is also an active archaeology buff).

A few minutes by ferry and I was in Denmark, at Elsinor, where Shakespeare set his tragedy at Kronberg Castle, but this turreted 16th Century Dutch Renaissance castle was built by Frederik II centuries after the historical Hamlet. In Copenhagen I found another impressive castle, this the creation of Christian IV in 1606. Its gardens blend from one style to another, herbaceous border, knot garden and park-estate.

But garden landscaping isn't the only thing that rivets the eye in Denmark. The design of jewelry, tableware, glass, chairs—almost everything that beguiles from the shop windows along Copenhagen's pedestrian street shopping area. And what can compare for gaity to an evening in the Tivoli Entertainment Park?

Phil Clark is Chief of Field Museum Natural History Tours.

Resources and Man

by Committee on Resources and Man of the National Research Council of the National Academy of Sciences.
San Francisco, Freeman & Co. (1969). $5.95.

With each new famine somewhere in the world, with each new medical advance that adds a new control on death without a commensurate control on birth, the specter of world overpopulation becomes more and more evident even to the most oblivious observer. Will mankind choose *quantity* of life at the expense of its *quality*, or the reverse? Indeed, is there still a chance to make such a choice? Over the past few years these questions have been bandied about with a high degree of emotionalism on both sides. This book, *Resources and Man*, details, with almost complete lack of emotion, the hard numerical facts on both sides of this issue. Eight experts have teamed together, each contributing a chapter, to address the question of how far the Earth's resources will stretch to accommodate a population that is presently doubling itself every 35 years!

The book examines four major areas: (1) projected population, (2) food resources, (3) mineral resources, (4) energy resources. Each question is handled in a careful, analytical manner with hard numbers and definite conclusions based on these numbers. Thus, it is not a book for casual reading, nor is it for the person who seeks vague generalizations. Some of the specific conclusions are worth stating in this review: (1) The oceans are not a "cornucopia" of mineral wealth, and never will be. (2) Contrary to popular opinion, the oceans will never be a major world food supply. They can supply at most only 2.5 times their present output of food products. At best they can become a supplementary source for much-needed protein, but never for food calories (i.e. carbohydrates and fats). (3) Petroleum and natural gas will be expended in about 100 years. Coal could last 400 years, unless we use it to replace petroleum, in which case, it would last at most 200 years. (4) The only long-term source of energy will be nuclear power but *only if* we redesign our present power reactors to breeder-types.

Some of the authors in this book clearly have worked harder at their respective contributions than others. The chapter by Thomas Lovering on "Mineral Resources from the Land" is disappointing because he spends most of his time in a belabored discussion on the problems involved in making mineral-resource projections. This identical kind of problem is, of course, faced by most of the other authors, who, nevertheless, state their methods and limitations and proceed to their respective assignments. The chapter by Marston Bates on "The Human Ecosystem" is completely qualitative and is more philosophical in approach. Its position, as Chapter 1, however, serves to delimit the areas to be considered. Chapter 2, "Interactions between Man and His Resources," consists of a series of vague, qualitative, sociological generalizations and is entirely out of place in a book of this kind. The chapters by S. Hendricks, P. Cloud, N. Keyfitz, and W. Ricker are excellent and workmanlike. The final chapter (8) by M. K. Hubbert on "Energy Resources" is outstanding and is the finest exposition on this subject available to the general reader. It covers all possibilities for large-scale energy generation (except wood-burning and wind) in a thorough and quantitative manner, and draws together a huge range of source material on this subject.

For the reader who is critically interested in these questions and wishes to have the best summation of quantitative information available this book is highly recommended. The pessimist will find here a great deal of quantitative justification to fortify his gloom; however, the optimist will not find himself vanquished by the data. A few gleams of hope are seen: falling birth rates in some Asiatic countries over the last decade; possibilities for increased yields of some crops in some places in the world; nuclear fission (breeder) reactors, and eventually fusion reactors, which are capable of providing energy for literally thousands of years.

The introduction (unsigned) to this book should be read both before and again after completing the book. In it are detailed twenty-six very specific recommendations to establish policies that will wisely stretch resources as far as possible into the future.

Many years ago Winston Churchill posed a question regarding the impending fall of Britannia as a world power. If, in the end, uncontrolled population demands cause mankind to outstretch its earthly resources and Civilization herself tumbles, we will again have cause to ask the same question: "Did she fall—or was she pushed?"

by Dr. Edward J. Olsen, curator of mineralogy, Field Museum

LETTERS

To the Editor:

I believe you have made a mistake in your story of the Origin of Skeletons in animals in the December *Bulletin* on the chart. It says man has been on the earth for two million years. Well, you may be mistaken, man has been on the earth between eight and 15 million years ago, and I have proof.

On page 4 paragraph 2 in the *1970 Young Peoples World Book Science Supplement* quotes "after examination of fossil teeth and jaws which had lain in the collections of the Calcutta and British Museums for many years, Drs. Elwyn L. Simons and David B. Pilbean, both of Yale University, assigned them to a manlike homonid that lived in India and Africa between eight and 15 million years ago." They took radiocarbon tests on the bones in California in 1969.

In California, Dr. Ales Hrdlicka of the U.S. National Museum was convinced that man had not reached the Americas earlier than 2,000 years ago. Researchers at the Los Angeles County Museum of Natural History announced in 1969 that a skull of a woman in the La Brea tar pits had been tested by means of radiocarbon. It turned out that the skull was 9,000 years old, more than four times more than what Dr. Ales Hrdlicka had said.

I hope this will prove what I have said, we should keep our minds open for further proof of man's existence.

Charles Matza, Jr.
Chicago

The author replies:

Charles Matza has been misled by some tricky terminology. The "man-like homonid" he refers to has been considered to be a member of the same family as man, but not yet a man (that is, of the genus *Homo).* One must be arbitrary in drawing a line between man and apes, and for this reason the date of two million years on my chart is also only approximate and arbitrary.

As to his other point, man was certainly in the Americas well before the 9,000 year date assigned to the La Brea skull, but here we are talking of thousands, not millions, of years.

Robert H. Denison

(Dr. Denison recently retired from Field Museum, having served as Curator of Fossil Fishes in the Museum's Department of Geology for the past 22 years.)

To the editor:

The *Bulletin*'s recent article on turtles in mythology and folklore contained much interesting material, but it did not explore the roles of the turtle in ancient Egyptian religion. Apparently, from prehistory (before c. 3000 BC in Egypt) through the Middle Kingdom and subsequent troubled interlude (c. 2000-1575 BC) turtles were good luck; many turtle figurines were made throughout that span, some used as burial objects. Probably the protective shell and ability to withdraw and emerge caused turtles to be associated with preservation and resurrection; this idea survived in a passage from the later Book of the Dead, "I have become Khepri (rising sun). I have germinated as plants; I have covered/ clothed myself as a turtle."

That spell was written when the turtle had already been redefined as an enemy, and it shows the conservative tendency of Egypt's faith which resulted in the retaining of contradictions! During the New Kingdom and later periods (from c. 1575 BC) the formula "May Re (sun-god) live and the turtle die!" was constantly reiterated on tomb walls and in funerary papyri, often illustrated by the deceased spearing a turtle. According to Dr. Henry Fischer's excellent study *Ancient Egyptian Representations of Turtles* (New York 1968), the turtle was cast as the Sun's antagonist because of the exceedingly furtive and somewhat nocturnal habits of the Egyptian river turtle *Trionyx niloticus*, which eventually impressed the people more than the sturdiness and renewing. (Dr. Fischer finds one anti-turtle spell already in the Coffin Texts, the Middle Kingdom predecessor of the Book of the Dead, just as we have seen a recollection of that reptile's originally good role in the latter body of texts.)

Turtle amulets had been discontinued during the early New Kingdom (indeed, some old ones were disfigured upon rediscovery); they were resumed c. 700 BC, but these were made to *ward off* turtles. The late period featured many charms of dangerous and noxious beasts based on a common magical principle of *homeopathy*, or like guarding against like.

Edmund S. Metzer
Chicago

Please address all letters to the editor to

Bulletin
Field Museum of Natural History
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

The editors reserve the right to edit letters for length.

FIELD BRIEFS

Lester Armour, 1895 - 1970

Lester Armour, long-time banker and philanthropist, and a member of the Board of Trustees of Field Museum since 1939, passed away on December 26 at the age of 75. Through the years, he served as a member of the Building and Nominating Committees, and since 1962 on the Finance Committee, offering his help and guidance in many matters vitally affecting the Museum. He was a Corporate Member, Life Member and Contributor of Field Museum.

In 1935 Mr. Armour retired from the meat packing business founded by his grandfather, where he had held the position of Executive Vice President. Later he became Vice Chairman of the Board of the Harris Trust & Savings Bank, a post he held until 1963.

Lester Armour

Mr. Armour was one of three prominent business men appointed public advisers to the Midwest Stock Exchange in 1965 by members of the Exchange's Board of Governors.

Among his many humanitarian activities, Mr. Armour supported the Salvation Army for many years and was a member of its advisory board. He was former Chairman of the Board of Trustees of the Illinois Institute of Technology, and a member of the Board at the time of his death.

Dr. Lewis Back from New Ireland

Dr. Phillip Lewis, curator of primitive art and Melanesian ethnology at the Field Museum of Natural History in Chicago, has returned from a yearlong expedition to the Melanesian Island of New Ireland in the Territory of Papua and New Guinea, where he was studying art in its social context. This trip was sponsored jointly by the Museum and the National Science Foundation.

This is Dr. Lewis' second trip to New Ireland, the first having taken place in 1953-54, when on a Fulbright Scholarship to the Australian National University in Canberra, he was enabled to study art in context in New Ireland. Since 1954 he has been studying museum collections from New Ireland in European, Australian and U.S. museums, including those of the Field Museum, which has the second largest New Ireland collection among world museums—about 2700 pieces. In 1970 he showed photos of these museum specimens, which had been collected over the past 100 years, to New Irelanders in order to learn more about them, he observed modern versions of their major memorial ceremonial, called *malanggan*, and he studied social changes in the same village visited in 1954 and again in 1970.

Lewis found that the *art* of making the carved and painted wooden images (called *malanggan*, also) is virtually dead, but that the ceremonies still flourish, but without the carving. Concrete gravestones are now made and they are supplanting the formerly made wooden carvings. "A sad fact is," said Lewis, "that just at the time [now] when New Irelanders are affluent enough to sponsor large and complex memorial celebrations, there aren't enough carvers still operating to be supported by the new wealth, so it goes into the expanding system of new-style memorials, i.e., with concrete grave markers."

Dr. Lewis is planning a book on New Ireland art which will incorporate the field observations of modern social context which have a direct bearing on how the art was made and used in earlier times.

Geology Field Trip to Ozarks

Dr. Matthew H. Nitecki, associate curator, Department of Geology, will conduct a field trip to the Ozarks April 4-10. This region that cuts across parts of Arkansas, Missouri, and Oklahoma is a diversified geological area of igneous and sedimentary rocks, some at least one billion years old. The sea covered the area many times, depositing predominantly limey sediments which later became sedimentary rock. Other geological processes produced deposits of mineable ores, particularly lead and iron. A wide variety of geological phenomena will be studied in the field, and fossils and minerals can be collected in the mines and quarries.

Anyone interested in joining this nontechnical field trip should phone Mrs. Maria Matyas, University of Chicago Extension, at FInancial 6-8300 for further information. Members of the Museum are eligible for a discount.

New Hall of Jades

Field Museum's famous collection of Chinese jades will again go on display in October in a setting befitting its standing as one of the finest in the United States. Mrs. John L. Kellogg, who has contributed so much to the cultural life of the city, is making the new installation possible through her generous gift. In appreciation of her gift and as a memorial to her husband, this hall will be named "The John L. and Helen Kellogg Hall."

During the past year and a half that the Hall of Jades has been closed to the public, extensive remodeling plans have been underway for the new hall. Mrs. Thomas Yuhas, who completed her M.A. in Asian art history at the University of Michigan, spent one year at Field Museum researching and authenticating the collection under the supervision of Dr. Kenneth M. Starr, former curator of Asian archaeology and ethnology.

Hundreds of the choicest and most representative jades from the Neolithic period through the Ch'ing Dynasty (1644-1912 A.D.) were selected. They will be installed in recessed display areas that are specially lighted to bring out the details and subtleties of each object.

Porcelains, bronzes, scrolls, rubbings, ceramics and poetry will supplement the jades in the new hall, putting them into proper historical perspective and showing how the symbolism of a dynastic period carried through in various art forms. Carpeting and teak walls will set off the displays and contribute to a contemplative atmosphere.

A sensitively carved small jade horse from the Sung Dynasty (960-1279 A.D.) is infused with a feeling for the spirit of the animal.

NSF Grant for "The Flora of Guatemala"

Field Museum of Natural History has been awarded a grant of $44,000 by the National Science Foundation to support continuing research entitled "The Flora of Guatemala." The grant, to run two years, is under the direction of Dr. Louis O. Williams, chairman of the Department of Botany.

According to Dr. Williams, when completed, "The Flora of Guatemala" will be the first comprehensive and modern account of the plant life of any large region of the American tropics. It will serve as important reference material for scientists in other fields who need to know about the vegetation of the area.

Eleven volumes of the flora covering flowering plants, ferns and mosses are finished at present, representing thirty years of research. It is estimated that four more years are needed to complete the final four volumes.

National Institute of Ecology Launched

Detailed plans for a National Institute of Ecology were presented to a meeting of the Institute's founders at Field Museum, December 30, 1970. The Institute, as a research, policy study, information clearing-house, and public education institution, should strongly advance our understanding of ecology and help us reverse our increasing degradation of the environment. The Museum is one of the founders, along with some thirty-five universities, other natural history museums, laboratories, research and development institutions, and oceanographic institutes. Dr. Robert F. Inger, chairman of scientific programs, has been deeply involved in the planning work, begun in 1968 by a study committee of the Ecological Society of America, with financial support from the National Science Foundation. Henry S. Dybas, head, Division of Insects, has been appointed Museum representative to the Institute, and Dr. Rupert L. Wenzel, chairman, Department of Zoology, is alternate.

The Society had been concerned since 1965, well before the term ec*o*l*o*gy became an everyday word, about the fact that existing information concerning the ecological hazards of much public and private activity is not getting through to either governmental agencies or the public. It was no less concerned about the present and future needs for new knowledge to predict the ecological effects of new technology. Since then almost everyone has at least become aware that large-scale use of herbicides in Vietnam, SSTs in the skies, and oil spills in any body of water must have immediate, probably enduring, and in the long run possibly unendurable environmental consequences.

The Institute will have six components. One will be a laboratory to conduct basic ecological research of scope beyond the capacity of existing agencies. An office of forecasting and planning will assist other agencies, public and private, in use of existing ecological knowledge to predict and thus make practical plans to avoid localized ecological problems. A division of policy research will work to bridge the gap between fundamental ecological knowledge and responsible public policy and social action. An office of information resources will be a centralized clearinghouse providing comprehensive library services, computational services, and inventories of ecological research in progress. A division of communication and education will build lines of two-way communication between ecologists and all segments of the public, including other scientists, public and private decision-makers, and the general public. A division of biome modeling and synthesis will have primary responsibility for planning and coordinating scientific activities, and will provide research assistance to outside scientists.

A mixture of public and private funds derived from both grants and income from contractual services will support the Institute, so that it can be independent of any governmental or private agency (including its parent organization, the Ecological Society of America).

Student Anthropology Program

Field Museum has been awarded a grant of $8,705 from the National Science Foundation for support of its Student Science Training Program in Anthropology, scheduled for June 28 through August 6. The course is under the direction of Miss Harriet Smith of the Museum's Department of Education.

The six-week program is a unique one in that it provides a sound foundation in the various fields of anthropology and is designed to assist students in testing a career interest. It is open to 27 high-ability high school students who have just completed their junior year. Selection will be on the basis of academic achievement, recommendations of teachers and personal interviews.

In its eighth year, the training course includes lectures by outstanding authorities, seminars, workshops, research projects, study of Museum collections and participation in an archaeological excavation.

Application forms are available from high school officials or Miss Smith and must be returned to Field Museum no later than March 15.

CALENDAR

Continuing

Catalogue of the Different Specimens of Cloth Collected in the Three Voyages of Captain Cook, to the Southern Hemisphere. London, Alexander Shaw, 1787, shown in the South Lounge. The rare copy consists of actual tapa cloth specimens collected during Captain Cook's voyages to the South Seas (1768-1780). The volume is the gift of Mrs. A. W. F. Fuller. Through March 21.

Life in Other Worlds? An exhibit of the *Murchison* meteorite, a Type II carbonaceous chondrite, of which only 14 exist out of the almost 2,000 known meteorites. Recently, amino acids, possible building blocks of life, have been reported in this meteorite. South Lounge. Through March 21.

John James Audubon's elephant folio, *"The Birds of America,"* on display in the North Lounge. A different plate from the rare, first-edition set is featured each day.

"Exploring Indian Country," Winter Journey for Children. The free, self-guided tour enables youngsters to see American Indians of three environments as the early explorers saw them. All boys and girls who can read and write may participate. Journey sheets are available at Museum entrances. Through March 9.

75th Anniversary Exhibit: A Sense of Wonder, A Sense of History, A Sense of Discovery, continues indefinitely. Exhibits relating to Field Museum's past and present and current research projects are shown in a new and different way. Hall 3.

Hours

9 a.m. to 4 p.m. Monday-Thursday
9 a.m. to 9 p.m. Friday
9 a.m. to 5 p.m. Saturday and Sunday and February 1 and 15

The Museum Library is open
9 a.m. to 4 p.m.
Monday through Friday

Begins February 7

26th Chicago International Exhibition of Nature Photography, featuring award-winning photographic prints. Sponsored by the Nature Camera Club of Chicago and Field Museum. South Lounge. Through February 28.

February 7 and February 14

A showing of prize-winning transparencies from the 26th Chicago International Exhibition of Nature Photography, 2:30 p.m., James Simpson Theatre.

Through February 7

A Child Goes Forth, an exhibit of toys and games from around the world, examines their importance in the cultural development of children. Hall 9.

Meetings

February 9, 7:45 p.m., Nature Camera Club of Chicago

February 9, 8 p.m., Chicagoland Glider Council

February 10, 7 p.m., Chicago Ornithological Society

February 10, 7:30 p.m., Windy City Grotto—National Speleological Society

February 11, 8 p.m., Chicago Mountaineering Club

February 14, 2 p.m., Chicago Shell Club

February 21, 2 p.m., Illinois Orchid Society

March 9, 7:45 p.m., Nature Camera Club of Chicago

March 9, 8 p.m., Chicagoland Glider Council

March 10, 7 p.m., Chicago Ornithological Society

March 10, 7:30 p.m., Windy City Grotto—National Speleological Society

Coming in March

Color in Nature, an exhibit of broad scope, investigates the color dimension of Field Museum's huge collections. The varieties of color in nature and the meaning of coloration in plants and animals are closely examined. March 10 through October 10. Hall 25.

"To See Or Not To See," Spring Journey for Children, begins March 10. Youngsters learn about the diversity of colors and color patterns of selected animals, as well as the advantages of mimicry and pigmentation changes, with the aid of a questionnaire. All boys and girls who can read and write may participate in the free program. Journey sheets are available at Museum entrances. Through May 31.

March 6

Spring Film-Lecture Series resumes with "The New Israel," narrated by Ray Green. A vivid and up-to-date portrayal of this ancient land and its people, that is a blend of the past and the present. 2:30 p.m., James Simpson Theatre.

March 13

Spring Film-Lecture Series continues with "The Call of the Running Tide," narrated by Stanton Waterman. Photographed in the islands of French Polynesia, much of it on sea bottom and along barrier reefs, it is a revealing study of the inhabitants and the many forms of sea-life surrounding them. 2:30 p.m., James Simpson Theatre.

March 20

Spring Film-Lecture Series presents "Uganda—Land of Stanley and Livingston," narrated by William Stockdale. Scenes of wildlife, the wonders of national parks and the people in the cities and remote areas. 2:30 p.m., James Simpson Theatre.

March 27

Spring Film-Lecture Series offers "Sweden Year Around," narrated by Ed Lark. All four seasons are encompassed in this motion picture journey to the land of the midnight sun. 2:30 p.m., James Simpson Theatre.

BULLETIN

. . . the patterning of human behavior might be explained by the archaeological record.

BULLETIN

Volume 42, Number 3
March 1971

Cover: The Revolution in Archaeology.
Photo at right courtesy Institute of Design,
Illinois Institute of Technology.

Field Museum of Natural History
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The Revolution

Up to and including 1960, I pursued four goals: (1) the application of palynology; (2) the closing of the gaps in the archaeological record by working in relatively unexplored areas; (3) a historical reconstruction of the relationship between the prehistoric "cultures" of eastern Arizona and the historic Hopi and Zuni cultures; and (4) the establishment of a stratigraphy of traits for the area.

In common with most of my colleagues, I had emphasized culture traits, trait lists, histories of sites and/or areas—all organized in a time-space dimension. I entertained the illusion that the facts would speak for themselves. I was carrying on "normal science," or solving jig-saw puzzles.

Since 1960, my goals and interests have been modified by the trend that is spreading across the country—a trend that symbolizes a shift from emphasis on particularisms to an imaginative era in which we build a cultural-materialist research strategy that can deal with the questions of causality and origins and laws. The trend toward a re-examination of goals, research methodology, and paradigms seems apparent in other fields—sociology, linguistics, geology, biochemistry, and physical anthropology—to mention only a few.

As a result, I have substantially altered the bearing, emphasis, and procedures of my research. Thus, a conceptual transformation, a revolution, has taken place for me.

In 1961-62, the subject matter of my researches changed slightly—to wit: I developed the desire for information on cultural ecology of eastern Arizona; but I was still concerned with the historical relationships mentioned above. Further, I expanded my interest in the stylistic traits of the "Snowflake culture" in Arizona and its ties with both its Anasazi and its Mogollon neighbors.

By 1963-64, substantial changes appeared in my research design. I was still committed to the old stance on writing the "culture history" of our eastern Arizona area. Two new dimensions, however, were added. One was theoretical; it consisted of focusing on culture, not as an aggregation of traits but as an adaptive mechanism that permitted man to cope with the daily problems of living. The facets of culture were sub-divided: (a) sociologic, (b) economic, and (c) ideologic. The other dimension was methodological. It was concerned with sophisticated statistical techniques, sampling, statistical models, and computer aid at all levels of research. It was not, as is naively assumed, "computer archaeology," for there is no such thing.

These shifts hastened to displace my old interest in regional cultural history by the analysis of individual sites as socio-cultural adaptations—as on-going social systems. By studying the patterns of culture represented by the distributions of artifacts at each site, I hoped to make contributions to anthropology. In 1965, many of these emerging trends had become more solid and firm. If a site represented a once flourishing social system, I felt we should analyze it by asking questions about the subsystems of which it was composed. I focused not upon traits but upon the patterned co-variation of groups of traits. I studied ecological, sociological, technological, economic, and ideological problems. I set contributions to the understanding of human behavior as the primary goal.

n Archaeology

Paul S. Martin

I now feel in a better position to make contributions to anthropology. I now regard the use of logic and of scientific methods as the minimum acceptable standard for good archaeology. By this I mean the procedure of advancing a hypothesis (defined as a statement of relationship between two or more variables) to explain observed data or behavior. By the interchange of deduction and induction, the hypothesis can and *must* be tested with independent but relevant data. Thus, by taking as our hypotheses general propositions concerning causes for culture change, we shall be able to make contributions to anthropology, to formulate probabilistic laws of cultural dynamics, the results of which may be relevant to contemporary world problems.

In describing this adaptation to my physical, social, and intellectual environment, I shall try to explain how this revolution came about. I do this, not because my metamorphosis is important to anyone but myself, but because the changes that I describe are the product of the dissatisfactions shared by many archaeologists. This essay may be of help to younger, creative men who recognize that something is lacking in their research strategies but who do not quite know how to remedy it.

Some years ago, Robert Maynard Hutchins is alleged to have described archaeology as a "tool course" that belonged in the curricula of vocational schools and not in those of a university.

This scornful evaluation really racked me, but it had enough truth in it to make it impossible to disregard. Actually, he was not far off target, especially when one recalls the then-current definitions of archaeology:

—*Archaeology, the science of what is old in the career of humanity, especially as revealed by excavations of the sites of prehistoric occupation. Archaeology, of course, is a sort of unwritten history.*

—*Archaeology deals with the beginnings of culture and with those phases of culture which are now extinct.*

—*Archaeology reconstructs human history from earliest times to the present. It is concerned with the beginnings of culture and also with cultures and civilizations that are now extinct.*

In general, then, there was agreement among most American archaeologists that archaeology was concerned with reconstruction of culture history and lifeways as well as with the delineation of cultural processes. We had a model for working out culture history, but lacked a model for explaining culture change. We were slowly realizing the importance of understanding cultural processes over vast periods of time.

These goals of archaeology had at one time been satisfactory as paradigms; but, gradually, the mortar fell out of the joints of our "edifice"! Crucial questions arose which could not be answered with the existing models. For instance, why did the mobile hunting-gathering culture of the Southwest change to a sedentary one; or why did cultures of Mesoamerica become urban? These are specific instances of a more general question: Under what conditions do changes in adaptive strategies occur? It appears that strategy shifts occur when there are major changes in population, integration, technology, or differentiation —particularly, the latter two. I began to feel that our research was futile; we were, in fact, not increasing our knowledge of the past nor applying it to contemporary problems of our society.

At this time, a crisis took place in my professional career. I had been vaguely aware of new trends, of fresh breezes that were disturbing my mouldering ideas. I finally awakened to the fact that I had to resolve this crisis either by catching up with what was going on, or by resigning myself to becoming a fossil. I must admit that at first the different ideas and approaches outraged me. I was hostile to them, probably because a 35-year professional investment was at stake. I was afraid of things strange and new. It is not uncommon for scientists to resist scientific discoveries.

Long before my dissatisfaction and unfulfillment became articulate, a few archaeologists and anthropologists from 1930 on had concluded that our traditional methods were leading them astray, down dead ends, and up against blank walls. It was borne in on these disaffected students that archaeology is part of anthropology and is, therefore, a social science. As practiced, however, it was at best a stunted history and presentation of facts for their own sake; and, at worst, a kind of stamp-collecting pursuit. The interpretation of interrelationships of events, time, and space could go on *ad infinitum* and never get anywhere. As one archaeologist put it, our accomplishments were "sterile

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methodological virtuosity." We were in a *cul de sac* because comparing forms and systematizing our data were not leading to an elucidation of the structure of social systems any more than did the ordering and taxonomy of life forms by Linnaeus explain the process of organic evolution.

We archaeologists were confronted with the bewildering and perplexing fact of a disparity between what we wanted to accomplish—an explanation of why cultures change—and what we were actually doing—histories of sites. For example, we recognized, though dimly, the desirability of explaining past cultural processes, but a research strategy for conducting such studies had not been developed in archaeological theory. In fact, we had

no theory and we lacked goals. We were in a vexing and painful predicament. We were digging up sites, towns, and cities; classifying pottery and tools with a fatuous obsession; dating places and things; writing reports and arriving nowhere. Rarely were explanations and predictions attempted; seldom, generalizations or probabilistic laws.

True, archaeology had contributed significantly to general knowledge: it had established the probable antiquity and origin of man; it had contributed substantially to the delineation of Biblical and Grecian history; it had made a significant start toward defining the origin and antiquity of the American Indians; it had demonstrated the separate development of cultures in the Old and New World; it had outlined the evolution of cultures, the origins of agriculture, and the development of systems of writing; it had aided in the destruction of many myths and much folklore concerning giants, races, and human origins.

I do not disparage or belittle these achievements. They were not, however, explaining, predicting, or clarifying cultural phenomena; they were not concerned with contemporary problems of behavioral science; and, finally, they were not helping man to understand and to interpret his world.

Clearly, this impasse would be resolved as it always has been in science—by the emergence of a new paradigm. This one would not be an extension of the older models that had guided us, but would be, rather, a reconstruction of the field from new fundamentals. As I look back with the benefit of hindsight, I think we began to realize that goals (explanations), investigative techniques, and collecting of data are not independent variables. On the contrary, they stand in a dependent relationship, one to the other. After that, a temporary agreement about what constitutes good research strategy and what results were acceptable came slowly into being.

Then, in 1961, by good fortune I was launched into a new stream of events that was to bring me hope of renewed progress and meaning in archaeology.

Lewis R. Binford, a student of Leslie A. White, and his students were discovering what others had stumbled on, namely that the traditional ways of archaeology were unpromising and ineffective. Fortunately, they were not deeply committed to the establishment; they perceived that the old rules no longer "defined a playable game." It is interesting to note that, as was true of other great innovators, they were young.

At this time, four of Binford's students —James A. Brown, Leslie G. Freeman, James N. Hill, and William A. Longacre —were collaborating with me in archaeological analyses. They showed me how we could build on what had been done and how advances could be made. They were kind, patient, stimulating mentors. I perked up. I listened. I attended seminars. I reread. I found most of the theories and practices of the past obsolete. I slowly became acquainted with new concepts and with the need for employing new and methodologically sophisticated techniques of data acquisition and analysis. I began to perceive what is meant by the nature of scientific explanations and devices for systematizing knowledge. Hence, a small group of archaeologists in various parts of the country accepted cultural-materialism as a valid strategy. They rejected historical-particularism; they stressed the need for devising a research design that would conform to uniform or accepted rationales on which to base acceptance or rejection of hypotheses. This group, and I now consider myself part of it, has re-oriented its theoretical and

methodological systems. These men are creating a new paradigm.

This change may not seem to some so profound as the shift from geocentrism to heliocentrism or those changes

brought about by Kepler, Newton, or Boyle, to name but a few. The point I wish to stress is that a new paradigm permits one to see things differently today than one did yesterday, even if and when looking at the same phenomena.

Let us consider two men looking at the console of a large pipe-organ. One man is an organist; the other, unlearned musically. The organist instantly "sees" many things: the various manuals (keyboards) as representing separate organs—the solo, the swell, the great, the choir, and the pedal keyboard, on which the feet play; the stops, each controlling a single rank or multiple ranks of pipes; the couplers, the thumb pistons, toe studs, expression pedals, and more. The non-organist is looking at the same details, but is not seeing that a certain stop will produce a loud tone or one of a deep pitch or that one's feet can "play" the pedals as nimbly as one's fingers. All he sees is a complex looking "thing" with black and white keys, strange looking knobs en masse, a bench, and a rack. They are not both visually aware of the same object. The non-organist must learn music and study the organ before he can see (hear, feel, sense) what the organist sees. Thus, the two men may be said to have vastly different conceptual organizations and, since their visual fields have a different organization, they observe different things.

So it is that the archaeologist armed with a different conceptual organization and a new paradigm can now see in familiar objects what no one else has seen before. He has a new way of thinking about his universe; he knows now how to "see" ancient sites, stratigraphy, stone tools, in a new and meaningful perspective. For example, I used to be a virtuoso of pottery types. Given almost any sherd from the southwestern United States, I could place it spatially and temporally. But I was unable to tell you a thing about the interrelationship of shapes, designs, types, and functions. I had not "seen" that a given pottery type *x* might have been used almost exclusively for ritual or burial purposes. Nor did it ever occur to me to postulate that pottery was more than a type or that it represented part of an articulated system that had been adapted by man to his environment in order to carry on the business of living. I was unable to *see* that the patterning of human behavior might be explained by the variability in the archaeological record.

The force of what I am trying to make clear about the ability to "see" may be made clearer by examples. It is said that prior to the time of Copernicus, western astronomers, obsessed by the Ptolemaic model, regarded the heavens as immutable; whereas the Chinese astronomers during the same centuries (prior to A.D. 1500) had recorded the appearances of new stars (novae), comets, and sun-spots. In other words, the Ptolemaic model held by western astronomers prevented them from actually observing what was there to see. Their model blinded them. By the same token, our models and our hypotheses must be created in such a way as to include multi-variate explanations in order that we may not be blind to reality. The paradigm within which we work determines what one is going to "see"—to observe.

Thus, as a result of a new paradigm, I live and work in a different world. The new paradigm that has emerged was a direct response to the crisis that had arisen because the traditional archaeological paradigm was askew. This kind of crisis leads to a scientific revolution.

What, then, are some aspects of this revolution-inciting paradigm and how is archaeology redefined?

To claim that some archaeologists have adopted a new paradigm is

equivalent to asserting that when they look at their world they see something new and different. If the claim is true,

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then I should be able to specify some of the principal changes in their conceptual organizations and the different things they observe. I think it is possible to point out some of the major differences.

According to the old view, archaeology was defined as a special kind of history. Data were regarded primarily as the function and result of unique events, and the task of the archaeologist was to collect random facts and create a reconstruction of past events and of by-gone life-ways. A whole was to be formed from random data.

According to the new view, archaeology is a science, for "science" includes not only physical and biological fields but also the social sciences—anthropology, sociology, economics. Even historical inquiry does not differ radically from the generalizing natural or social sciences, in respect to either the logical patterns of its explanations or the logical structures of its concepts. Archaeologists must now regard data as unique expressions of recurring

cultural processes. Understanding data is worthwhile primarily as a means of understanding these recurring processes.

In the old view, reports or monographs concerned with archaeological survey and/or complete descriptions of all recovered data from a site were considered all-important. Usually, such reports included a history of the region or a reconstruction of the history of a site. In a sense, it was at best highly sophisticated antiquarianism.

In the new view, the function of science—and hence of archaeology—is to establish general laws covering the behavior of the observed events or objects with which the science in question is concerned. This enables us to connect our knowledge of separated events and to make reliable predictions about other events. Statements with a high degree of probability covering a broad range of phenomena are among the important aims of science.

Our ultimate goal in anthropology and archaeology is to formulate laws of cultural dynamics; to seek trends and causes of human behavior; and, as noted above, to make probabilistic predictions.

To apply this to an archaeological situation is neither difficult nor impossible. Human behavior is patterned (demonstrable and demonstrated); and if the patterning has not been disturbed by erosion, plough, or pot-hunters, it can be recovered by proper techniques of limited excavation, that is, by an adequately designed sampling procedure. Data relevant to all parts of the extinct socio-cultural system are preserved. We have only to devise a proper definition of culture and appropriate techniques for extracting this information from the extant data. Thus, a systems approach to culture permits us to view a site at a single point in time. When one system is compared to another, we perceive process at work—that is, change with or without continuity. By process, I mean the analysis of a system at one point in time and at one place, and how it is transformed into a different system in the same area at a later time. The comparison of systems—not individual "traits"—provides data for understanding trends and for comprehending regularities. Once these are comprehended, one can make probabilistic predictions.

Under the old view, culture was defined implicitly or explicitly as a set or an association of traits, qualities, properties, or features. Arrowheads, pots, houses, firepits, orientation of the dead, bone tools, manos, axes, ornaments—all of these and hundreds more are traits. Thus, archaeologists spoke of the Effigy Mound "culture," the Desert "culture," the Beaker "culture," the Megalithic "culture." Each of these was characterized as possessing certain traits that set it off from all other neighboring or distant "cultures." Archaeologists even spoke of certain tribes as being the "brown-ware (pottery) people." Minute differences in projectile point shapes were thought of as being important in distinguishing one people from another; and whole migrations of people were postulated on the basis of a single trait or a unique association of traits.

Under the new view, culture is thought of as man's extrasomatic adaptation to his total sociological and ecological environment. Prehistoric communities (sites) are studied as whole systems each subsystem—technological, sociological, ideological—of which is a closely knit, interrelated set of functional parts. Patterns of significantly co-varying clusters of stylistic categories and attributes of data derived from all subsystems are sought.

From the old view, insofar as archaeology held any logical structures, it was thought to be inductive. To some, it demonstrated a kind of mysticism in that artifacts recovered

from a dig were assumed to speak to the archaeologist who thereby identified himself with the objects (supplemented the real with the ideal). However, facts cannot be expected to unscramble themselves and produce a theory in the same way as scrambled letters in an animated cartoon unscramble and form a word. Random facts were avidly collected in the belief that this was good procedure and that the end (reconstructing prehistoric life-ways) justified the means (haphazard collecting of data, with no goals or hypotheses in mind).

From the new view, the time to retool is here. It is the consensus that the fruitful approach to a science of the past (as in all sciences) lies in those systems of logic in which deduction and induction interplay.

Archaeology can be structured, it need not be haphazard or vague. Tentative hypotheses may be deductively formulated to give direction to scientific investigation. Such hypotheses determine what data should be collected at a given point in an investigation by means of test implications. It can be shown that the old method of fact collecting is a sterile procedure and produces a morass. Worse, such a procedure will fail to reveal regularities and will lead to no conclusion. (Recently, I heard a colleague describe the data from an impressive series of excavations and then tell his audience that he did not know what to do with these data!)

Actually, most archaeologists have prior or implicit ideas and postulates and even derived theories, but they often fail to make these explicit. They shrink from the ridicule that might beset them if they were to make known these hypotheses. It would take but little intellectual shift to train themselves in the hypothetico-deductive approach. They would then realize that hypotheses are formulated or invented to account for observed facts and not the other way around.

Our knowledge of the past can only be increased by these procedures of interplay and feedback of deduction-induction, formulating hypotheses concerning human behavior and then testing them by relevant archaeological data. The only limits to increasing our knowledge of the past lie in poor intellectual training and in failing to understand that all archaeological remains have relevance to propositions bearing upon cultural processes and events of past times. The accuracy of our knowledge of the past may be measured by the degree to which our hypotheses about the past are confirmed or rejected.

In the light of the above suggestions, we redefine archaeology as a discipline that deals with the socio-cultural systems and cultural processes of the past. Archaeology is a social science because its goal is to explain human behavior. Archaeology is anthropology because it uses the concept of culture. Because these goals are accomplished by using data from the past, the science is archaeology. Using data from the past, however, does not make it a type of history. It is not history because archaeology deals with general relationships between variables of human behavior, and not with explaining sequences of unique events.

The new paradigm does not resolve any problems. Its value rests in the fact that it revolutionizes our methods of thinking and permits us to view our inquiries in a different way and with greater scope. It is a new way of regarding the problems of archaeology. It is high time that archaeologists make use of the new research tools given them by the logic and structure of science.

Although I have written this essay in the first person, I emphasize that my efforts have been the results of suggestions, collaboration and cooperation with young, ardent, capable, and dedicated scientists—Lewis R. Binford, James A. Brown, Leslie G. Freeman, John M. Fritz, James N. Hill, Mark P. Leone, William A. Longacre, Fred T. Plog, Edwin N. Wilmsen—to name but a few.

Adapted and reprinted, by permission of the Society for American Archeeology, from *American Antiquity*, Volume 36, Number 1, Januery 1971.

Dr. Paul S. Martin is chairman emeritus of anthropology at Field Museum.

International nature photograp

More photographers than ever before this year sent more photographs than ever before to be considered for the 26th Chicago International Exhibition of Nature Photography. Over 4,000 color slides and 400 prints were submitted by some 1,000 photographers from 48 states and many other countries. Field Museum and the Nature Camera Club of Chicago are joint sponsors of this biggest exhibition of nature photography in the world, held in the Museum. We wish there were space to reproduce more than the four entries shown here.

No monetary awards are involved. It is a noncommercial, nonprofessional event. Most entrants are amateur but avid nature photographers. But the honor of having one's work accepted is an acknowledged standard of accomplishment that even some professionals seek.

A lot of work is involved in opening boxes, carefully preparing all the slides and prints for judging, showing, and finally returning to their owners. Most of it is done by members of the Nature Camera Club, with assistance by the Museum staff in setting up the exhibit.

The challenge of putting nature's beauty and diversity on film makes this hobby so exciting. The reward comes when people respond to an unusual glimpse of nature caught by your camera —something they may otherwise never have seen or noticed.

William Burger

President, Nature Camera Club of Chicago

ıy exhibition

Photos: *Sand Curves* (page 9), by Alexander Dupper, Lodi, California. *Redwood in Fog* (page 10), by Dr. Fred Modern, Long Beach, California. *Caracal Lynx* (page 11), by Earl Kubis, Downers Grove, Illinois. *Machaeon Swallowtail* (page 11), by Tom Webb, Edmonton, Alberta, Canada.

FIELDIANA

Patricia M. Williams

Last year was *Fieldiana's* 75th birthday. In those 75 years Field Museum has published over 1,100 issues of *Fieldiana*. The list of *Fieldiana* titles stands a towering 22 feet high in the Museum's 75th Anniversary Exhibit and *Fieldiana*'s distribution is worldwide in scope. And yet, unless you're a professional scientist, you may have never even heard of *Fieldiana*, let alone read a copy.

Fieldiana is a continuing series of scientific papers and monographs dealing with anthropology, botany, geology and zoology intended primarily for exchange-distribution to museums, libraries, and universities, but also available for purchase.

Fieldiana was begun in what is often referred to as the "Museum Age"—the 1800's. Many of this country's great natural history museums were founded in the nineteenth century and their scientific series began to proliferate toward the end of that century. For example, the *Bulletin of the American Museum of Natural History* first appeared in 1881, the *Proceedings of the U.S. National Museum* in 1878, the *Smithsonian Miscellaneous Collections* in 1860, and the *Contributions from the Gray Herbarium* in 1891.

Field Museum's *Annual Report of the Director* for 1895 introduced the series which would one day be called *Fieldiana* as "the medium of presenting to the world the results of the research and investigation conducted under the auspices of the Museum. The publications are intended primarily to convey information upon the collections and expeditions of the Museum. There is no restriction, however, as to authorship or subject, provided the papers come within the scope of scientific or technical discussion."

At that time the Museum itself was still evolving toward its present division of interests and the scientific series reflects this evolution. Then, as now, there was a Botanical, Zoological and Anthropological Series but instead of a Geology series the Museum offered both Historical and Geographical publications. In fact, publications 1, "An Historical and Descriptive Account of the Field Columbian Museum" and 2, "The Authentic Letters of Columbus" were both in the now defunct Historical Series.

Fieldiana has reflected not only the growth and development of Field Museum, but of the various sciences as well. For example, anthropology was just emerging as a professional discipline in the United States at the time of *Fieldiana*'s introduction and some of the most important early anthropologists contributed to the series. W. H. Holmes published one of the world's first reports on the archaeology of the Yucatan in the new-born Anthropological Series. G. A. Dorsey contributed several landmark publications on various American Indian tribes, recording firsthand details of ceremonies and myths which were impossible to obtain even a few years later. H. R. Voth, a missionary, recorded descriptions of sacred American Indian ceremonies and his publications are standard references today.

Dorsey and Voth published in Field Museum's series between 1897 and 1912. Around 1912 Berthold Laufer, a

scholarly giant of world renown, began to publish. His "Jade, a Study in Chinese Archaeology and Religion" (1912) was one of the first authoritative works on jade and is now a classic. In 1927 J. Eric Thompson published a very short, very technical paper called "A Correlation of Mayan and European Calendars." This calendar, which correlates Christian chronology with Mayan hieroglyphics, continues to be the standard reference point for workers in this field.
In 1931 Roy L. Moodie contributed "Roentgenologic Studies of Egyptian and Peruvian Mummies,"—one of the first published collections of mummy X-rays. Paul S. Martin, who has published more on the Southwest than any other anthropologist, authored several volumes in the *Fieldiana: Anthropology* series. Ralph Linton, A. L. Kroeber, W. Hambley, Fay Cooper Cole, and Alexander Spoehr are among the prominent anthropologists who have contributed to *Fieldiana* in the past.

Reviewed in the same detail, the lists of *Fieldiana: Botany, Geology,* and *Zoology* are seen to be studded with the names of outstanding scientists advancing new ideas, describing new genera and species. The colossal floras in the Botanical Series are known to botanists the world over and represent the work of many men. The "Flora of Peru," begun in 1936 and still in progress, runs to over 6,000 pages to date. The "Flora of Guatemala," begun in 1957, continues. Just beginning is a series on the flora of Costa Rica to record the remarkable botanical diversity of that area before much is eradicated by encroachment of the human species and its technology.

Many of the geology publications have been landmarks in the study of the earth and early life, presenting new concepts, data, techniques, and interpretations. One outstanding example, "The Paleoecological History of Two Pennsylvanian Black Shales" by Rainer Zangerl and Eugene S. Richardson, is now used as advanced reading in universities.

Fieldiana: Zoology is an abundant source of descriptive and interpretative material dealing with insects, invertebrates, and vertebrates from every area of the world. W. H. Osgood and K. P. Schmidt, both former chief curators, were prolific writers and published often in the *Fieldiana* series. D. Wright Davis' mammoth "The Giant Panda: A Morphological Study of Evolutionary Mechanisms" is certainly one of the most noteworthy issues of Fieldiana from a standpoint of both quality and size (339 quarto pages, 160 illustrations).

It is largely through such publications that Field Museum's reputation as a scientific institution is maintained and enhanced, that its collections and staff become known to the scientific community.

Any title of *Fieldiana*—dated 1895 or 1971—can be examined in the Museum library. All that are not out of print are available for purchase.

In this age of imperative relevance, *Fieldiana* is relevant. It describes and interprets our world and its inhabitants as it was and is. For conservationists of both human and natural resources, *Fieldiana* provides a record of what was so that we can measure what we have changed, improved or destroyed. *Fieldiana* has been pure science as well—irritating to those who demand "But what can you *use* it for?" but inspiring to those who appreciate and desire knowledge for its own sake.

Patricia M. Williams is managing editor of scientific publications at Field Museum.

FIELD BRIEFS

Dr. VanStone New Anthropology Department Chairman

Dr. James W. VanStone has been named chairman of the Department of Anthropology at Field Museum. He succeeds Dr. Donald Collier, who re-assumes his former position of curator of Middle and South American archaeology and ethnology. The appointment is in accordance with the Museum's new policy of four-year term appointments for the chairmen of its scientific departments.

Dr. VanStone is former curator of North American archaeology and ethnology. He is a member of a joint committee of the Arctic Institute of North America and the Bureau of Land Management, Department of the Interior, advising on environmental protection in conjunction with the Trans-Alaska pipeline. The committee, composed of seven northern specialists, reviews the work of the archaeologists hired by the Trans-Alaska Pipeline system.

An authority on the peoples of the North American arctic and subarctic, having taught anthropology for eight years at the University

Dr. James VanStone

of Alaska and seven years at the University of Toronto, Dr. VanStone joined Field Museum's staff four years ago.

Francis Brenton Sails Catamaran Back from South America

Francis Brenton, voyager, writer, photographer and adventurer, returned recently with more than one hundred artifacts he collected for Field Museum while exploring the jungles of South America.

His journey began a year ago at the top of the Amazon, where he purchased a 20-foot dugout to traverse its tributaries. "Collecting in this region," says Brenton, "was from the Rio Ucayali and other rivers branching off the main Amazon River, such as the Mazon, Napo, Loreto, Yavari and half a dozen others. Tribes were mostly Shipibo, Jivaro, Yagua and Tucuna. The artifacts acquired included blowguns, bows and arrows, hammocks, pottery, a headdress, flutes, clothing, medicinal plants, baskets, bags, ankle and wrist ornaments made of jungle seeds, and other similar trinkets."

Obtaining another 20-footer at Belem, Brazil, Brenton lashed the two dugouts together to form a catamaran, which he named the Sarape. From Belem, he sailed up the coast to the Guianas and continued to the mouth of the Rio Orinoco in Venezuela. In this area he visited the Guahibo, Makaritari, Piaroa, and Delta Indians, adding more items to his collection along the way.

Returning back down the Orinoco, Brenton headed for Trinidad. At this point in his narration he stops to explain, "Anyway, when I reached the Atlantic from the Orinoco, the Sarape started taking on water by the bucketful, through the seams which the ants had eaten clear of calking. The typewriter was thoroughly soaked and I also felt the urge to jettison weight, for I was six to eight miles from land at the time." Brenton was referring to the typewriter he was using to record daily events for his forthcoming book, *The Sarape*. It went overboard without much further ado.

The last thirty days of Brenton's voyage, from Trinidad to Miami, were relatively calm and uneventful.

Francis Brenton has soloed the Atlantic three times, twice in dugout canoes. He is the author of *A Long Sail to Haiti,* and *The Voyage of the Sierra Sagrada.*

Even though his latest expedition is barely over, Brenton is busy making plans for the next one. He will leave Miami soon in the Sarape, sailing up the Inland Waterway to Newport News, from where he will head for Plymouth, England. He expects to sail along the coasts of France and Portugal as far as Madeira, photographing and writing along the way, and looking for new adventure.

Francis Brenton and Dr. Donald Collier, curator of Middle and South American archaeology and ethnology, examine blowgun, darts, and manioc squeezer, some of the objects Brenton brought back to the Museum from his most recent voyage.

Rock Hounds Honor Dr. Richardson

Dr. Eugene S. Richardson, Jr., curator of invertebrate fossils, has been honored by the American Federation of Mineralogical Societies. The Scholarship Foundation of this nationwide federation of rock hound groups, encompassing 60,000 members, voted their annual Scholarship Foundation Award to him for 1971, "for outstanding achievement in the field of Earth Sciences."

Dr. Richardson will thus have the privilege of selecting schools that will receive grants from the Foundation to assist six graduate students for two years each in their work toward a master's or doctor's degree in any of the earth sciences. The substantial resources of the Foundation that make these grants possible have been accumulated over the years through many small fund-raising activities of the local societies and contributions of the members.

The Foundation president, W. H. de Neui, wrote that "Dr. Richardson's selection to receive this honor is particularly gratifying; he has done so much to further among the 'common men' the interest in paleontology, we can think of no one that is more worthy of the Award. He regularly and frequently lectures to Chicago area audiences and works closely with local club members in their search of the strip coal mining area southwest of Chicago, which has produced so many spectacular paleontological finds."

In addition to his active professional writing and other work, Dr. Richardson has indeed contributed much to the activities of these

eager nonprofessional groups. He is advisory editor of paleontology for *Earth Science Magazine*, and an honorary member of the Midwest Federation of Mineralogical Societies, the Lake County Gem & Mineral Society (Waukegan), the Earth Science Club of Northern Illinois, and the Chicago Rocks & Minerals Society.

Geology Field Trip

Details of the April geology field trip to the Ozarks will be explained to all prospective participants on Saturday, March 20 at 10:30 A.M. at 65 East South Water Street.

The group will fly to St. Louis on Sunday, April 4 and return to Chicago Saturday, April 10. A chartered bus will transport participants into the field. Four long hikes will require hiking clothes. Tuition of $160 will include air transportation, the chartered bus in Missouri, and all meals. (Members of the Museum are entitled to 10% discount.) Hotel reservations will be made for the group and will be an additional $5 to $8 a day.

The trip is non-credit course N963 offered by the University of Chicago Extension in cooperation with the Department of Education of the Field Museum of Natural History. Matthew H. Nitecki, associate curator in the Museum's Department of Geology, will conduct the course. Arrangements to join the group should be made by calling Mrs. Marie Matyas, University of Chicago Extension, at FInancial 6-8300.

Hans Conried Visits Field Museum

Christopher C. Legge, custodian of anthropological collections, shows Hans Conried, the well known actor, a necklace that once belonged to Quenah Parker, one of the most warlike chiefs of the Comanche Indiens. Said Mr. Conried during his recent visit, "I have been coming here for many years—whenever I am in town. Field Museum is one of the greatest museums in the world."

Wood Collection Contributed to Agriculture Department

Field Museum recently transferred its worldwide wood collection of more than 20,000 specimens to the Forest Products Laboratory of the United States Department of Agriculture Forest Service at Madison, Wisconsin. The gift was made possible through the efforts of Dr. Louis O. Williams, chairman of the Museum's Department of Botany.

With this acquisition, the extensive Forest Products Laboratory collection, which includes the Samuel James Record collection acquired from Yale University in 1969, now totals about 100,000 specimens of wood from every major forest area in the world, making it the world's largest research collection of woods.

The original set of voucher specimens (specimens of leaves, stems, flowers and fruits mounted on herbarium sheets) for Field Museum's wood collection remains available in its herbarium for study purposes, together with the original voucher specimens for many of the woods from the Samuel James Record collection, determined by Paul C. Standley, outstanding authority on tropical American botany who spent a "life time" at Field Museum.

More recent vouchers from Forest Products Laboratory's valuable acquisitions in Peru have been determined and the study set and types deposited in Field Museum's herbarium. Duplicate specimens of many of these recent Peruvian collections have been distributed to other scientific institutions, including Peruvian, by Field Museum.

NSF Grant for Archaeology Program

A grant of $22,000 has been awarded Field Museum by the National Science Foundation for support of its "New Perspectives in Archaeology" 1971 summer program for high ability college sophomores and juniors. This special program has been conducted at the Museum's field station at Vernon, Arizona since 1964 under a National Science Foundation grant for undergraduate participation. The project is under the direction of Dr. Paul S. Martin, chairman emeritus of anthropology at Field Museum.

Students selected to participate in the ten-week session will be involved in excavation, reconnaissance, and research into the prehistory of the Southwest. Each student will conceive and execute an independent research project. He will generate an hypothesis, gather data to test it, and demonstrate laws concerning human behavior. Dr. Martin believes such laws may throw light on contemporary world problems.

Dr. Martin has worked in the Southwest for over forty years. His published reports on archaeological sites in New Mexico, Colorado, and eastern Arizona have filled a dozen volumes of Field Museum's scientific series *Fieldiana: Anthropology*. In 1968 he received the Alfred Vincent Kidder Award for outstanding contributions to American archaeology. An article by Dr. Martin is featured in this issue of the *Bulletin*.

McCormick Trust Gift

Stanley Armstrong, executive director of the Robert R. McCormick Charitable Trust, and E. Leland Webber, director of Field Museum, look over construction work in a light well area et Field Museum where much-needed additional office and reseerch space is being created for the scientific departments. McCormick Trust contributed $150,000 for the remodeling, in addition to a previous gift of $300,000 for new facilities for the Exhibition Department.

TWO NIGHTS TO REMEMBER!

This year, Members' Night will be held on May 6 and 7, to take care of over-flow crowds and to give members a chance to participate in all of the special activities. All events will be the same for both evenings. Be sure to mark your calendar.

LETTERS

To the editor:

I cannot help but react to the letter written by R. B. Ayres in response to Dr. P. Ehrlich's population article. Mr. Ayres begins with the false assumption that the population crisis is a problem only for the rest of the world. In fact, that is the least of the problem. A child born in the developed countries (the U.S., W. Europe and Japan) will, in the course of its lifetime, consume 50 times as much of the resources of the world as a child born in the underdeveloped world. Clearly, it is this country that is at the heart of the world's crisis.

Mr. Ayres also falsely assumes that it is the people of the ghettos that make them such. When trying to arrive at the roots of poverty perhaps Mr. Ayres should ask the landlord who refuses to repair ghetto homes while making an exhorbitant profit off the peoples right to decent housing. Or the real estate agents who refuse to sell or rent to blacks outside the confines of the ghetto, thus creating a trapped colony. Or the white store-owners and corporations that exploit this trapped colony and remove its wealth to the suburb.

All of Mr. Ayres' assumptions add up to a blatantly racist analysis of the world. One in which the white man is culturally and racially superior to both the underdeveloped world and the black colony at home. Finally, by denying any political role in social reality, Mr. Ayres assures us of his applause of racism, slavery and exploitation. I would suggest that perhaps he has been in the Arizona sun too long and is so far removed from reality that his bigotry is perverse.

John L. Lawrencen
Associate Professor of Anthropology
U.C.L.A.

To the editor:

Another vote in favor of continued information about the population problems. In fact two votes. My husband and I agree completely with Mr. Alan Garrett's letter in the January, 1971 *Bulletin*. We have only been readers of this publication for a year or so and look forward to every issue.

Mrs. Lawrence C. Burns
Winnetka, Illinois

To the editor:

I have just read the article "Canning a legend." As a human being and a dog owner and an animal lover I feel deeply disturbed. I hardly ever feed my dog canned food, but all the same how can I find out which firms use "wild horses?" Or do all of them? Is there anything one can do apart from donating money when you see an advert in a paper? I wish one could advertise the facts pictorially on television—on the same channels that advertise dog food. I think *all* hunting or hounding by plane should be forbidden, but what can I do about it?

Ruth Duckworth
Chicago

Editor's note:

The International Society for the Protection of Mustangs and Burros is one organization that would welcome interest and support. It can be addressed in care of Mrs. Helen A. Reilly, Badger, California 93603. Hope Ryden in her book *America's Last Wild Horses* identifies several others, and also prints Senate Bill 3358, introduced by Wyoming's Senator Clifford P. Hansen last year, "to authorize the Secretary of the Interior to protect, manage, and control free-roaming horses and burros on public lands." The bill was read twice and referred to the Committee on Interior and Insular Affairs.

Please address all letters to the editor to

Bulletin
Field Museum of Natural History
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

The editors reserve the right to edit letters for length.

CALENDAR

HOURS
9 a.m. to 5 p.m. Saturday-Thursday
9 a.m. to 9 p.m. Friday

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday.

Spring Film-Lecture Series, presented at 2:30 p.m., James Simpson Theatre

March 6

"The New Israel," narrated by Ray Green. A vivid and up-to-date portrayal of this ancient land and its people, that is a blend of the past and the present.

March 13

"The Call of the Running Tide," narrated by Stanton Waterman. Photographed in the islands of French Polynesia, much of it on sea bottom and along barrier reefs, it is a revealing study of the inhabitants and the many forms of sea-life surrounding them.

March 20

"Uganda—Land of Stanley and Livingston," narrated by William Stockdale. Scenes of wildlife, the wonders of national parks and the people in the cities and remote areas.

March 27

"Sweden Year Around," narrated by Ed Lark. All four seasons are encompassed in this motion picture journey to the land of the midnight sun.

CONTINUING

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. A different plate from the rare, first-edition set is featured each day.

75th Anniversary Exhibit: A Sense of Wonder, A Sense of History, A Sense of Discovery, continues indefinitely. New and exciting display techniques explore Field Museum's past and present and current research projects. Hall 3.

THROUGH MARCH 10

"Exploring Indian Country," Winter Journey for Children. The free, self-guided tour enables youngsters to see American Indians of three environments as the early explorers saw them. All boys and girls who can read and write may participate. Journey sheets are available at Museum entrances.

BEGINS MARCH 11

Color in Nature, an exhibit of broad scope that uses examples from Field Museum's huge collections to explore the nature and variety of color in the physical and living world around us. It examines the meaning of color in the reproduction, survival and evolution of plants and animals by focusing on its many roles—as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling and vitamin production. Through October 10.

A male Greater Bird of Paradise, held by Dr. Rupert L. Wenzel, chairman of the Department of Zoology, displays his bright colors for the favor of female birds.

"To See or Not to See," Spring Journey for Children, helps them learn about the diversity of colors and color patterns of selected animals, as well as the advantages of mimicry and pigmentation changes, with the aid of a questionnaire. All youngsters who can read and write may participate in the free program. Journey sheets are available at Museum entrances. Through May 31.

THROUGH MARCH 21

Catalogue of the Different Specimens of Cloth Collected in the Three Voyages of Captain Cook, to the Southern Hemisphere, London, Alexander Shaw, 1787, shown in the South Lounge.
The rare copy consists of actual tapa cloth specimens collected during Captain Cook's voyages to the South Seas (1768-1780). The volume is the gift of Mrs. A. W. F. Fuller.

Life in Other Worlds? An exhibit of the *Murchison* meteorite, a Type II carbonaceous chondrite, of which only 14 exist out of the almost 2,000 known meteorites. Recently, amino acids, possible building blocks of life, have been reported in this meteorite. South Lounge.

BEGINS MARCH 22

A rare, wild albino mink, in a special display in the South Lounge. This almost adult female specimen is the gift of Terry L. Perry of Johnston, Iowa, who captured it about 16 months ago. Through May 16.

MARCH 28

"The Bahamas," a free wildlife film, offered by the Illinois Audubon Society. 2:30 p.m., James Simpson Theatre.

Meetings

March 9: 7:45 p.m., Nature Camera Club of Chicago (Everybody is welcome)
March 9: 8 p.m., Chicagoland Glider Council
March 10: 7 p.m., Chicago Ornithological Society
March 10: 7:30 p.m., Windy City Grotto—National Speleological Society
March 11: 8 p.m., Chicago Mountaineering Club
March 14: 2 p.m., Chicago Shell Club
March 16: 7:30 p.m., Chicago Area Camera Clubs Association
March 21: 2 p.m., Illinois Orchid Society

COMING IN APRIL

The Afro-American Style, from the Design Works of Bedford-Stuyvesant, an exhibit of hand-printed textiles blending classical African motifs and contemporary design. April 7 through September 12. Hall 9.

Spring Children's Programs at 10:30 a.m., James Simpson Theatre.

April 3: Honor day for Cub Scouts and film program
April 17: Film program
April 24: Museum Traveler Day with Journey awards and film program

Spring Film-Lecture Series presented at 2:30 p.m., James Simpson Theatre.

April 3: "Stone Age New Guiana," with Lewis Cotlow
April 10: "Rajasthan: India's Desert State," with Len Stuttman
April 17: "The Right to Live," with C. P. Lyons
April 24: "Adriatic Italy," with Al Wolff

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Field Museum of Natural History

BULLETIN

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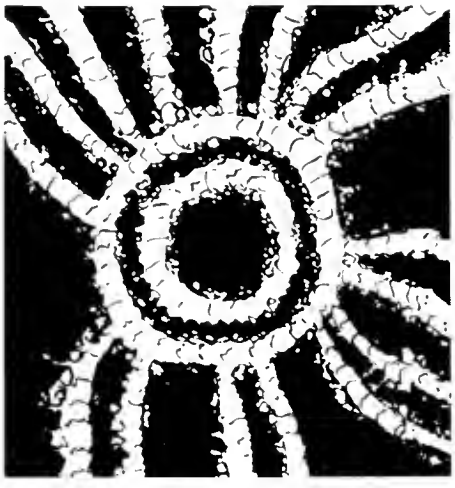

Cover: Flower motif found in designs on pages 2, 4, and 5 enlarged.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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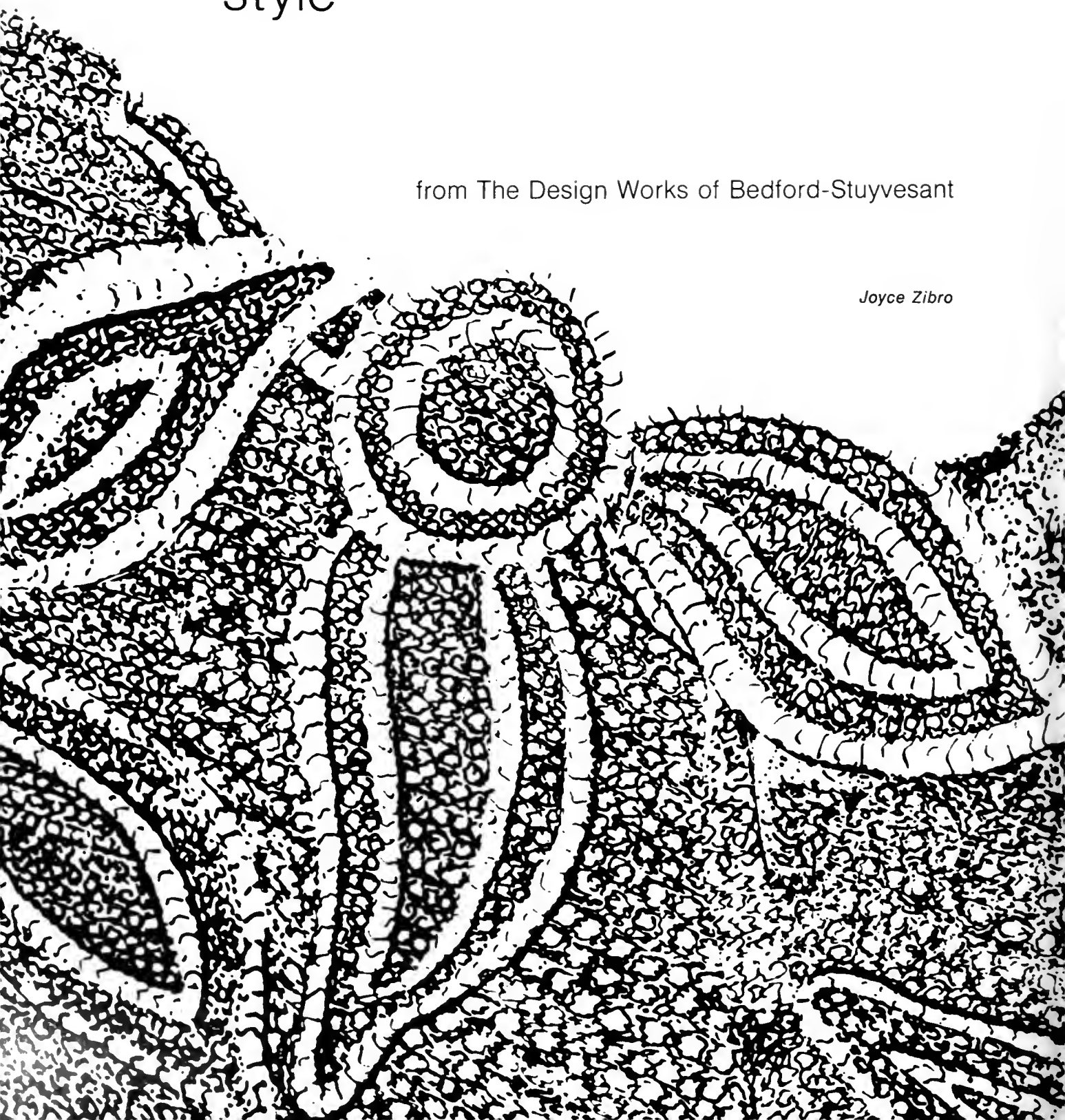
Afro-american style

from The Design Works of Bedford-Stuyvesant

Joyce Zibro



"This is our story," reads a small, red card which comes with products from The Design Works of Bedford-Stuyvesant. "In the fall of 1969, we opened a workshop in Bedford-Stuyvesant, dedicated to creative design and quality craftsmanship. After a year of research, training and experimentation, our artists produced a first collection melding the classics of African art with a distinctly contemporary esthetic. Our craftsmen hand printed the designs on cotton linen, and silk."

Now, after a lot of research and experimentation, and with the factory's Print Department producing 500 yards of fabric a day, the first collection from Design Works goes on exhibit at Field Museum. Opening April 7 in Hall 9 under the title The Afro-American Style from The Design Works of Bedford-Stuyvesant, the exhibit will include many examples of handsome silk-screened textiles, some made up into apparel, table linens and decorative items. Exhibited along with these beautiful craft products will be the original art pieces which inspired their designs—Benin bronzes from Field Museum's famous collection of Benin art.

Field Museum possesses the largest and one of the most comprehensive collections of Benin art in the United States. Mr. Leslie Tillett, world-famous textile consultant to Design Works, wrote after seeing the Museum's Benin collection, "A wide research program has been going on for many months to unearth the best of African art. Some of this we have been lucky enough to see in Africa, but we've found the most inspiring group in the Benin collection in your museum."

The ancient African kingdom of Benin, in what is now western Nigeria, is recognized as having produced art of high technical mastery and esthetic excellence over a long period—certainly over the last five centuries, perhaps even longer. Although some excellent carvings in ivory and wood have come down to us from Benin, it is the bronzes which continue to attract most attention from anthropologists, art historians, and artists. The bronzes, produced through the lost wax (*cire perdue*) process, were the work of court artists. Included among the fine old pieces which have come down to us from these artists are great bronze portrait heads of the Obas (Benin Kings) and bronze relief panels which once decorated the rooms and galleries of the palace. The panels show the Oba and courtiers, noble warriors, European merchants, hunting and battle scenes, and the animals which played a major role in Benin life such as panthers, serpents, and mudfish. Life-size bronze cocks with carefully engraved feathers were also produced by Benin artists.

The lost wax method of casting, very simply, consists of modeling a wax image over a clay core, covering the model with clay, and applying heat. At one and the same time, the clay is thus made hard and strong, and the wax is melted away, leaving a negative clay impression of the original wax sculpture, which is then filled with metal. Finally, the mold is broken, leaving the positive cast in metal. The term "lost," or *perdue*, refers to the original sculpture in wax which is, indeed, lost as the heat melts it away.

The lost wax method of casting has probably existed in Benin since at least the 1300s and probably even earlier. It may have been introduced from the East or from north of the Sahara, or both. Benin tradition states that the process was introduced to Benin by Iguehga, an artist dispatched from nearby Ife about the year 1280. In any case, by the time the first Europeans arrived in this part of West Africa in 1485, Benin bronze casting was well developed. Iguehga, by the way, is still venerated by Benin artists today.

The high point in Benin art was reached in the 1600s and lasted through the first quarter of the 1700s. Most scholars agree that the art was in a period of decline when Benin City was sacked and burned by a British punitive expedition in 1897.

Field Museum early in its history recognized the value of Benin art and acquired many specimens during the period 1889 to 1907. Dr. George A. Dorsey, then chief curator of anthropology at Field Museum, upon his return to the United States from a trip to England in 1898, wrote a memorandum to the director of the Museum: "While in Liverpool in the Free Public Museum, I saw for the first time a number of the bronze objects and carved elephant tusks from Benin, West Africa; later on in my visit to other European museums, I saw a large number of additional specimens especially in Berlin where they have the largest collection in existence. These bronze casts and carved elephant tusks are probably the most remarkable specimens which have ever been brought out of Africa. Their presence at Benin was probably unknown until about three years ago when the first of these wonderful specimens . . . was brought to the attention of anthropologists of Europe."

The collection was greatly enlarged by the generous gift in 1963 from Mrs. A. W. F. Fuller of her late husband's major private collection of Benin work. Captain Fuller had been a life-long collector of outstanding art specimens from Africa and the South Seas.

The Afro-American Style exhibit, in addition to presenting the original Benin art work and the products from the Design Works of Bedford-Stuyvesant which were inspired by it, will tell the history of this new enterprise. Field Museum is pleased to be playing a part, albeit a small one. The story goes something like this.

"Bedford-Stuyvesant is the Harlem of Brooklyn," says one resident of the area. Often referred to as the second

largest ghetto in the United States, after Chicago's Southside, Bedford-Stuyvesant comprises 653 blocks stretching in a nine square mile area of central Brooklyn. Into these blocks are crammed half a million people, 90 per cent of whom are black. Bedford-Stuyvesant has all the problems of any big city ghetto—inadequate housing, poor health facilities, widespread unemployment. Some statistics: high school dropouts—80 per cent of all teenagers; families headed by women—36 per cent; families with annual income under $3,000—27 per cent; unemployment—7 per cent; underemployment—28 per cent; infant mortality rate—one of highest in country; homicide rate—reported as one of highest in country; rats—no one has ever counted. (These figures are based on the 1960 census. It is likely that the 1970 census will show no appreciable change.)

Early in the century Bedford-Stuyvesant was a white, upper-middle-class community. Residents lived in sturdy brownstones, built between 1880 and 1930, along tranquil tree-lined streets. The first wave of black migration reached Brooklyn during the Depression of the 1930s, and the second wave rolled in during World War II. War industry jobs were plentiful then in the Brooklyn Navy Yard, just a few minutes away from the heart of Bedford-Stuyvesant.

Many of the aged buildings are now decayed, plaster now falls from walls, and roaches and rats run everywhere. Bedford-Stuyvesant has no municipal hospital, and the area boasts only one high school within its boundaries.

Then in February 1966, the late Senator Robert F. Kennedy took a walking tour of Bedford-Stuyvesant. Senator Kennedy's tour got a lot of publicity, but to the residents of the area he was just one more in a long procession of politicians who walked through their misery into newspaper headlines. One

Lynette Charles Johnson, a resident of Bedford-Stuyvesant, models a hostess gown from Design Works in Field Museum's photography studio. Mrs. Johnson worked part-time as a lecturer in zoology in Field Museum's Department of Education last winter while completing her M.A.T. at the University of Chicago. Familiar with Benin art even before coming to the Museum, Mrs. Johnson taught biology while with the Peace Corps for two years in Owo, Nigeria—just 75 miles northeast of Benin City.

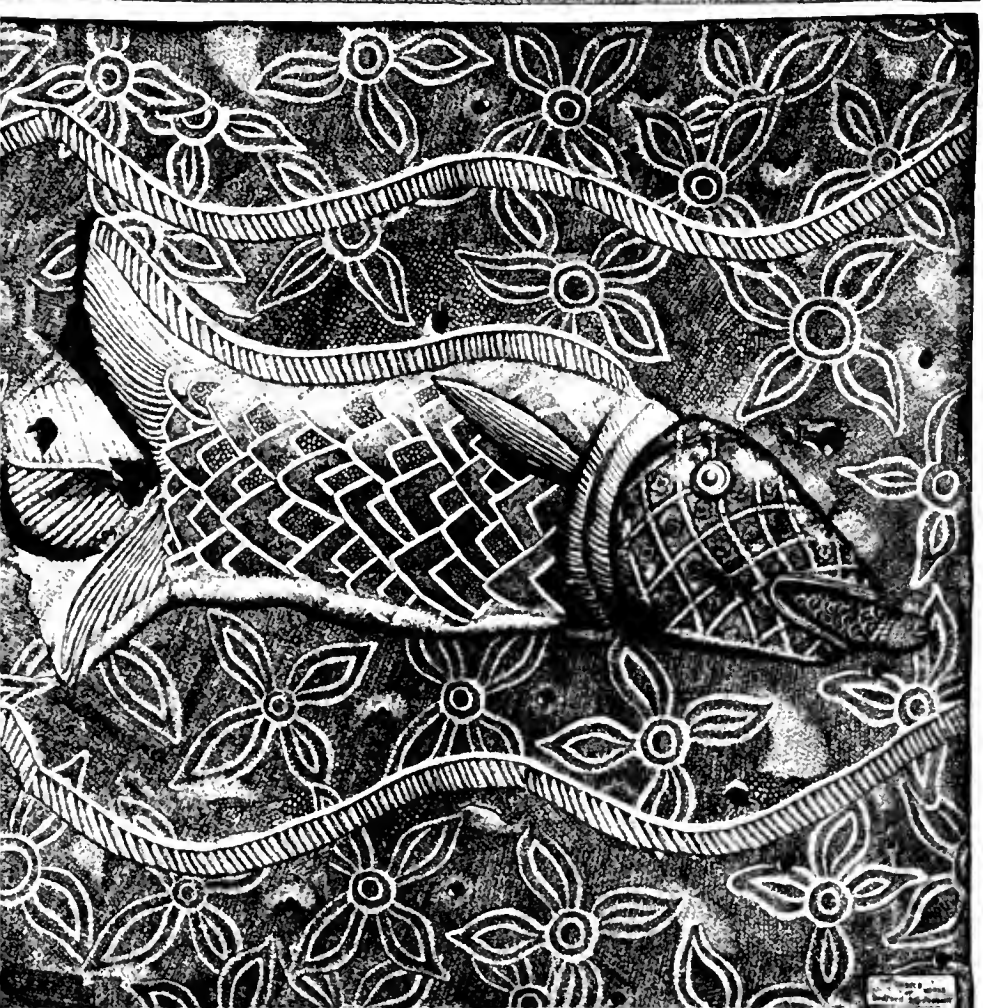
community leader put it to Kennedy like this: "Senator, we have been studied, examined, sympathized with, and planned for. What we need now is action."

Kennedy acted. Within eleven months, he returned to Bedford-Stuyvesant with a program aimed at nothing less than the total physical, social, and economic rehabilitation of the community. By May of 1967 Kennedy's program, backed by Senator Jacob K. Javits and Mayor John V. Lindsay, was in operation.

Two nonprofit corporations were formed: Bedford-Stuyvesant Restoration Corporation, whose twenty-six board members are local residents, and Bedford-Stuyvesant Development and Services Corporation, whose twelve-man board is drawn from the nation's business establishment. Franklin A. Thomas, a lifelong resident of Bedford-Stuyvesant and a former deputy police commissioner and former assistant U.S. attorney from the southern district of New York, was hired as president and executive director of Restoration Corporation. Eli S. Jacobs, an investment banker, took leave of absence from White, Weld and Company to direct Development and Services until a permanent replacement could be found. Early in 1968, John Doar, former assistant attorney general of the civil rights division of the Department of Justice, took over the job.

Restoration Corporation with its staff of 150 local residents develops and directs projects. Development and Services Corporation has such business giants on the board as IBM chairman Thomas Watson, William Paley, chairman of CBS, C. Douglas Dillon, former Secretary of the Treasury, and Benno C. Schmidt, managing partner of J. B. Whitney & Co., along with Ethel Kennedy, who took her husband's place on the board. They raise funds, generate ideas, bring in new businesses, and provide technical expertise in administration.

These two corporations working hand in hand have produced some impressive results in Bedfort-Stuyvesant. More than fifty one- to four-family brownstone houses have been rehabilitated and resold to community people at cost. An additional 1,828 houses have undergone exterior renovation. Over 1,600 new jobs have been created and some 3,000 people placed in new or existing jobs. This is



in addition to the work done at four Neighborhood Centers through programs dealing with health care, youth development, sanitation, and cultural affairs and education.

Where does The Design Works of Bedford-Stuyvesant come in? It was bound to happen—a local firm that recognized the importance of Africa as a source of inspiration for the designs and manufacture of textiles. Restoration Corporation produced the idea of a textile business to develop talents of local residents while at the same time helping an ethnic minority give expression to its own cultural background. In conjunction with Development and Services Corporation, they raised some $120,000 of the venture capital. The First National Capital Corporation together with Wall Street investors Peter Loeb and Robert Tobin contributed amounts adding up to $60,000. Another $60,000 was lent by the Chemical Bank.

Mr. Mark Bethel, president of Design Works, considers the fourteen persons presently employed by the company as the "nucleus, or fiber, for future expansion." With the exception of four employees in the Print Department, all have professional experience in their respective areas.

Briefly, this is how the operation works. Using African art as inspiration (in the case of this first collection, Field Museum's Benin bronzes), patterns are designed and coordinated. The design is then sent out to be photographed and made into a silkscreen, which consists of material stretched on a heavy wooden frame on which the design has been stenciled and the areas which are to remain white painted with some substance, such as gum or shellac, which will make the material impervious to the ink used. When the screen is returned to Design Works for reproduction, it is placed in contact with the fabric to be printed and a puddle of ink is scraped from one end

Too valuable to be included in the traveling exhibit of The Afro-American Style, Field Museum's original Benin bronzes have been reproduced in fiber glass casts. Here, John Harris, preparator in the Museum's Department of Geology, removes the fiber glass cast of a bronze cock from the mold. The original Benin bronze cock is at left.

to the other by means of a rubber squeegee. The design is reproduced on the cloth as the color is forced through the pores of the screen in areas not blocked out by the gum or shellac. One design can require as many as four or five screens, one for each color in the pattern. It is a hand process and gives a precise, clear pattern.

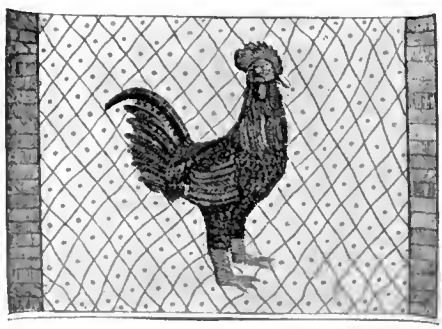
Various weights of cotton are used for the majority of the textiles, from sailcloth for drapery and upholstery material to butterfly net for sheer curtains. In addition, three weights of silk are used, primarily for boutique items such as ties, scarves, and some apparel. The colorist for Design Works mixes all of the more than forty colors to print on the fabric. Printing is done on three thirty-yard-long tables. The large screens require two-man teams. Daily output is about 500 yards.

If the response of major department stores across the nation can be used as a gauge, Design Works is well on its way to success. It markets its products in its own boutique shops—one located on the premises at 11 New York Avenue and another on the upper East Side of Manhattan—as well as in key stores across the country, including W. J. Sloane in Washington and New York, Bloomingdale's in New York, Marshall Field in Chicago, Woodward and Lothrop in Washington, D.C., and I. Magnin in California.

"Our goal," says Bethel, "is to seek out and develop the black talents of the community. It is projected that eventually Design Works will employ 250 persons."

Two hundred fifty jobs in a sea of one-half million people may not sound like much, but when you multiply Design Works by the fifty other local businesses started through Restoration Corporation and consider that all employees are local residents pouring their money back into the community, the picture takes on another complexion. The people of Bedford-Stuyvesant, with a helping hand from big business, have that proverbial bootstrap in hand and they're pulling hard.

Joseph Coles, a former laundry truck driver and now production foreman in Design Works print shop, sums it up like this: "Businesses like The Design Works of Bedford-Stuyvesant aid everyone. I feel it builds community closeness, an interest in the community and bettering it. Like most depressed areas, work is hard to obtain here. Bedford-Stuyvesant is not industrial, and many people have to go out of the borough to Manhattan to get work. Once we and other businesses like us get established, it will be more convenient for residents of the area to get work. A mother who wants to work, for example, must travel to Manhattan and can't be home with her children at lunch. If she could find work in the borough, a fifteen-minute ride home would enable her to prepare lunch for her children." Coles views his job in Design Works as "hard work but work you can see the end results of. It's something you've had a hand in," he says, "and you know that you did it with your utmost ability."



The Afro-American Style from The Design Works of Bedford-Stuyvesant will remain at Field Museum through September 21. Field Museum's chief exhibit designer Ben Kozak designed the exhibit so it can easily be disassembled to travel and, if funding can be obtained, it will travel around the state of Illinois in the fall. In the meantime, ten smaller traveling exhibits have also been prepared. These will be displayed in community centers in Chicago's inner city through spring and summer.

A museum is not often recognized as a resource that can stimulate combined artistic and economic development. This function, among our many, applies directly to some of our contemporary problems.

Joyce Zibro is editor of the Field Museum Bulletin *and Public Relations Manager.*

MEMBERS' NIGHTS MAY 6 AND 7

OPEN HOUSE FROM 6:00 TO 10:00 P.M.

Members' Nights, 1971, feature "The World Around Us." Each night will be a full, identical program of special exhibits, films, entertainment, and demonstrations focusing on this theme. Something will be happening on all four floors every moment.

You can

learn about how important color is for plants and animals in their struggle for evolutionary survival.

go fossil-hunting (by a film) in Illinois for Pennsylvanian concretions with a staff geologist.

preview the reinstallation of Malvina Hoffman's famous sculptures of people from various parts of the world, "Portraits of Man."

see (and even buy) modern Afro-American style textiles with silk-screened designs inspired by the Museum's Benin bronzes from Nigeria.

shop for jewelry, textiles and coffee in "Tiendacita Guatemalteca" (a little Guatemalan store).

follow the "Search for Some of Nature's Surprises" (arranged especially for children).

see four films: "Patterns for Survival" (A Study of Mimicry), "Fossils: From Site to Museum," "Malvina Hoffman: Her Travels and Works," and "Color in Flowers" (a slide-lecture).

—and this is most fascinating to many people—go behind the scenes in research areas and meet the scientific staff. Some of the special offerings by the departments of anthropology, botany, geology and zoology, in addition to those shown in the photographs, include:

a display of pottery recently collected in Nigeria

a continuing discussion by staff members: "The Botanical Library and its uses"

a display interpreting "Faults and Earthquakes"

an exhibit explaining the "Water Supply of Chicago"

an exhibit of skeletal materials used to make articles of personal adornment from around the world, together with specimens of the finished product and photographs of the live animals.

Our membership has been growing, and so has the popularity of this once-a-year event arranged just for members. Attendance has gone from 3,000 in 1966, and 4,500 in 1968 to 8,500 in 1970. That is why this year's program will be a two-night instead of a one-night-stand. Attendance on Friday night will probably be much heavier because families with children will prefer to come then. We urge you to plan on coming Thursday night if you don't have school children.

Photos, top to bottom. "Fossil Show and Tell," (or bring your own coal-age fossils and match them with ours!) with Dr. Eugene S. Richardson, Jr., curator of fossil invertebrates, Department of Geology. Left, Department of Botany herbarium assistant Ronald Liesner demonstrates how plant material is prepared for the herbarium. Right, Melvin A. Traylor, associate curator of birds, Department of Zoology, shows part of the Museum's Birds of Paradise collection. Mrs. Christine Danziger, conservator, Department of Anthropology, tells about one of the Haida model houses from the Northwest Coast, collected in the late 19th century. Mrs. Danziger is responsible for the architectural reconstruction and preservation of the polychrome sculpture of these houses. Mario Villa, tanner, Department of Zoology, and some of the animal skins he will show Museum members.

The White Flowered Bottle Gourd

Louis O. Williams

Of all the plants useful to man, *Lagenaria siceraria* (Mol.) Standley must surely be one whose usefulness is most obvious from just a glance. Its common English name—bottle gourd—succinctly suggests this usefulness. When the fruit of the plant is functioning as a utensil, it is usually called calabash—*calabaza* in Spanish-speaking countries of America.

In spite of its obvious usefulness, sometimes the plant is not even included in works on economic botany, that branch concerned with the kinds of plants "useful" to man. The whole range of economic plants has been subdivided into categories in about as many ways as there have been authors writing about them. The four categories set up by Dr. Albert F. Hill in his volume entitled *Economic Botany*, for instance, are: Industrial Plants and Plant Products, Drug Plants and Drugs, Food Plants, and Food Adjuncts. The bottle gourd does not seem to fit into any of the four—and indeed it is not mentioned in the book.

We assume that the bottle gourd originated in the Old World, although Linnaeus, when he described the plant in 1753, presumed that it was American. Alphonse de Candolle's *Origin of Cultivated Plants* is still one of the best sources on the origin of useful plants (my copy is the English edition of 1884). De Candolle believed the literature to indicate that the gourd was native to or at least wild in Africa and from there spread to the rest of the tropical world. He did not believe that the plant existed in America before the arrival of Europeans. We know now, however, that it was in America and widely dispersed here long before European man arrived.

Dr. Richard MacNeish has just sent word in a personal communication of much the oldest radio-carbon date for any New World bottle gourd material: "Two pieces of probably wild *Lagenaria* in Ayacucho [Peru] complex, dated 12,200 B.C." This evidence does not

Carved gourd. Yoruba tribe, Oyo, Nigeria. Collected 1970.

of course imply human use, although it is now believed that man may have arrived in Peru at about the same time.

The oldest known New World bottle gourds associated with human use, excavated in the Ocampo Caves in the Mexican state of Tamaulipas, have been dated at about 7000 B.C. by the carbon-dating technique. Both the Old and the New World have yielded evidence from the fourth millennium B.C. Specimens have been found in an Egyptian tomb of the Fifth Dynasty, and Junius B. Bird found abundant material in the Huaca Prieta midden in Peru in strata dated at about 2500 B.C. Thousands of fragments indicated various uses, and intact gourds attached to fishing nets indicated that they had been used for floats, as they still are today.

If as a hunter and fisherman prehistoric man migrated to the New World from Asia across the Bering Sea, which is the present widely held belief, it would have been virtually impossible for him to have brought the bottle gourd, or any other plant, with him. The regions he had to traverse were far too harsh and the time span, measured in human generations, far too long for any plant life to have moved with him, for it would have to have been propagated along the way. The only commensals or companions that could have accompanied man on this great trek were probably his dogs, which, like man, can sustain themselves on a purely hunting and fishing diet.

When man from Asia did reach an area far enough south to meet the bottle gourd plant in its preferred habitat, no doubt he quickly discovered these fruits which can be such useful containers for many things. And no doubt he—or, perhaps, she—began selecting gourds by shape and size. One for a water bottle, one for a float for a fish net, one to make into a cup, and so on. He may have merely exploited different shapes of the gourd or he may have helped to establish different shapes by his picking and choosing. Most likely, a little of both happened. In any event, we do have many types today, in both the New World and the Old World.

But do we have a single species in the two hemispheres or are two different species improperly covered by the name *Lagenaria siceraria?* To prove the point one way or the other would require a considerable amount of field work and garden cultivation and study.

Group of eight fishnet floats dating from about 1600 B.C. found together with fishnet of cotton cord at Huaca Prieta on the shore at the mouth of the Chicama Valley, Peru. At same excavation site, pieces of same type gourd found at bottom of deposit dated from about 2500 B.C. Photo by Dr. Junius B. Bird courtesy American Museum of Natural History.

No modern scientific study of the systematics of *Lagenaria* has been published. Dr. Alfred Cogniaux, the last and great monographer of the cucurbit family, considered all the bottle gourds to be a single species that were native to tropical Africa and India but were then (1881) found over the rest of the tropical world, either cultivated or growing at the edges of disturbed land. Botanists invariably complain, and I among them, that they never have sufficient material or knowledge about a plant or a group of plants under study. This is especially true of plants used by man.

If two species are involved, they would have arisen independently of one another in the two hemispheres. The improbabilities are enormous that such close convergence would have occurred, though convergence is a well known biological phenomenon—that is, two different and geographically separated lines of evolutionary descent becoming like each other.

It seems to me more reasonable to assume that only one species is involved and that the plant arrived in America a very long time ago. How, then, did it get here from the other hemisphere? There seem to be two possibilities: it drifted across an ocean by itself, or it was carried in a manned or empty canoe.

Mature bottle gourds are very durable, and they are light in weight and float easily. Dr. Thomas Whitaker and Dr. George F. Carter in "A Note on Longevity of Seed of Lagenaria siceraria (Mol.) Standl. after Floating in Sea Water" (1961) reported that after they floated bottle gourd fruits for 347 days and then stored them for six years, 24 per cent of the seeds finally germinated. These tests indicate that *Lagenaria siceraria* fruits *could* have been distributed from continent to continent by oceanic drift. Of course there is still no proof that they *did*.

Whitaker and Carter point out that the bottle gourd is not a strand plant.

Even if gourds had been transported by oceanic drift, they would have to have been carried from the place where stranded to a suitable ecological niche. I would point out that such a "suitable ecological niche" often occurs in the disturbed land right behind a strand.

I like the drift theory better than the transport theory because it seems to me probable that this interesting plant established itself in the New World a very long time before man did. The ocean currents that wash the western side of Africa flow west and wash the eastern side of South America. (The currents on the western side mostly flow outward toward the Pacific basin.) Hence the possibility of gourds drifting over from Africa has existed for perhaps hundreds of thousands of years. It seems to me probable that they did so many times. If they were transported in man-made craft, they could hardly have come over more than 15,000 years ago, and probably a lot more recently. Whatever sea-going craft man might have made that long ago could hardly have sustained the trip.

There is the argument that, if the bottle gourd is so old here, we should find it growing wild. I would reply that much field experience in the tropics has taught me that it is difficult to look at a plant and be sure whether or not it is "wild." *Lagenaria siceraria* does like disturbed land, such as at the edges of cultivation. But land behind a strand is also disturbed, and not necessarily by human beings. Also, there are several other cucurbits that are useful to man which no one doubts are native to America but which have never, to my knowledge, been seen as "wild" plants. They too are found in archaeological midden heaps.

Thus the category "useful plants," which may be as old as man himself, does not mean that the movement of such plants is necessarily associated with man. One of man's blessings is his imagination—which includes his ability to recognize a good thing when he sees it. The bottle gourd is such an obviously "good thing." It is easy to believe that wherever and whenever he found it, man would soon begin to use it.

Dr. Louis O. Williams is chairman of the Department of Botany at Field Museum.

Hidden color pattern in fossil shells

Katherine Krueger

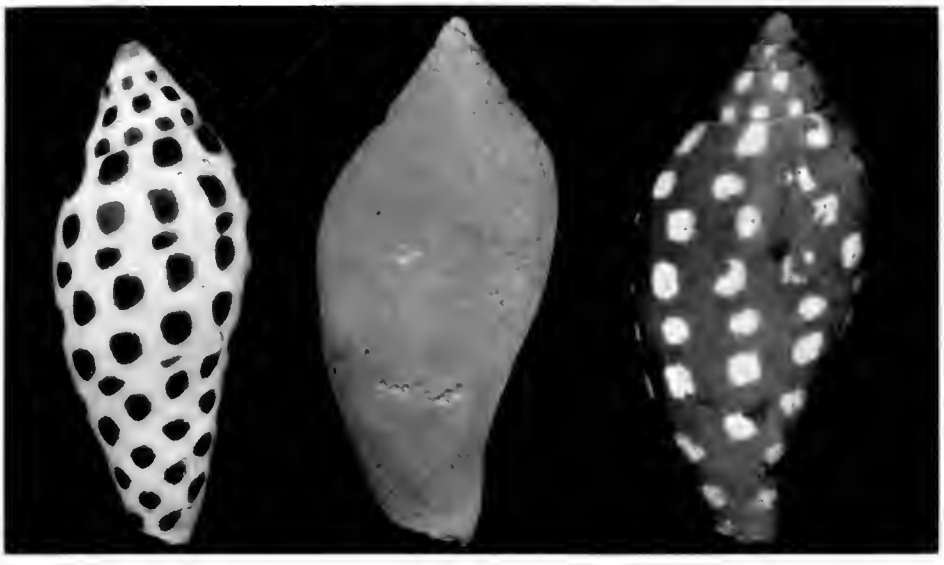
Modern species of seashells display distinctive colors, shapes, and surface ornamentation. Most buried shells, during the processes of fossilization, become dull white. With rare exceptions, even the most perfectly preserved fossil specimens lack color. Therefore paleontologists have had to rely on the small variations of ornamentation and sculpture to differentiate species within the larger groups, unaided by the additional factor of color pattern that helps biologists classify the often brightly colored living forms.

Top to bottom: *Conus spurius* (Recent or modern), *Conus spurius* (fossil), *Conus spurius* (fossil under ultraviolet light).

Some groups of shells may occur in both modern and fossil collections, since many present-day molluscan families were already in existence as much as 70 million years ago. So that the relationship between modern and fossil specimens can be firmly established—the true evolution of a species traced—the paleontologist studying the Ice Age or older shells would like to use the same guidelines as the biologists. In the last ten years one such guideline, the color pattern, has been developed. Some fossil shells will, under ultraviolet light, show fluorescence wherever former coloration occurred on the shell. Thus the paleontologist can observe a color pattern almost as readily as can a biologist.

This fluorescence phenomenon is being actively investigated by Drs. Harold E. and Emily H. Vokes at Tulane University in New Orleans and by Dr. Axel A. Olsson of Coral Gables, Florida. They have worked out techniques for photographing the shells under ultraviolet light and are using the color patterns as important, definitive data in their studies. Most of their research has been on fossil shells of the southeastern United States from the dawn of the Tertiary, approximately 70 million years ago, to Recent time. Many correlations had previously been drawn between fossil species and their Recent relatives, but evolutionary paths of groups have always been littered with problems of "missing links" or poor specimens. Every new method of establishing a relationship between shells of different geologic epochs is welcome. The fluorescence phenomenon promises to be a highly significant method.

What one sees under the ultraviolet light is not really the color, but rather the color *pattern* of a shell. It was Alex Comfort who, only 20 years ago,



Left to right: *Scaphella junonia* (Recent or modern), *Scaphella floridana* (fossil), *Scaphella floridana* (fossil under ultraviolet light). Photos courtesy Drs. Harold E. and Emily H. Vokes, Tulane University, Department of Geology.

pointed out that when a living mollusk secretes shell material from its mantle it introduces pigmentation into certain zones of the developing shell. The pigment-producing cells, called chromatophores, vary in position. As their position changes, the pigmented zones they produce narrow or expand into stripes. If the chromatophores move back and forth, zigzags appear. Intermittent activity of the chromatophores produces a series of dots. A continuous band of the cells produces the background color of a shell. The location of these chromatophores and their range of movement are determined by the genetic code of a species. The patterns they make constitute as distinctive a feature as the various ridges, nodes, or whorls of a shell, although often they are highly variable within a species.

The actual color produced by these chromatophores, which we don't see under ultraviolet light, usually is not significant for taxonomists, since the animal's diet can influence the color of its shell, and its growth rate can affect the intensity of this color. Therefore, the color patterns that we do see under ultraviolet light in some cases convey more useful information than the actual colors of the shells, which we don't see.

Under ultraviolet light the patterns appear to glow against a purple background. This fluorescence occurs when the ultraviolet light excites certain electrons in the pigment molecules, which are still locked in the shell material. Though these pigments were rendered colorless by chemical alteration after burial because of the action of ground water, their basic molecules are still there.

But the shell must be properly prepared before the ultraviolet light will reveal the position of the pigment. Many shells naturally exposed to sunlight on the fossil outcrop for a length of time will, without any further treatment, fluoresce under ultraviolet light. Shells that have remained buried since their original deposition millions of years ago will fluoresce if first soaked in strong laundry bleach for a minimum of three days. In some cases the bleach will even produce a rust-colored pattern where the pigmented regions occur.

Probably the ultraviolet light technique reveals the position of only certain pigments and not others. But this kind of research is very new, and its full capabilities have yet to be learned. It is an exciting new tool for tracing the ancestry of living mollusks in fossil specimens.

Katherine Krueger is assistant in paleontology in Field Museum's Department of Geology.

How an exhibit is made — Color in Nature

Lothar P. Witteborg

What is behind the Museum's presentation of a new exhibit like Color in Nature in Hall 25, which was opened to the public March 11?

It started as one item among many in a list of suggested 1971 exhibits assembled early in 1970 by Solomon Smith, the Museum's coordinator of temporary exhibits. It emerged as one of the four selected by the Museum's ten-man exhibit committee—composed of the director, chairmen of the four divisions (anthropology, botany, geology, zoology), chairman of the education dpartment, planning and development officer, building superintendent, business manager, and chairman of the exhibition department.

It was among those chosen because color, as one of the fundamental dimensions of nature, is also one of the main dimensions of the Museum's collections. We know that the evolutionary function of color in plants and animals is often a critical aspect of their total character. We are aware of color in inanimate nature, but little more than some physical facts about how it is produced are understood.

The choice and execution of the Color in Nature exhibit demonstrates two exciting modern ideas in operation.

Assistant graphic designer Kathleen Kuhlman.

Bob Martin, designer of the exhibit.

One is about the nature of learning, and one is about the art of design.

Old ideas about both learning and design usually involved static facts or objects or pieces. New ideas about both involve a sense of dynamic flow. For instance, knowledge was often thought of as accumulation of facts—orderly, but in an essentially encyclopedic kind of order. "Furniture of the mind" was a favorite metaphor, but it did not mean the kind of comfortable furniture that invites one to slouch in it with shoes off. Knowledge is now more often thought of as systems and subsystems of relationships with which we interact. Unless "pieces" of information can be assimilated into patterns, little "learning" occurs.

Similarly, the old concept of design was based on arrangement of static elements around an axis, a kind of "middle," so as to produce a sense of equilibrium or symmetry. Design was often thought of as decoration for its own sake, to satisfy an esthetic appetite. Design is now more often thought of as a means to improve the effectiveness of communication and the flow of information.

Both of these new ideas are rooted in the fast, complex flow of modern industrial "mass" society. And both ideas represent challenge within the walls of a natural history museum as much as in the "outside world." A natural history museum is now an essential part of the mass education framework necessary to support a modern society. It must certainly continue to develop further its capacity to generate new knowledge and understanding through research, but its unique responsibility—different from that of all other institutions in our society—is to make knowledge about our natural world concrete, accessible, and understandable to everyone. A museum is truly the most public of all educational institutions. The challenge is to educate by conveying understanding of the patterns of these complex, dynamic interrelationships.

The design of nature is a dynamic flow with many dimensions. Our designs for explaining it in exhibits must flow too and must combine as much concrete demonstration as possible with only as much abstract explanation in words as necessary. The whole must create a synthesis of visual appeal to both the emotions (by its interest) and the mind (by its logic).

To attempt to achieve such a grand goal, exhibit designers must think first,

Exhibition Department illustrator Zbigniew T. Jastrzebski.

work later. They must thoroughly understand the information content and all the interrelationships in order to find the "storyline" pattern around which they can build to satisfy the three fundamental design principles—function, flow, and form.

In the case of Color in Nature, the Museum's first sizable interdisciplinary exhibit, the several "storylines" worked up by each of the scientific staff concerned had to be woven together. The exhibit is probably the most comprehensive assemblage of information about color in nature that has yet been attempted anywhere. Rupert L. Wenzel, chairman of the Department of Zoology, was the overall scientific coordinator; Donald Simpson contributed for Botany; Edward J. Olsen for Minerals; Melvin A. Traylor for Birds; Hymen Marx for Amphibians and Reptiles; Loren P. Woods for Fish; Alan Solem for Invertebrates; Philip Hershkovitz for Mammals; and John Kethley for Insects.

Bob Martin of the Exhibition Department, assigned to the project as main designer, and Solomon Smith did extensive background reading in the subject matter and met frequently with the scientists as a general plan for the exhibit took shape. Eventually a rough scale model was made that divided the available space in Hall 25 into broad subject areas and a visitor flow path.

Bob Martin and student helper Dale Lehman install some of the larger specimens first.

A segment of the finished exhibit.

The designer always has these performance standards in mind: (1) to provide visual interest to gain attention and start the viewer's eye moving; (2) to simplify visual representation and organization for speed in viewing, reading, and understanding; and (3) to provide visual continuity for clarity in sequence. To satisfy these criteria in the realm of museum exhibition design, we divide the design problem into two distinct areas of specialty. The three-dimensional, or exhibit, designer works with space and structure plus color and lighting. The graphic designer works with one-dimensional forms, color, typography, and projected visual images (in this case, slides). The two specialists must work in close harmony in order to achieve the desired results. Don Skinner came into the project as graphic designer at this stage, when the general spatial arrangement of the exhibit and the specific areas of content were being tied down.

After decisions were made about the specimens and objects to be used, we needed also the specialized artistic and technical skills of the illustrator, the model maker, the sculptor, the taxidermist, the audio-visual expert, and numerous other specialists.

Most of the specimens chosen were rather small, so Bob Martin had to develop a method to protect them that would not interfere with easy viewing or would not distract from the storyline continuity. The solution was to place the specimens behind a large expanse of glass that did not determine or in any way interfere with the way they were arranged and displayed and that did not seem to be a barrier to viewers.

Photographs were taken of supplementary items, graphic panels were prepared, and hundreds of 35 mm. color transparencies were edited. Eventually the specimens to be used were removed from various halls in the Museum and placed in their new temporary setting in Hall 25.

The composite result drew upon all the new forms of visual communication technique, which newspapers, magazines, television, and even packaging have, in fact, pioneered and learned to exploit for the purpose of mass selling to a mass society. Our purpose is to transmit information by means of every appropriate visual mode simultaneously, and to do it simply, clearly, and fast. This purpose can be achieved only by design, good "information design"—which doesn't just happen by accident. Sure formulas, smart gimmicks, short-lived fads like "cadillac tail fins" or novelty type faces have no place. The principles of information design being developed today are a response to a need of modern society. They aim always and above all for comprehension.

When the final installation of Color in Nature was completed, the scientific staff had logged over 500 man-hours and the Exhibition Department over 2,000 man-hours. Design is expensive, but we know now that it is necessary.

Lothar P. Witteborg is chairman of the Exhibition Department at Field Museum.

Superhighway-Superhoax
By Helen Leavitt. New York, Ballantine Books, 1971. 311 pp. $.95

There can be few arguments with any of the statements of Helen Leavitt in *Superhighway—Superhoax*, or with the facts she draws upon to support them. Urban transportation, she says, is sinking into a morass of higher public transportation costs, lower quality and service, and greater street and highway congestion. In 1907, horse and buggy travel in New York City averaged 11.5 mph; in 1966, motor vehicle travel averaged 8.5 mph.

Homes and businesses continue to be paved over with expressways, interchanges, and parking lots. A 1966 relocation study through the Federal Highway Act predicted that between 1967 and 1970, 146,950 additional persons, 16,679 business and non-profit organizations, and 4,890 farms would be uprooted.

Air pollution—60 percent produced by internal combustion engines—continues to rise to more and more intolerable levels. Carbon monoxide concentrations commonly reach peaks in metropolitan rush-hour points of 100 parts-per-million and more, enough to cause headaches, physiologically impair vision, and affect the heart and lungs. Lead content in blood for metropolitan dwellers averages 2.5 parts-per-million or one-third the way to "classical lead poisoning," as defined by the U.S. Public Health Service. Tests of traffic policemen and toll-booth operators in Europe have recorded concentrations significantly above the threshhold level for lead poisoning.

The "urban sprawl" of parasitic suburbs is crippling the central city that it feeds upon, by draining the core city's tax base and sharply decreasing downtown retail business. More than 60 percent of the land in the central business district of the nation's capital is devoted currently to the moving and storage of automobiles. The majority of this land is nontaxable. At the same time, suburban residents find that they are driving more and everyone is enjoying it less.

Everyone is suffering the consequences of noncomprehensive urban planning. Charles Haar of the U.S. Department of Housing and Urban Development is quoted: "It is difficult for the poor central city resident without an automobile to persuade himself that a new superhighway which he will not use, but which requires him to pull up roots and find a new home, is a beneficial improvement—particularly if the alternative modes of transportation he depends upon, buses or subways, give increasingly poorer service at higher costs." And from Professor Ian McHarg, University of Pennsylvania: ". . . the problem about highways is [that] we permit engineers to have a profound effect upon cities and, in fact, design them."

What is the underlying cause for "highway planning" of the cities—indeed, of the nation? The purpose of the book is to answer this question by demonstrating how an overemphasis of national economic priorities on highway transportation has loaded the transportation balance almost to the point of excluding alternative modes of transportation. "Since 1956 American taxpayers have spent $196 billion in federal, state and local taxes on highway construction. In the same period, we spent a total of $33 billion for all other modes, including the Coast Guard." In 1956, with the passage of the Highway Act, two of the commitments made were these: $27 billion for 90 percent federal funding of the 41,000 miles of interstate highway (this figure was raised to $41 billion within two years); and establishment of the Highway Trust Fund (to expire in 1972), which funnelled all federal taxes on motor vehicles, gasoline, and ancillary equipment into a special account "to meet those obligations of the United States incurred under the Federal-Aid Road Act attributable to federal-aid highways." An interlocking web of special interest groups supported this measure and have subsequently acted to protect the Highway Trust Fund from any encroachment by proponents of other transportation systems: "auto manufacturers, labor unions, engineers, road contractors, truckers, steel, rubber and petroleum producers, busline and highway officials, and congressmen."

If any criticism could be levelled at Helen Leavitt's book, it would be the extent to which she dwells on this conglomerate "highway lobby," which she calls the "Road Gang." Two complete chapters (4 and 5) and extensive portions of the rest of the book deal with this group, which emerges as being far more extensive, complex, and interlocking than even the highway systems which it promotes. Needless to say, the "Road Gang" is demonstrated to be extremely powerful. Senator Tydings of Maryland wrote to one of his complaining constituents: "We must recognize the fact that for all practical purposes the industries and interests constituting what is commonly known as "the highway lobby" have sufficient political influence to prevent any diversion of the highway trust fund before the completion of the present interstate highway program."

Mrs. Leavitt concludes her book with some suggestions for positive action. She recommends banning automobiles from certain core-city areas; instituting tax-supported free public transportation; applying the full resources of modern technology to development of efficient, quality public transportation; and levying tolls on autos entering the city. (To elaborate on the last, I suggest a toll system which computes charges in direct proportion to horsepower, or in inverse proportion to the number of passengers, or both.)

All of these suggestions follow from the observation that the transportation system creates its own demand much more than the demand creates the system. The consumer uses what is available, particularly when he has no practicable choice.

The book *Superhighway—Superhoax* is a persuasive outgrowth of Helen Leavitt's effective actions in Washington, D.C. to stop construction of a freeway destined to replace her home and neighborhood. Mrs. Leavitt has mobilized her data with great ability as well as conviction.

by Jonathan Taylor, coordinator of N.W. Harris Extension, Department of Education, Field Museum.

FIELD BRIEFS

Museum Acquires Rare Shell

Acquisition of a perfect specimen of *Conus gloriamaris*, the most famous sea shell and one of the world's rarest, was made possible recently through the generosity of Mr. and Mrs. Arthur Moulding.

Although first described in 1777 and represented by about 25 specimens in Europe prior to 1800, only four additional specimens were found between 1800 and 1957.

Since 1957, living specimens have been collected in waters off the Philippines, the Bismarck Archipelago and the Solomon Islands.

This beautiful shell, approximately four inches long, will be on display in the South Lounge May 17 through July 11.

Tours to Scandinavia, India and Ceylon, Africa

Field Museum's Worldwide Natural History Tours will visit Scandinavia, June 8-July 2, India and Ceylon in October, and in 1972 two tour groups will visit Africa, January 14-February 6, and February 11-March 5.

A slide lecture on the India and Ceylon tour will be given by Tours Chief Phil Clark at 8 p.m. on Friday, June 4 in the Field Museum lecture hall. Mr. Clark is presently in India preparing the tour.

The African tours will visit Nigeria, Cameroun (featuring the Sultanate of Bamoun), and Kenya. In Kenya, the January group will visit Tsavo, Lake Nakuru, and Nairobi game reserves. The February group will visit Samburu, Lake Nakuru, and Nairobi game reserves.

Information on the tours may be obtained by writing Natural History Tours, Field Museum, Roosevelt Road at Lake Shore Drive, Chicago 60605, or by telephoning 922-9410 and asking for the Natural History Tours office.

Large Piece of Rare Meteorite Found

Dr. Edward J. Olsen, curator of mineralogy in the Museum's Department of Geology, holds a 103 pound mass of a rare iron meteorite called Campo del Cielo. The meteorite is 4 billion, 550 million years old and originally weighed about 15 tons. Pieces ranging from a few pounds up to a few tons in weight have been found scattered over several square miles in the Gran Chaco Region of Argentina. The meteorite was first found in the year 1576 by Spanish explorers. This particular piece, discovered by Dr. T. Bunch of NASA's research facility at Ames Research Center, Mollett Field, California, is a new find. Most of the larger pieces of this meteorite were found long ago. Dr. Bunch and Dr. Olsen have been working together for nearly five years on rare iron meteorites of this type.

This piece, shipped from Argentina by Dr. Bunch, has been cut into several slices by International Harvester Co. in Hinsdale. Dr. Olsen sought the aid of International Harvester because their heavy industrial shops in Hinsdale had metal-cutting saws capable of slicing such large pieces of iron. The purpose of slicing is to provide specimens for research and exhibit.

Society for Economic Botany Meeting

The Society for Economic Botany will hold its annual meeting and symposium in the Field Museum lecture hall April 25-28. Dr. Louis O. Williams, chairman of the Department of Botany and a founding member of the international organization, is coordinator of the meeting.

The members of The Society for Economic Botany are interested in all aspects of man's uses of plants—for foods, for drugs, and for industrial purposes.

All meetings of the Society will be held in Field Museum with the exception of the final meeting which will be held at Morton Arboretum on April 28. A symposium entitled "Search for and Introduction of Economic Plants," to be participated in by eleven well known plant scientists, will be held on April 27. The meetings on April 26 and 28 will be given over to research papers on many aspects of useful plants. Mr. M. J. Wells of the Botanical Research Institute, Republic of South Africa is the member coming the greatest distance to participate. He will give a paper on "Economic Botany in South America."

Famous Potters of San Ildefonso Honored at Luncheon

E. Leland Webber, director of Field Museum, Mr. and Mrs. Joseph F. Estes, and Popovi Da (top) and Mrs. Maria Martinez and Mrs. Clara Montoya (front) photographed at a recent luncheon at the Museum honoring Mrs. Martinez and her son, Mr. Da.

More than fifty years ago, Mrs. Martinez and her husband, Julian, began experiments that resulted in the renaissance of pottery making at San Ildefonso Pueblo in New Mexico. Today, she and her son continue to make the pottery much as their ancestors did.

In introducing the famous potters of San Ildefonso, Dr. Donald Collier, curator of Middle and South American Archaeology and Ethnology, said "They have changed and elevated traditional Indian technique and style, and have created a new style which is yet truly Indian. Their achievement epitomizes the history of the Pueblo peoples and cultures in this century and during the past 400 years."

LETTERS

To the editor:

I thought that matter of the wild horses was under control, and I was very distressed to read this article about them in the February *Bulletin*. What can one do to help the brave Mrs. Velma Johnston?

Karl Menninger, M.D.

Mrs. Velma Johnston replies:

Thank you for your interest and concern in behalf of the wild horses of America.

There are now so many protective bills concerning wild horses being introduced in Congress, there is little that can be done to further the cause during this interim between introduction and committee assignment.

As soon as a decision is made concerning which bills the International Society for the Protection of Mustangs and Burros (ISPMB) will support, bill numbers are designated, and the names obtained of committees to which the bills are assigned, a directive will be sent out informing you of the action to be taken.

I would suggest that you see the January 1971 issue of *National Geographic* and, if possible, read the book, *Mustang, Wild Spirit of the West*, by Marguerite Henry. Miss Hope Ryden has also written a fine book on the entire subject—*America's Last Wild Horses*.

Velma B. Johnston
President, ISPMB

Editor's note:

For our readers who may not be aware of the purpose and activities of the International Society for the Protection of Mustangs and Burros we reprint the following from a recent ISPMB news bulletin:

ISPMB is a non-profit organization having as its objective the preservation and protection of the wild horses and burros. It is devoted to the creation and encouragement of an awareness among the people of the need for such protection and preservation.

The first Wild Horse Refuge was set up in Nevada where there are about 200 head of wild horses on this 435,000-acre Refuge. There is also a Wild Burro Refuge in Inyo County in California of 3,600,000 acres. In September of 1968 the newest Wild Horse and Wildlife Range, lying along the Montana-Wyoming boarder, was designated by the Secretary of the Interior. None of these "just happened," but were established in response to the pleas of thousands of individuals throughout the nation. There must be more refuges set up in our Western States and laws enacted to provide humane and wise control of these wild horses and burros that they may receive the protection they so richly deserve—a legacy for future generations to admire as the generations before them have done.

Additional information about ISPMB may be obtained by writing to Mrs. Velma B. Johnston, president of ISPMB, at 140 Greenstone Drive, Reno, Nevada 89502.

To the editor:

Congratulations to Patricia M. Williams on her article on the wild horses in the February *Bulletin*. I have been in correspondence with Hope Ryden after her Today show.

I like the new format of the *Bulletin*.

Henry Field
Department of Anthropology
Harvard University

To the editor:

Having seen occasional copies of your magazine during the past few years, I was greatly impressed, recently, by the new format and by what seemed to be so much more interesting, timely articles. It is a great improvement, and as a high school teacher I would be interested in how a school subscription may be obtained.

Michael E. Goldwasser
Pallrey Street School
Watertown, Mass.

Editor's note:

A school subscription to the *Bulletin* may be obtained by writing to Publications Office, Field Museum of Natural History, Roosevelt Rd. at Lake Shore Drive, Chicago, Ill. 60605. Subscription rate for schools is $3 a year.

CALENDAR

HOURS

9 a.m. to 5 p.m. Saturday-Thursday
9 a.m. to 9 p.m. Friday

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday

CONTINUING

Color in Nature, an exhibit of broad scope, explores the nature and variety of color in the physical and living world around us, and how it functions in plants and animals in their struggle for survival, reproduction, and evolution. Using specimens from the Museum's huge collections, it focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production. Hall 25.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge, with a different plate featured each day.

75th Anniversary Exhibit: A Sense of Wonder, a Sense of History, A Sense of Discovery, continues indefinitely. Field Museum's past and present, and some of its current research projects are presented in a new and exciting way. Hall 3.

"To See or Not to See," Spring Journey for Children, helps them learn about the diversity of colors and color patterns of selected animals, as well as the advantages of mimicry and pigmentation changes, with the aid of a questionnaire. All youngsters who can read and write may participate in the free program. Journey sheets are available at Museum entrances. Through May 31.

A rare, wild albino mink, in a special display in the South Lounge. This almost adult female specimen is the gift of Terry L. Perry of Johnston, Iowa, who captured it about 16 months ago. Through May 16.

BEGINS APRIL 7

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of hand-printed textiles blending classical African motifs and contemporary design. The original Benin art from Field Museum's collection, which inspired many of these designs, is shown in conjunction with the textiles. Through September 12. Hall 9.

BEGINS APRIL 18

Portrait of the Chippewa, a collection of 100 photographs edited from over 5,000 negatives taken on the Red Lake Indian reservation in Northern Minnesota. The exhibit portrays the Chippewa in his culture and shows him in relation to his family and his way of life. Through May 15. South Lounge.

Free Spring Children's Programs at 10:30 a.m., James Simpson Theatre

April 17

Color in Nature is the theme of the program, which includes a film journey to the wilderness country of the American West to observe the life and habits of the elk, grizzly bear, and mountain sheep.

April 24

Museum Traveler Day, with presentation of awards to youngsters participating in the Journey program. A color motion picture, "The Eruption of Kilauea," a dramatic documentary of the active Hawaiian volcano, follows.

Spring Film-Lecture Series, presented at 2:30 p.m., James Simpson Theatre

April 17

"The Right to Live," narrated by C. P Lyons. A film using the great outdoors and animals in their natural environment as subject matter, to stress the need for the preservation of wildlife and natural resources.

April 24

"Adriatic Italy," narrated by Al Wolff. A motion picture journey to the little known scenic East Coast from Brindisi to Trieste, with stops at Rome, Venice and Florence.

COMING IN MAY

"Portraits of Man," a group of sculptures by Malvina Hoffman, permanently reinstalled in the corridors overlooking Stanley Field Hall and in the North and South Lounges beginning May 7. These bronze and stone sculptures of people from various parts of the world are some of the finest representations of Malvina Hoffman's work in Field Museum's collection.

A Specimen of the *Conus gloriamaris,* the most famous sea shell and one of the world's rarest, shown in the South Lounge May 17 through July 11. Acquisition of this perfect specimen was made possible through the generosity of Mr. and Mrs. Arthur Moulding.

Volume 42 Number 5 May 1971
Field Museum of Natural History

BULLETIN

BULLETIN

Volume 42, Number 5
May 1971

Cover: Color in living forms reveals as often as it conceals. The ultimate end is the same—perpetuation of the species.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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Color in Flowers

William C. Burger and *Ronald Liesner*

Perhaps we should explore the why of flowers before we examine flower color. Plants without flowers, such as ferns and mosses, have swimming sperm. The sperm must swim through water or across a surface film of water to achieve fertilization. Part of the life cycle of these plants is thus tied to the presence of water or wet conditions. These plants cannot reproduce sexually in places that aren't moist for at least a short period of time.

Flowers were invented as part of a grand new strategy for reproduction which made water no longer necessary for fertilization. That strategy was fertilization by pollen. It is the function of flowers to produce and receive pollen. Pollen grains arriving at or near the female organs grow toward their goal, fertilization.

But now there is the problem of transportation. If the pollen can't swim, who will carry it? There are two obvious solutions: the wind and the wildlife.

Plants like oak trees and grasses and many others have chosen the wind. This is a chancy business, a statistical problem: how to make sure the pollen will reach its proper destination. Invariably these plants produce a lot of pollen. Almost as invariably, the flowers of wind-pollinated plants are nothing worth admiring. Their flowers are usually small and inconspicuous. But that makes sense—the wind can't see. These plants are investing in pollen, not makeup. We want to talk about those plants that have invested in color to insure their pollination. These are the plants that have chosen the wildlife.

It takes more than mere color to insure that animals will transport pollen from flower to flower. The main reward for these animals is usually sweet nectar or nutritious pollen; color and odor are the signals that tell them where it's at. Color, odor, and nectar are expensive, but this is the price the plant must pay for the service of pollination. The currency of living things is energy and it requires a lot of energy to make colorful petals, attractive aromas, and sweet nectar. We can think of a living thing as having two energy budgets: one to keep itself alive and the other to reproduce and keep the species alive. Flowers, fruits, and seeds are the investments a plant must make to keep its particular species going.

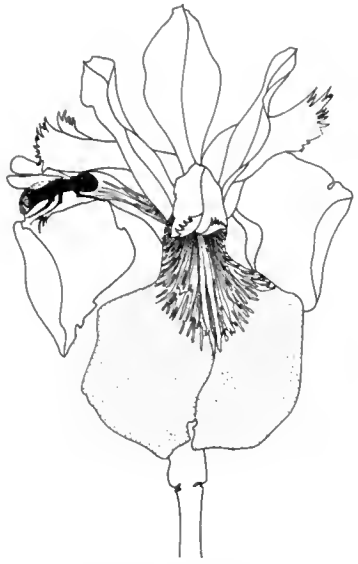
But why all the trouble of flowers and pollination? Why not just have small parts that could form new plants? Wouldn't it be simpler for an organism to produce young all by itself? Many plants can produce new plants by themselves. Why bother with pollination between distant plants, which is one of the major results of having colorful flowers? If there were no advantage, all this energy spent on fancy flowers would be a waste. There does seem to be an advantage. This advantage is a more variable population resulting from the mixture of hereditary material.

The more variable a population, the greater is its potential for improved adaptability to its environment and its chance of surviving if the environment changes or catastrophe strikes. Pollination between distant plants results in more variable offspring. This is what flowers are for.

We explored the "why" of flowers; let's now take a look at the "how" of color. We all know that white (and white light) is a mixture of all the colors and that the absence of color (or of light) is black. We see color when we see only part of the light spectrum. Color can be produced physically, as when a prism refracts a beam of sunlight and disperses it into its components, from blue through green and yellow to red. Many things can break up white light similarly, such as water droplets making a rainbow, atmospheric particles making the sky look blue, or the scales of some of the most spectacular butterflies. But the color of flowers is not this type of "physical" or structural color. Flowers usually produce color with pigments. Pigments are compounds that absorb some part of the spectrum; it is by reflecting back the rest that they produce their "color." Thus, a compound that absorbs blue, red, and yellow will look green. One that absorbs everything but red will look red. Pigments of many kinds are responsible for the colors of flowers.

The how of color also requires understanding how color is seen. People with good color vision can distinguish between hundreds of colors, but experiments with honeybees indicate that they can see only about four distinct colors. Moreover, the honeybee can see part of the spectrum that is not visible to us. How can we discuss what the bee sees when its vision is so different in both sensitivity and ability to discriminate? How can we understand the effect of flower color on animals whose vision differs so much from our own? Perhaps the best way to approach the problem is to think in terms of contrast. After all, the flower has a simple message: "Here I am." The prime function of

Photo: Looking deep into the flower of a common hollyhock, *Althaea rosea*, which belongs to the family that also includes cotton, okra, hibiscus, and the mallows. Photo by William C. Burger.



The lower petal of the iris provides a broad landing field and distinct lines that guide the bee to nectar.

flower color is to stand out in bold contrast against its surroundings.

The most contrasting image against a background of mixed browns and greens may be pure white. The white of flowers is due to the air spaces within cells rather than to a white pigment. This white is formed in the same way as the white of snow and foam: the air cells scatter and reflect the light falling on them. White and the very pale colors are characteristic of flowers pollinated by moths at dusk and dawn. These light colors are the most efficient in reflecting the dim light. Bees are attracted to white flowers, but only if the ultraviolet wavelengths are not reflected. Similarly, bees can be taught to visit a white disc, but only if that disc does not reflect the ultraviolet.

The bees distinguish between white that includes ultraviolet and white that does not—something we cannot do.

Yellow and orange are apparently very attractive to a wide range of insects. They are common flower colors. Our goldenrods, dandelions, and butterfly weeds can often be seen with visiting bees, wasps, hover flies, and even a few beetles.

Bees have been shown to be blind to red. Nevertheless, the red poppy of Europe and our gardens is often visited by honeybees. This apparent contradiction is explained by the fact that the red poppy also reflects ultraviolet light. Again, the bee distinguishes a difference that we cannot see.

Red flowers, especially those with narrow tubes, are regularly visited by birds. These red flowers apparently stand out in bold contrast to the background greens for the birds as they do for us. How different from Rover, who has a lot more trouble fetching a red ball in the green grass than a blue one. Getting back to flowers, typically bird-pollinated flowers lack fragrance. This is not surprising since birds have a very poor sense of smell (differing again from Rover).

Quite a number of flowers pollinated by flies and beetles and having very disagreeable odors (to us) are very dark brown or deep red-purple. Early experiments indicated that flies were not attracted to these colors. But later work showed that flies which normally prefer yellow and orange shift their preference to brown and purple when exposed to the odors of decay. The insects require two signals in this instance: sight and odor. Odors play an important role in many other flowers, and it is often difficult to distinguish which clues the visitor has used to find a particular flower. A straight flight path to the flower indicates that the visitor has used vision, but a crooked flight into the wind indicates that aroma is the clue.

Once the insect has found the flower, it may receive further visual cues. Many bee-pollinated flowers have stripes or patches of contrasting color, known as honey-guides. These help the insect find the nectar. Experiments have shown that bees usually land on the edge of an evenly colored area and move in from the edge, even if food is always in the center. However, when stripes or patches of contrasting color are in or point to the center of the area, the bee lands directly on the center. Thus, the white petals (called rays) of the daisy serve to center the yellow disc. Many flowers have special lines or colors that indicate the nectar-producing areas; these are the guide lines and target colors.

The next time you see a pretty flower you might ponder its meaning. Not the poetic purpose of song and fable, but the business of enticing animals to help it in that universal biological goal: procreation.

Dr. William C. Burger is associate curator of vascular plants in the Department of Botany at Field Museum. Ronald Liesner is herbarium assistant.

THE GREAT FRIGATE BIRD

Melvin A. Traylor

Courtship of Great Frigate Bird, by Grant Halst, Rochester, New York, selected as best print in the 26th Chicego International Exhibit of Nature Photography.

These courting Great Frigate Birds turn back the clock thirty years to two exciting days spent on Tower Island in the Galápagos, when I saw this magnificent pirate for the first time. As our ship approached the cove at the head of Darwin Bay, we were struck by the numerous bright red spots like flowers scattered through the brush. When we landed we could see that each splash of color was the throat pouch of a courting male frigate bird. The majority were alone, sitting on a nest to guard it from rapacious neighbors, but occasional ones had their mates beside them. Some pairs sat quietly, others fenced with their bills and croaked love songs, and recently reunited pairs were, in William Beebe's immortal words, "going through various forms of dying ecstasies."

The bright red pouch of the male is strictly a courtship ornament, worn night and day during mating, but folded up and tucked away when the trials of raising a family begin. A male with a brilliant pouch is almost invariably on an empty nest, while the subdued ones, with shriveled pouch, are incubating an egg.

When incubating, the frigate bird is comparatively unimpressive. Being primarily an aerial machine, its legs are short and its feet weak, good only for perching. If forced to move about, it hops and flops and appears singularly inept. However, as soon as it lifts its wings and rises from the nest, the frigate becomes a new being, the absolute master of the air. No other bird combines such ability to soar for hours on motionless wings with such speed and agility. Its flight is deceptive, for the slow wing beats give no hint of great speed. Only when the frigate swoops down to catch a flying fish in the air does one realize its power and control.

The frigate, or man-o-war, earned its name from its habit of pirating food from other birds. At Tower Island the victims were usually the boobies that shared the rookery. When the boobies had young in the nest, they would feed well out to sea and return only when their crops were full. Then they had to run the gauntlet of the frigate birds soaring high above the island, waiting for them. Although to us the boobies' flight seemed fast, it was no match for the speed of the men-o-war. The frigates would dive-bomb and harass the boobies, even snatching them by wing or tail tip and flipping them over to make them disgorge part of their meal, which a frigate would seize triumphantly in the air. Not that it could necessarily enjoy its loot, for other frigates would chase the pirate in turn, and a fish might change beaks three or four times before a lucky thief succeeded in swallowing it.

Melvin A. Traylor is associate curator of birds in the Department of Zoology at Field Museum.

Color in Animals

Rupert L. Wenzel and
Solomon A. Smith

The glorious spectrum of a rainbow, the flaming colors of a fall landscape, the softly sensuous hues of the Grand Canyon, the dazzling blue of a Morpho butterfly; all evoke a variety of emotional responses in man—wonder, surprise, joy. They may even give him pause to reflect on their meaning, and on his own place in the universe.

Both primitive and civilized people have used colors in many ways—to identify group, to symbolize status, to present an awesome visage in combat, to conceal soldiers from the enemy, to attract the opposite sex, to enhance objects, to interpret the world around them, to give pleasure, to calm the ill. Interestingly, some of these uses are similar to functions of color in nature.

Yet, man is so conditioned by color, both in nature and culture, that he tends to take it for granted. Although he easily adjusts to the black and white or intermediate grays of non-color television and photography, he may find it difficult to imagine living in a world without color. That is, unless he is blind or completely color-blind, for in a psychological or physiological sense, color "exists only in the eye of the beholder." In this sense, there is no color without color vision, that remarkable ability of eye and brain to respond to different wavelengths of light by perceiving the sensations as color.

Physically, colors are simply various wavelengths of that segment of the electromagnetic spectrum that is reflected from objects and perceived by creatures as light. The physical basis of color has existed since radiant energy burst forth in the universe many billions of years ago. These energy waves of colors were reflected from the sky, the waters, and the rocks and minerals of our planet earth long before there was life, and thus before there were any eyes to sense them.

Photos: Top—*Phylobates bicolor* with tadpoles on its back, from Cordillera, Azul, Peru; body length 1¾ inches. Bottom—A crab spider which has caught a long-horned beetle by imitating its buttercup yellow background; from Marin County, California; body length ½ inch. Copyright by Dr. Edward S. Ross, California Academy of Sciences.

Some biochemists believe that ultraviolet light provided the energy needed for life to originate. Certainly light in its colors has been woven into the fabric of life and evolution ever since, and life as we know it would not otherwise exist.

The earliest animals could not see. At best, some—like protozoa, minute one-celled animals—could only sense light and shade. Primitive light receptors evolved in some animals, and later these were elaborated into complex eyes that could distinguish form and tones of light and gray, fuzzily at first, "as through a glass darkly," more sharply in higher forms.

Although some lower animals may have been sensitive to a narrow range of light wavelengths, none had color vision that could distinguish all the colors of the light spectrum.

At some unknown time and place, some animals first achieved the ability to distinguish colors—perhaps to help them recognize enemies, mates, prey or other food. Color then took on new dimensions, even for plants, which themselves cannot see. And natural selection served to combine vision, color, form, and behavior into patterns unbelievably well suited for survival.

But it would be a mistake to assume that colors in animals and plants had no significance before the evolution of color vision in animals. For even though no creature could see them as colored, pigments were present in many early plants and animals. Unlike the inorganic pigments we use in paints and most dyes, the pigments of plants and animals are organic chemical compounds. Many are either essential to life processes of the organism that produces them—like chlorophyll in photosynthesis—or are important in intermediate stages of metabolism, or are waste end-products. Some of these may be deposited in the shell or skin of an animal. It requires less energy to "dump" such wastes this way than to excrete them through special organs.

Because of local differences in biochemical activity in the skin, it is possible that such pigments were often deposited unevenly, to produce patterns. Even though seen as tones of gray by other color-blind animals, these patterns could increase an animal's chance of surviving and reproducing if they helped camouflage it from an enemy, or rendered it easily recognizable by others of its kind, including potential mates. This is true for many living animals.

The extent of color vision in the animal kingdom has not been sufficiently investigated for anyone to make more than a few generalizations.
Although the origin of color vision is unknown, it is clear that it evolved more than once, independently, and that its history is interwoven with that of adaptive coloration in plants and animals.

In general, animals which are active in the evening or in the dark, like owls, lack color vision. They also tend to be somberly colored or mottled, to match the backgrounds on which they rest during the day. Moths which are chiefly nocturnal are excellent examples of this, though day-flying moths may be brightly colored, like butterflies.

Most diurnal birds have excellent color vision, much like that of humans, but some tend to be more sensitive to reds and oranges. Significantly, the flowers and seeds of many plants that depend upon birds for pollination or dispersal are often red or orange. So are the warning colors of many insects—like the monarch butterfly—that may be distasteful or dangerous to bird predators.

Little is known about color vision in reptiles and amphibians. Probably all tortoises and turtles have it, and it is clear from inferred evidence that at least some lizards and toads do too.

Animals

Many fish have excellent color vision, as one would expect from the bright colors which they display.

Interestingly, most mammals appear to have poorly developed color vision or to be color-blind. But man and other primates, like the chimpanzee, have excellent color vision. Their color sensitivity may have evolved in tropical regions of the world as a means of recognizing highly colored fruits which were important in their diet and thus to their survival.

Although there is evidence that birds and many other vertebrates discriminate colors in much the same way humans do, this is not true for all animals that have color vision.

For example, a flower that has pigment which reflects ultraviolet light may appear to man to be entirely yellow; but to a honeybee it may appear to be largely deep purple with a narrow lighter yellow margin. Bees can sense ultraviolet; man cannot. On the other hand, bees are blind to red, which man can see.

Colors in plants and animals may be either *structural* or *pigmentary,* or a combination of the two. Structural colors are produced chiefly by ultra-fine structures which break up light and reflect wavelengths of various colors—much as cut-glass does. These colors may be iridescent, or non-iridescent like the dazzling blues of many morpho butterflies, whose wings have been so commonly used to make butterfly trays and pictures. In these, the tiny scales which form the "powder" of the wings have complex structures which reflect wavelengths of blue light and absorb others.

Pigmentary colors are produced by various molecules of organic pigment compounds which absorb certain wavelengths of light and reflect or transmit others.

Coloration in animals plays many roles. Because of its heat-absorbing qualities, dark pigment is important in heat regulation in many cold-blooded desert animals, especially those that are active during cool hours of early morning and evening.

Eumelanin is the pigment which is conspicuous in dark-skinned peoples. By screening out excessive ultraviolet light, eumelanin helps maintain a favorable level of vitamin D production in the skin of people living in tropical latitudes, where ultraviolet radiation is intense. An excess of the vitamin is toxic. Conversely, the light skin of originally northern peoples permits maximum absorption of ultraviolet in northern latitudes, where the radiation is low. Coupled with a high intake of vitamin-D-rich food, like fish, this helps prevent rickets and other bone disorders which result from a deficiency of the vitamin.

But most coloration in animals functions either to conceal them or make them conspicuous. Conspicuous coloration tells something about an animal to other animals. In other words, it is a form of communication—between prey and predator, rival males, opposite sexes, or other members of the same species, including parent and offspring.

Warning coloration may tell a predator that a creature possesses bad taste or smell, a sting, or a poison, like the scarlet tree frog *Phylobates bicolor,* whose bright color advertises the fact that it is poisonous when eaten. The orange-reds of ladybird beetles and milkweed bugs advertise their distasteful qualities.

Animals quickly learn to avoid what is unpleasant, through tasting. A laboratory toad, for example, may be conditioned to avoid the conspicuous banded patterns of a bumblebee and its mimics after only one unpleasant experience.

Many small animals, like the caterpillar of the swallowtail butterfly shown here, have conspicuous *false eyes.* It is thought that predators like birds and lizards retreat when confronted by such imitation eyes, responding as though they were confronted by some larger creature. The front end of the caterpillar of one moth found in Trinidad actually resembles the head of a small snake, complete with eyes, and "strikes" at intruders. The false eye of one sphinx moth caterpillar may actually "wink."

False eyes may also function as *deflective coloration* to divert the attack of an enemy. A predator often strikes at its prey's head, and the illusion of reversed posture created by false eyes and stance causes the enemy to lunge in the opposite direction to that in which the prey will move in attempting to escape.

But conspicuous coloration is by no means confined to predator-prey relationships. It plays a wide variety of roles in reproduction and social behavior. It may aid in establishing and maintaining breeding territories. For example, the familiar red-winged blackbird displays his bright shoulder markings to attract females and to discourage other males from approaching his territory. The bright blue tail of the young five-lined skink shown here apparently signals that it is juvenile and thus inhibits attack by an aggressive male parent, which resists intruders into its territory.

The males of some species, like the Bird of Paradise, display their bright colors all together to compete for the favor of the females. This *sexual selection* by the female perpetuates the colors of the most brilliant and pleasing males.

Conspicuous colors of either male or female may signal readiness to mate, like the yellow markings that appear on the female Spotted Turtle, or the bright red patch on the chest and rear of the female Hamadryas Baboon, or the red breast pouch of the Frigate Bird.

Conspicuous color markings may "release" or trigger other kinds of

behavior patterns too among individuals of the same species. Display of a red spot on the bill of the adult Western Gull (*Larus occidentalis*) causes the hungry chicks to peck at the parent, which then regurgitates food for them. Experimentation has shown that if the red spot is covered with paint, the chicks do not peck and the adult ignores them.

Concealing coloration is widespread in the animal kingdom. Its camouflage may conceal an animal from its enemies or from its prey, or both. The color of some animals may impart a *general resemblance* to the surroundings, like the white of the arctic fox or the green of many insects and tree snakes in rain forests. A few animals, like chameleons, can change their color to match the background. In many sea animals, such as sharks and other large fish, the form of the body is obscured by *counter-shading,* the color being darker on top and lighter on the bottom. *Disruptive coloration,* like the bold stripes of many tropical fish, may break up the outline of the body so that it is not easily seen. Coloration may also resemble special characteristics of the background, like the mottled pattern of the horned lizard or the color and texture of the crab spider pictured here. The *special resemblance* of some animals to inedible objects in their environment, like dead leaves or bird droppings or twigs, is achieved through a combination of coloration, form, and behavior. There are even insects that camouflage themselves by carrying debris around on their body.

Mimics are among the most "unbelievable" examples of adaptation and evolution. Their resemblance to other animals or plants, which are called models, is a special kind of deception. The preying mantis that closely resembles the orchid on which it rests, the robber flies which resemble bumblebees, and the moth whose color pattern is nearly identical to that of a butterfly in the same habitat are a small sample of mimics. Mimicry has for decades provoked much thoughtful speculation as well as uninformed nonsense.

The famous 19th century naturalist Henry Bates puzzled over the fact that in a given locality along the Amazon River several unrelated species of butterflies and day-flying moths were almost exact "look-alikes," even to many minor details of their complex color pattern. He concluded that one of the species was a "model" mimicked by the others and that the conspicuously colored model was distasteful to predators like birds, which, through unpleasant taste trials, learned to avoid it. He reasoned further that the mimics were palatable species and that when predators learned to avoid the models, they also avoided the mimics. The mimics' resemblance to the models thus conferred a degree of protection on them as well.

The naturalist Fritz Müller sought to add another dimension to the Bates mimicry theory. He found mimicry groups that included more than one—often several—presumably distasteful "look-alikes." He reasoned that if it was advantageous for a palatable species to mimic a distasteful one, it was also reasonable to expect that different distasteful species would gain an advantage if they resembled each other. Not only would the losses suffered through taste trials by young birds be divided among the several distasteful species, the predators would learn to avoid them all more effectively because they needed to learn to avoid only one rather than several color patterns. This kind of mimicry is now called *Müllerian mimicry.* There may be Batesian mimics of the Müllerian mimics too.

Over the years there has been much argument about mimicry. Few denied that Batesian and Müllerian mimicry did indeed exist, but the explanation was open to question. It was necessary first to demonstrate that

Photos: from top to bottom—*Papilio larva* (caterpillar of swallowtail butterfly), from Krachong Forest in Thailand; body width ⅜ inch. Horned lizard, from El Rosário, Baja California; body length 5 inches. Five-lined skink, from Marin County, California; body length 6 inches. *Nymphalidaa anaaa ityS* (dead leaf butterfly), from Tingo Maria, Peru. Copyright by Dr. Edward S. Ross, California Academy of Sciences.

the models were actually distasteful. This seemed dubious when early experiments and observations with the common Monarch Butterfly, which was supposed to be unpalatable and mimicked by the palatable Viceroy, indicated that Monarchs were readily eaten by birds. This evidence caused biologists to discredit Bates' and Müller's hypotheses and to give alternative explanations, some of which now seem quite ridiculous.

The classic experiments by Dr. and Mrs. Lincoln Brower of Amherst College and their co-workers and colleagues clearly support the original theses of Bates and Müller. They also showed that the conclusions regarding the Monarch's edibility were based on incomplete evidence. It had been assumed that the distasteful qualities of the "model" butterflies were due to substances ingested by the caterpillar when feeding on plants like milkweeds and that these poisons were carried through in the adult butterfly. This is now known to be true for the Monarch as well as for other "models." The problem was that in some areas the Monarch caterpillars feed on species of milkweed that do not contain the distasteful or poisonous components, and in these areas Monarch Butterflies are indeed eaten by birds. But butterflies from caterpillars that fed on milkweeds containing certain heart poisons were not just distasteful to birds, they actually made the birds ill to the point of wretching. Birds which experienced this in the laboratory sometimes wretched at the very sight of a Monarch if it was offered to them a couple of days later.

Although the suppositions of Bates and Müller were valid and explain why mimicry is advantageous to the mimic, they do not explain the mechanism by which the mimic comes to resemble the model. *Natural selection* provides what is to most biologists not only the most reasonable explanation, but the only one which has experimental and observational evidence to support it.

Many animals exhibit easily demonstrable individual variation in structure, ecological tolerance, behavior, physiology, and coloration. Much of this variation is due to inherited—that is, genetic—differences. An animal that may, to quote Darwin, "vary however slightly in any manner profitable to itself under the complex and sometimes varying conditions of life" will have a better chance of surviving. In other words, an animal with a superior genotype (its total hereditary material or genes) will have a better chance of surviving than an inferior one. But, what is more important than survival itself is the contribution that will be made by the survivors of each generation to the genetic pool of the next and subsequent generations.

The history of the Peppered Moth (*Biston betularia*) in England is one of the most convincing examples of natural selection that has been witnessed as well as verified by experiment.

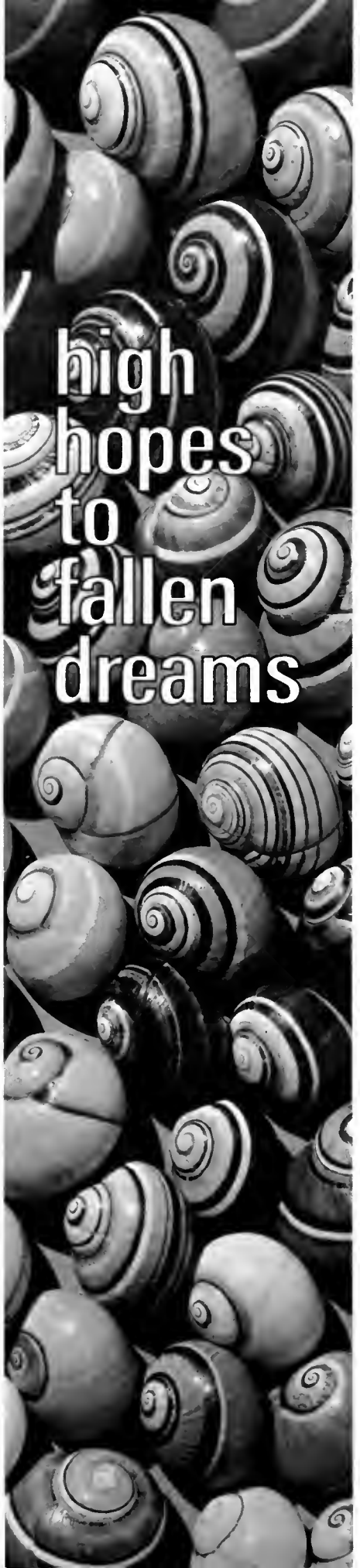
Before the Industrial Revolution, pale lichens covered trees over much of England. When light-colored Peppered Moths rested on such a tree trunk they were almost invisible to bird predators. With the Industrial Revolution, the lichens near many cities either disappeared or were darkened by soot deposits. In 1848 a dark form of the Peppered Moth was first observed. This form was inconspicuous and thus protected from predation when it rested on the darkened tree trunks. It gradually increased in numbers while the light form, now conspicuous, suffered heavily from predation. By 1900 the ratio of dark to light forms was 99 to 1. This ratio is now shifting back as pollution control in Britain eliminates much of the soot deposition and more of the lighter forms of the Peppered Moths survive.

Dr. H. B. D. Kettlewell of England performed a series of wonderfully designed experiments—in natural habitats—to demonstrate the different survival values of the dark and light forms when exposed to predation by birds. Breeding experiments then demonstrated a simple genetic basis for the dark and light forms.

When one reflects on this simple example of natural selection, it is much easier to understand how such marvelous adaptations as those exhibited in mimicry, concealment, and conspicuous coloration could evolve. For many of these genotypes represent an accumulation of "superior" or "successful" genes which survived and were passed on through many thousands, even millions, of generations, by means of natural selection.

As Charles Darwin wrote in *Origin of Species:* ". . . whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

Dr. Rupert L. Wenzel is chairman of the Department of Zoology, and Solomon A. Smith II is coordinator of temporary exhibits at Field Museum.



high hopes to fallen dreams

Alan Solem

One of my more irreverent colleagues divides the birds into big white birds, little bitty brown birds, and owls. For my own part, I think of Illinois mammals as foxes, opossums, skunks, squirrels, deer, raccoons, and squeaky things. Since professional systematists can view common animals in this cavalier fashion, it is no wonder that things so far out of the ordinary experience as sea snail shells become clumped and confused in the eyes of the average person.

A few sea shells are genuinely rare, quite beautiful, well publicized, and eagerly sought by shell collectors. Individual specimens have sold in recent years for $2,000 to a rumored $4,000 each. Two of these rarities, *Conus gloriamaris* and *Cypraea leucodon*, have been widely publicized. Blurred photographs of *Conus gloriamaris* have appeared in popular magazines, while *The Guinness Book of World Records* lists *C. leucodon* as "the rarest shell in the world." Accompanying this totally incorrect listing is a small black and white photograph.

Two or three times a month I receive a telephone call or a letter from a person who is certain he has one or the other of these very rare shells. It may have come down through the generations in a box of shells collected by a New Bedford whaling captain or been bought in an antique shop or picked up while serving in the South Pacific during World War II, or even found discarded by a janitor cleaning up an apartment for new tenants.

Often the person will have seen a magazine or newspaper picture of these rare shells and his memory will be triggered. The shell in a box in the attic will be remembered, and casual curiosity brings shell and picture together. They *look* the same. Excitement mounts. A trip to the local library to look through its few shell books is of little help. If these rarities are illustrated in the books, no mention is made of similar looking shells.

Hopes grow that a specimen of the treasured shell is in hand. Pride of ownership, a sense of discovery, visions of unexpected wealth, and, above all, the scent of treasure trove mingle. Calls to local colleges, bird watcher clubs, natural history societies, and aquarium stores fail to yield an authoritative answer. Eventually either the Shedd Aquarium or Field Museum is suggested. A short time later my telephone rings or a letter comes to my desk. More often than not this is followed by a visit to my office. Field Museum has just obtained a specimen of *Conus gloriamaris*. Of *Cypraea leucodon* we have only good color photographs. We have several hundred specimens of the species that are generally confused with both of them. A glance at the proffered shell tells me that the high hopes are in vain. A walk to our collection cabinets, an opened drawer, a few words pointing out that we have from 40 to 200 specimens that are the same as the visitor's shell, an explanation as to how it differs from the pictures of the rarity—and the dreams have fallen.

More than ninety per cent of the mistakes involve the same common shells. Since the rarities are surrounded by both history and romance, a brief review of their background and the points of difference from the common species seems of general interest.

Cypraea leucodon, sometimes called the white-toothed cowry, was discovered in 1828. This three-inch shell with white spots on a light brown background was known only from a single specimen until 1960, when a second shell was reported. It had lain

Top row: *Oliva porphyria; Conus textile; Conus gloriamaris.* Bottom row: *Cypraee mauritiana; Cypraea tigris; Cypraea leucodon. (Cypraea leucodon* reproduced by permission from *Van Nostrand's Standard Catalog of Shells,* 2nd ed., 1961, Van Nostrand-Reinhold Books.)

from The Action Line, *Chicago Today* . . . "I've been saving a sea shell I found in the South Pacific in 1943 as a souvenir. But after reading the *Guinness Book of World Records,* it appears it might be a rare type of cowrie and I might part with it for a price. Do you know of a good conchologist who could advise me?"—Frank Svihula

Action Line: Alan Solem, Ph.D., believes you are the proud possessor of a very common species of shell that has a value of approximately 25 cents. The curator of invertebrates at the Field Museum, however, cannot be absolutely sure. Here's what to do next: If the coloring on the shell's back consists of brown spots on a white background you've got the 25 cent variety. If there are light spots on a dark background, turn the specimen over. Along the edge of the shell opening are a series of "teeth." Again, you're stuck with the cheapie if the top part of the teeth is dark brown and the intervals between them are whitish. A brownish color to the teeth means that Solem will gladly set up an appointment for you to verify its identity.

unrecognized in, first, the Boston Society of Natural History, and then the Museum of Comparative Zoology at Harvard University. The shell had been collected about 1840 and had remained incognito for 120 years! In 1965 another specimen was recovered from the stomach of a fish caught in the Sulu Sea off the Philippine Islands. Examining Philippine fish stomachs promptly became a popular pastime. At least slight success has resulted, because the *Hawaiian Shell News* for January 1971 announced that two *Cypraea leucodon* were being displayed at a Philippine shell show. Obviously now five shells are known, and very probably a few more rest unpublicized in Philippine private collections.

Public recognition of *C. leucodon* as a "most rare" shell rests solely on the listing in the Guinness book. Literally hundreds of molluscan species are known only from single specimens, yet excite no interest. They are small, colorless, or unpublicized. The two species normally confused with *C. leucodon* are the Tiger Cowry *(C. tigris)* and the Humpback Cowry *(C. mauritiana).* Both are worth 25¢ to 50¢ at most. Color differences, which can be seen in the picture, are summarized in the table on the next page. The easiest distinction is that only the rare shell has white spots on a brown background.

Conus gloriamaris has been famous for more than 200 years. This 4″ to 6″ tapered shell with white and gold markings was a source of frantic bidding at shell auctions in the late 18th century. We do not know where these early specimens were collected. Only when Hugh Cuming picked up two live shells on a reef at Jacna, Bohol Island, Philippines in the fall of 1836 was a locality identified.

Tradition has it that Cuming "fainted with delight" at this find. The historical picture of Cuming as a hard-headed businessman suggests rather that he capered in glee at the potential profits. These plus two other specimens collected from Indonesia during the 1890s were the only four specimens found between 1800 and 1957!

C. gloriamaris shells have sold for as much as $2,000. A specimen stolen from an exhibition case at the American Museum of Natural History in New York has never been recovered. Only 22 examples, including the stolen shell, plus a few records in the early literature that could not be traced to known specimens were listed in a catalog of known specimens published in 1949. In the early 1950s a few additional shells were located in small provincial museum collections in Europe.

Late in 1956 a live specimen was dredged off Corregidor Island in the Philippines. In 1963 a specimen was found near Rabaul, New Britain in the Bismarck Archipelago of the South Pacific. Others had been collected a few years earlier but not publicized. The next few years saw many specimens collected in the Bismarcks and Solomon Islands, and in the summer of 1970 over 100 specimens were collected off Guadalcanal in the Solomon Islands. As a result, the price for a good specimen has dropped from about $1,500 to $500. It's still an expensive item, but in this day of inflation not nearly as valuable as before.

A grim and snowy February day was greatly brightened by a small package from Guadalcanal. Inside was a 104 mm. long specimen of *Conus*

Species	C. mauritiana	C. tigris	C. Leucodon
Size	3-6″	3-6″	3-3½″
Background color of shell	chocolate	white	brown
Color of shell base	dark chocolate	white	brown
Color of spots	light brown	brown	white
Apertural teeth	long and indistinct, brown on top, white in inter-spaces	short and indistinct	long and sharply defined

gloriamaris complete with operculum and in perfect condition. Through the generosity of Mr. and Mrs. Arthur Moulding, Field Museum now owns this shell, which will be on display in the South Lounge May 17 through July 11. The vast majority of specimens found in recent years have been of the 80-90 mm. size and usually have several noticeable flaws in the shell. This example had been injured in life, as is typical of the species, and it repaired itself during later growth. Visiting shell collectors have viewed it with delight equal to my own. It is a magnificient addition to Field Museum's collections.

My own experience has been that the Indopacific *Conus textile* and *Oliva porphyria* from West Mexico are the two species most frequently confused with *C. gloriamaris*. Perhaps a geographic factor is involved, since at the American Museum of Natural History in New York the Florida species *Oliva sayana* replaces the West Mexican shell. The *Oliva* totally lacks the vertical reddish lines found on the two *Conus* shells, has a heavy callus with spiral ridges on the median line of the shell opening, and the early whorls are minute with a distinct channel where the whorls meet. Both of the *Conus* have, typically, a yellowish-orange base color, white "tent-like" markings edged with a dark red line, plus vertical and somewhat wavy dark red lines. There are no spiral ridges and no channeling of the whorls. *Conus textile* is generally smaller, only 3″ to 4″ long, its "tent-like" markings are proportionately larger, it is distinctly more rounded in outline, and the spire (upper portion of the shell) is less elongated. *Conus gloriamaris* has an elongated spire, rather flat sides to the shell, is larger (4″ to 5″ long), the "tent-like" markings are very small, and usually the vertical red lines are fewer in number.

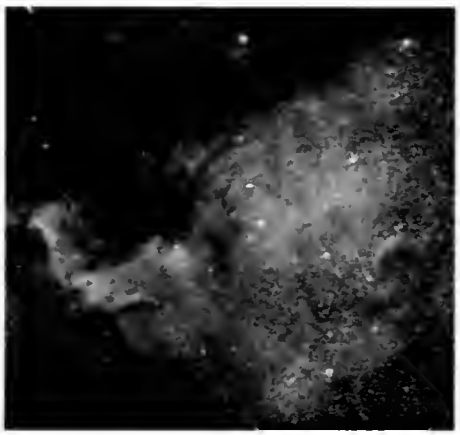
The success of lotteries is based on the wistful hope of a lucky break. While the chances are very small that your attic contains one of the two valuable shells described here, some specimens of *Conus gloriamaris* that were in collections of the last century have disappeared from sight. One shell of *Cypraea leucodon* did sit unrecognized in a big museum for many years. Now where did we put that box of sea shells from Aunt Marie's house. . . . .

FURTHER READING

S. Peter Dance's *Shell Collecting—An Illustrated History* (Faber & Faber, 1966) contains a full review of *Conus gloriamaris* and a guide to the earlier literature. Additional information is given by R. T. Abbott in *Notulae Naturae* of the Academy of Natural Sciences of Philadelphia, number 400, 1967. *Cypraea leucodon* is briefly mentioned by S. Peter Dance in *Rare Shells* (Faber & Faber, 1969).

Dr. Alan Solem is curator of lower invertebrates in the Department of Zoology at Field Museum.

Color in the Non-biological World



Edward J. Olsen

This discussion should begin by saying what light really is; but this is not possible, since light is essentially more primitive than any of the terms that might be used in an effort to explain it. —SIR CHARLES DARWIN

This view of the physicist grandson of the author of *Origin of Species* fairly well sums up the current state of understanding of the phenomenon of light. For at least 2,500 years Western man has wrestled with the question of what light "really is."

In the Classical World several fanciful views were held. One explanation regarded light as a stream of minute, invisible particles fired like projectiles from any light source. Isaac Newton, twenty-one centuries later, came to the same conclusion. He developed the idea and expanded it into a physical theory of the mechanics of motion of the particles, and it came to be called the *corpuscular theory of light*.

During his own time, however, and in the following two centures, an impressive body of experimental data accumulated indicating that light could *only* be explained as a wave-like phenomenon which is propagated away from a source much like ripples on the surface of a pond into which a pebble has been dropped. The hypothetical medium through which it was propagated was called the *ether*. The *wave theory of light* became extremely successful in predicting its behavior under all known conditions, and the corpuscular theory gradually dropped into disuse—until the early part of this century. It was then that certain experimental results arose which could only be explained when light was treated, again, as having the properties of particles (that is, corpuscles).

Thus arose a good deal of consternation in the world of physics over this puzzling dual behavior of light. Was it made up of waves or of particles?

The puzzle was compounded by other new experiments which suggested that this kind of dual behavior is not restricted to light. There are, for example, very minute particles called electrons. These are definitely particles. In all normal experiments electrons behave like tiny, electrically charged particles. If, however, they are accelerated to very high velocities, they exhibit wave like characteristics. Upon slowing down, they cease acting like waves and once again act like particles. Now what do you make of that?

If you are not a physicist you must remain baffled. If you are a physicist you must become mentally ambidexterous: when it is necessary to treat light as a wave, you do so; when it is necessary to treat it as a stream of particles, you do that. At the present time then you cannot ask what light "really is." This essential duality of light (and matter) is today the major metaphysical frontier in the natural sciences.

In our exhibit Color in Nature it is more convenient to treat light as waves. Waves have three basic properties. *Wavelength* is the measure of the length of a wave from the top of one wave crest to the top of the next crest. *Frequency* is a measure of the number of crests that appear to pass a given point in one second of time. Thus, if 60 crests pass in one second, the frequency is called 60 cycles per second, or 60 Hertz (abbreviated, 60 Hz.). The cycle-per-second unit was named "Hertz" to honor a 19th century German physicist. *Amplitude* measures the height of the crests and is a measure of the energetic power of the wave. It is possible to have two waves of the same wavelength and frequency, but very different amplitudes.

When white light shines through a prism or reflects off a finely ruled grating, it is broken up into the visible *spectrum* of colors: red, orange, yellow, green, blue, violet. The wavelengths range from 27-millionths of an inch at the red end to 15-millionths of an inch at the violet end; the corresponding frequencies are from 430 trillion Hz. to 770 trillion Hz., respectively. This is

the range of frequencies visible to the human eye. Some animals—bees, for example—are capable of seeing beyond the violet into the ultraviolet.

Beyond the ultraviolet, at ever-decreasing wavelengths, the spectrum continues through X-rays, gamma rays, and finally cosmic rays, which are of extremely short wavelengths, trillionths of an inch, and hence very high frequencies. Beyond the red end of the visible spectrum, at ever-increasing wavelengths, are the infra-red, which we cannot see but can sense as heat waves, radar waves, television waves, and ultimately radio waves, with wavelengths that range over ten miles long and hence have extremely low frequencies, under 10,000 Hz.

This whole expanse, from gamma waves to radio waves, is called the electromagnetic spectrum, so called because a ray of any of these waves has associated with it an electrical field and a magnetic field.

In the natural world we are deluged with the visible colors. When sunlight impinges upon our atmosphere it is refracted (scattered) by the atoms of the air as well as by suspended water droplets and very fine dust. Because blue light is more strongly scattered than other wavelengths of the color spectrum, the sky apears blue; some of the blue wavelengths in the sunlight are bent downward toward the earth's surface. The other colors are less affected and generally pass on through our atmosphere. This effect is strongest at right angles to the sun; when the sun is low, the sky goes from whitish to pale blue around the horizon to deeper blue, almost violet, overhead.

The blue of the sea is the blue of a cloudless sky reflected in the water. When the sun is covered by clouds, the sea appears greenish due to the microscopic plants, phytoplankton, that float just under the surface. These faint greens are swamped out by the blue on sunny days. On very cloudy days even the greens cannot be seen and the water appears gray, even black, due to the weak light.

During a rain the air is filled with droplets of water, and because it is necessarily always cloudy during storms, the sky is dark. If, however, there should be a break in the clouds and the sunlight streams through, we may obtain one of Nature's most spectacular color displays—a rainbow. A water droplet at a certain angle between the sun's rays and your eye can act like a prism and break up the sunlight into the spectrum of colors. All the raindrops in the air which are located at the proper angle act cooperatively, each contributing its small share, producing the strong and bright spectrum which we observe.

Sunrises and sunsets usually present the most memorable displays of color in the sky—red, yellow, orange, pink, blue-greens, and greens. These colors become prominent because the sun's rays are passing through more of the earth's atmosphere when the sun is close to the horizon. So, before it reaches your eye most of the blue end of the spectrum has been removed by scattering downward and upward. In addition, because of daytime winds and animal and human activities during the daylight hours, many particles of dust have been lofted into the air. These aid in scattering the blue wavelengths out of the sunlight making it appear redder. The more such dust in the air, the more spectacular the sunset. This is why sunsets are often redder in populous areas, around cities, where there are a great many more dust and smoke particles in the air than in isolated places. It is also the reason that sunrises are usually less spectacular than sunsets; animal and human activities are much diminished during the dark hours of the night, so there is less dust in the air at sunrise. Also, the dust from the previous day has settled during the night and night breezes are commonly less gusty, raising less dust. This again is different in populous areas. In large cities it is common to burn trash during the nighttime hours, giving the air an abundant supply of fine particles that scatter the morning's rays, producing redder sunrises than might otherwise be the case.

Most of us are not accustomed to thinking of color in the space away from our earth. It is there, albeit it is not especially spectacular. The planet Mars is a definite rusty red color; Venus is snow white; Mercury and our moon are gray; the planet Neptune is pale green; and Jupiter has a huge, bright red spot in its upper atmosphere that revolves around the giant planet. Beyond our solar system the stars themselves show a range of colors—some red, some yellow, some brilliant white.

Photos: At left—North American Nebula in Cygnus; from Hale Observatories, Pasadena, California; copyright by California Institute of Technology and Carnegie Institute of Technology. At right, from top to bottom—*Novacekite*, a uranium mineral; *Smithsonite*, a zinc mineral, which comes in several different colors; and *Cuprite*, a copper mineral.

The color of any mineral is purely an accidental feature of it. This is in contrast to plants and animals where coloration usually plays a significant role in several aspects of survival. For a given mineral, whether it has one color or another is purely immaterial and irrelevant from the mineral's point of view, if an inanimate object can be thought of as having a point of view.

The origin of colors in most minerals is only poorly understood. It is not uncommon for a specific mineral to show a wide variety of colors in its different occurrences in nature. The common mineral fluorite, for example, has been found in twelve different colors. In some instances fluorite will show a color change within a single crystal—a matter of an inch or less. There is no clear explanation of the wide variety of colors in this mineral.

Occasionally, however, color can be related to the chemical composition of a mineral. Manganese minerals are often red; cobalt minerals often pink; copper minerals often green, and so forth. It is, unfortunately, not always that simple. Some copper minerals are blue; some manganese minerals black; some cobalt minerals silver colored. There are no perfect rules in this regard.

A minor impurity can sometimes cause a mineral color to change. The mineral called *microcline* is normally creamy white. With a small impurity of lead (about 0.03 percent), it is a startling blue-green color that is attractive enough to create a demand for the mineral as a semi-precious gemstone —called *Amazonstone*. The mineral *sphalerite*, a compound of zinc and sulfur, in its pure form is pale amber in color. A few tenths of a percent of iron impurity cause it to darken to a shiny black, called *blackjack* by miners.

The chemical addition of oxygen to a mineral always alters the color and properties. Minerals that contain small amounts of iron become pink or reddish-brown by oxidation. In the extreme case, a mineral can be completely converted by this process to a new mineral with a very different appearance. The mineral *galena*, for example, is a lustrous metallic gray. It is a combination of equal parts of lead and sulfur. When it is oxidized with four parts oxygen, it becomes the mineral called *anglesite*, which is clear, transparent, and colorless—very different from galena in appearance.

Heating a mineral in air can sometimes cause mild oxidation to take place. This principle has been used for centuries in the gem industry. When gem quality green *beryl* is mined, it is routinely heated in air for a period of days. This sometimes converts it to a medium-blue color, and it is then called *aquamarine*, which is a good deal more valuable than green beryl. Similarly, colorless to pale pink *spodumene* can be converted to the deep rose-colored gem *kunzite*, and gray *zoisite* to a deep blue gem called *tanzanite*.

It has long been known that exposure to radioactivity and X-rays can change the color of a mineral. Quartz becomes smoky, white topaz becomes brown, white fluorite becomes purple. Such radioactively induced changes are not always permanent, however. Once the mineral is removed from its radioactive surroundings it will often gradually revert to its original color.

In some rare instances a mineral will change its color when the atoms that compose it are geometrically rearranged. The best examples of this phenomenon are the minerals composed of simple carbon. When the carbon atoms are arranged in stacks of planar sheets, the mineral is black and shiny, almost metallic in appearance. It is called *graphite*. When the same carbon atoms are relinked into a three-dimensional network, the mineral is transparent, clear, and brilliant—*diamond*.

Probably the questions that are most often asked a mineralogist by the public pertain to why minerals exhibit the often striking colors they do. These are, regrettably, just the questions that cannot be answered. One can occasionally produce a weak reply, knowing that the "answer" is really no answer at all. A great deal is known about the properties of mineral structures—their physical and electrical properties, geometrical properies, etc. Unfortunately, these are not the aspects about which most people are curious.

One could say that if so little is known about coloration in minerals, perhaps the mineralogist ought to devote some effort to a study of it. Mineralogy, like most of the geological sciences, depends heavily for its advances in understanding upon advances in the disciplines of physics and chemistry. Mineral color is the result of the interaction of light upon solid matter—the chemical compounds we call minerals. Search for a real understanding of color production in these solids leads us immediately back to the question of the nature of light itself. And that, as we have seen, leads right back to the dual nature of light as a form of electromagnetic radiation—one of the major unresolved questions of the physical universe today.

Dr. Edward J. Olsen is curator of mineralogy in the Department of Geology at Field Museum.

CALENDAR

HOURS

9 a.m. to 6 p.m. Saturday-Thursday
9 a.m. to 9 p.m. Friday

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday

CONTINUING

Color in Nature, an exhibit of broad scope, examines the nature and variety of color in the physical and living world around us, and how it functions in plants and animals in their struggle for survival, reproduction, and evolution. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using specimens from the Museum's huge collections. Through October 10. Hall 25.

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of hand-printed textiles blending classical African motifs and contemporary design. The original African art from Field Museum's Benin collection, which inspired many of the designs, is shown in conjunction with the textiles. Through September 12. Hall 9.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition set is featured each day.

75th Anniversary Exhibit: A Sense of Wonder, A Sense of History, A Sense of Discovery, explores Field Museum's past and present and some of its current research projects in a new and exciting manner. Continues indefinitely. Hall 3.

BEGINS MAY 7

"Portraits of Man," a selection of sculptures by Malvina Hoffman of people from various parts of the world, on permanent display in the second floor corridors overlooking Stanley Field Hall and in the North and South Lounges. These bronze and stone sculptures are some of the finest representations of Malvina Hoffman's work in Field Museum's collections.

THROUGH MAY 15

Portrait of the Chippewa, a collection of 100 photographs edited from over 5,000 negatives taken on the Red Lake Indian reservation in Northern Minnesota. The exhibit portrays the Chippewa in his culture and shows him in relation to his family and his way of life. South Lounge.

THROUGH MAY 16

A rare, wild albino mink, in a special display in the South Lounge. This almost adult female specimen is the gift of Terry L. Perry of Johnston, Iowa, who captured it about 16 months ago.

BEGINS MAY 17

A Specimen of the *Conus gloriamaris,* the most famous sea shell and one of the world's rarest, shown in the South Lounge through July 11. Acquisition of this perfect specimen was made possible through the generosity of Mr. and Mrs. Arthur Moulding.

THROUGH MAY 31

"To See or Not to See," Spring Journey for Children, helps them learn about the diversity of colors and color patterns of selected animals, as well as the advantages of mimicry and pigmentation changes, with the aid of a questionnaire. All youngsters who can read and write may participate in the free program. Journey sheets are available at Museum entrances.

BEGINS JUNE 1

"Dinosaur Hunt," Summer Journey for Children, seeks out Museum exhibits and paintings with the aid of a question and answer sheet, to acquaint youngsters with the prehistoric animals. All boys and girls who can read and write may participate in the free program. Journey sheets are available at Museum entrances. Through August 31.

MEETINGS

May 11: 7:45 p.m., Nature Camera Club of Chicago
May 11: 8 p.m., Chicagoland Glider Council
May 12: 7 p.m., Chicago Ornithological Society
May 13: 7:30 p.m., Windy City Grotto—National Speleological Society
May 16: 2 p.m., Illinois Orchid Society
May 23: 2 p.m., Chicago Shell Club

MEMBER'S NIGHTS

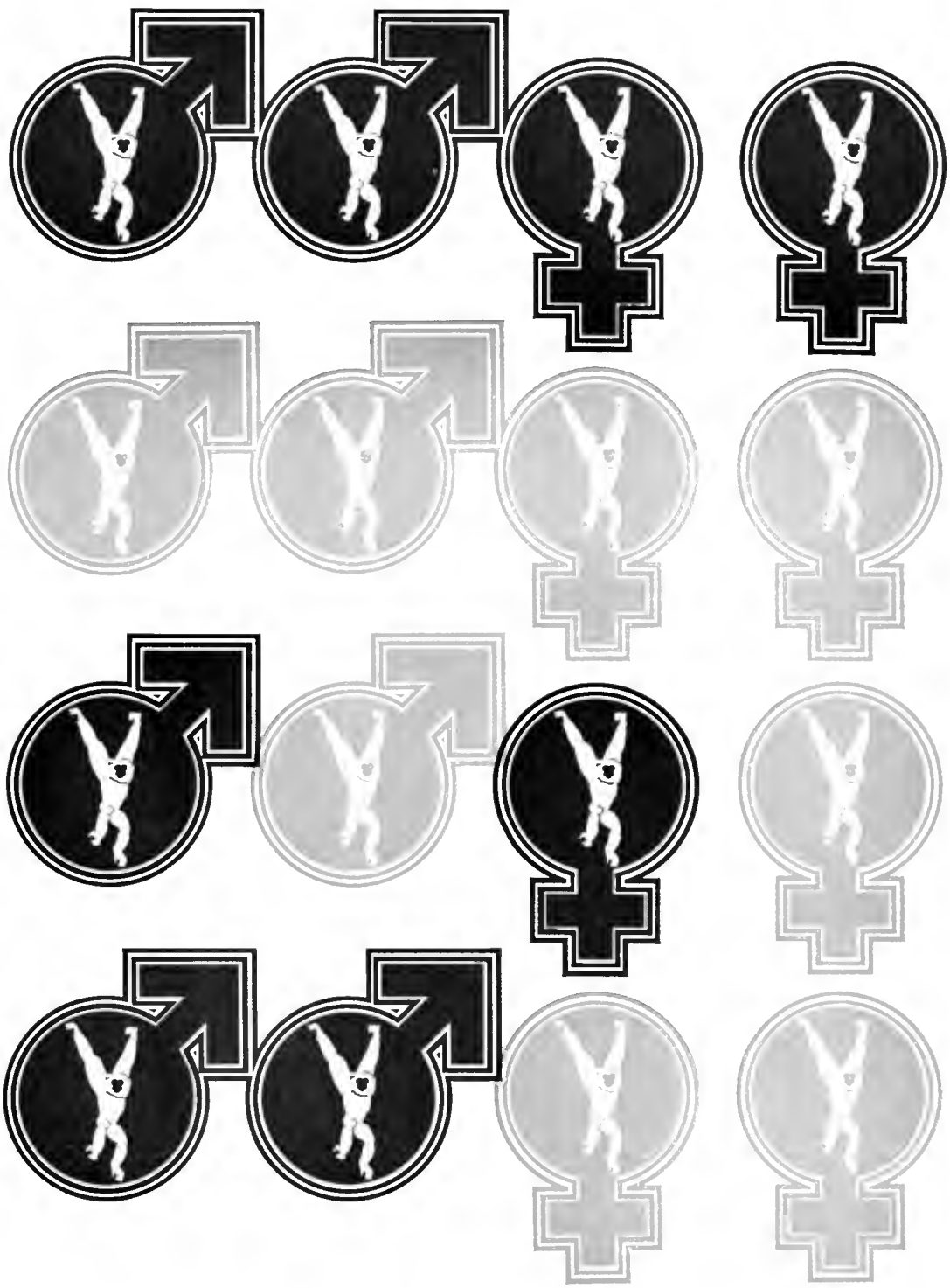
MAY 6 AND 7, 1971
6:00 to 10:00 p.m.

Exhibits, films, entertainment, and special events focus on "The World Around Us."

This is a once-a-year opportunity to meet with the members of the scientific staff in all the departments—anthropology, botany, geology, and zoology—and to see the unusual behind-the-scenes displays and demonstrations they have arranged for you.

Programs for both evenings are identical. Friday night attendance probably will be much heavier, since families with children prefer that evening. You are urged to plan on coming Thursday night if you don't have school children.

Florida Museum of Natural History BULLETIN



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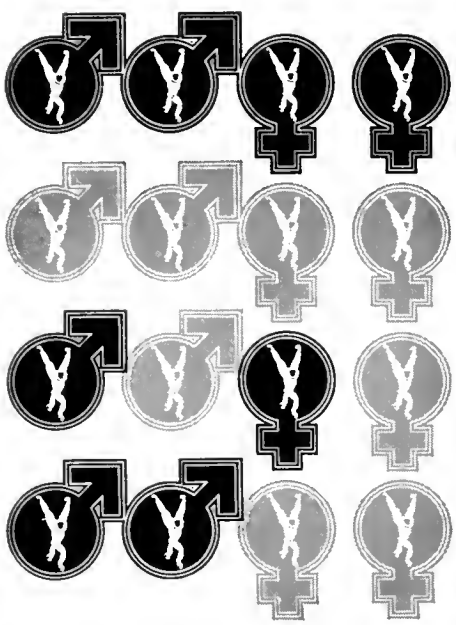

Cover: Gibbon species show three different patterns of color variation; monomorphism, all the same color; asexual dimorphism, color unrelated to sex; and sexual dimorphism, color linked to sex.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans.

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Color and sex in gibbons

Jack Fooden

Gibbons are small thickly furred apes that live in the dense tropical rain forests of Southeast Asia. They are the smallest of the four so-called anthropoids or apes—the tailless non-human primates that most closely resemble the human primate, us. The gorilla, chimpanzee, and orangutan are the other three. Gibbons are highly skilled brachiators, unlike the larger apes (and virtually all monkeys). That is, their characteristic mode of locomotion is swinging from branch to branch by their arms. In fact, they are often spectacular "trapeze artists," making aerial leaps as wide as forty-five feet. They are also highly vocal. Their loud singing, especially in early morning, can be heard for more than a mile through the forest. It probably serves to establish territorial feeding boundaries between neighboring troops. Some species have a highly expandable resonating throat pouch which gives several tones to their hoots and wails, and at a decibel level that would be appreciated by admirers of our own echo-chamber and electronic amplification technology.

Many Gibbons live in monogamous "nuclear family" troops consisting of a mother, father, and up to three offspring, of ages two years apart. The family would usually be no larger than five because gibbons breed only every two years, only one infant is born at a time, and when the oldest offspring is around six it is chased out of this family circle. Gibbons are in their prime between ages seven and seventeen, although their maximum life span is about twenty-five years.

All of these behavioral characteristics make the various species of gibbons, genus *Hylobates,* inherently interesting to the species *sapiens,* genus *Homo.*

The great French zoologist of the 18th century, Buffon, was the first person to describe the animals in some detail to the West. His information was a by-product of French colonial incursions into the gibbon's native regions in Southeast Asia. But the Chinese have long known and been fascinated by gibbons. The history of their interest in gibbons was recently documented by the late R. H. van Gulick, Litt. D., a gentleman scholar whose own affection for the animals developed in the course of his career in the Far East in the diplomatic service of his country, the Netherlands:

> From the first centuries of our era on, Chinese writers have celebrated the gibbon in prose and poetry, dwelling in loving detail on his habits, both in the wild and in captivity. Great Chinese painters have drawn the gibbon in all shapes and attitudes; till about the 14th century from living models, and when thereafter the increasing deforestation had reduced the gibbon's habitat to southwest China, basing their pictures on the work of former painters and on hearsay. So important was the gibbon in Chinese art and literature, that he migrated to Japan and Korea together with the other Chinese literary and artistic motifs, although [neither] Japan nor Korea ever belonged to the gibbons' habitat. The gibbon thus occupies a unique place in Far Eastern culture, it being possible to trace the extent of his habitat, his appearance and his mannerisms for more than two thousand years.

The gibbon has been considered by the Chinese from ancient times to be the aristocrat among apes and monkeys; he symbolized a "gentleman." The macaque, on the other hand, "was the symbol of human astute trickery but also of human credulity and general foolishness," according to van Gulick.

The philosopher Huai-nan-tzu, who died in 122 B.C., wrote a parable that became a kind of proverb through the ages:

> If you put a gibbon inside a cage, you might as well keep a pig. It is not because the gibbon is then not clever or swift anymore, but because he has no opportunity for displaying his abilities.

Whatever mythological or symbolic significance became attached to the gibbon, close observation was involved also. However, thorough modern behavioral studies of gibbons have only recently begun to be made.

But there is another, non-behavioral, characteristic of gibbons that is most interesting to me as an evolutionary zoologist. The color of the dense fur that covers the body of gibbons varies strikingly from one species to another, and in some species from one individual to another. The colors range from pale silver-gray to blond to medium brown to dark brunet or blackish. This coat color variation presents an intriguing problem for evolutionary interpretation. Some interpretations can now be made, at least tentatively, on the basis of evidence already available.

I first became seriously interested in the problem of gibbon coat colors in 1967 as a result of an expedition to western Thailand that I conducted for Field Museum, with the support of a grant from the U.S. Public Health Service.

Although our primary objective was to study monkeys that inhabit the forests of this region, my field companions and I collected several gibbon specimens also, of the species *Hylobates lar*—more particularly, the subspecies or race *Hylobates lar entelloides.* One of the most striking things about this subspecies is that there are two sharply defined color types—blonds, which are pale yellowish buff, and brunets, which are blackish brown. The local people in Thailand call them *cha-nee khao* ("white gibbon") and *cha-nee dam* ("black gibbon"). I knew these color types existed because the fact had been reported in scientific literature, and also the observation that coat color in this subspecies is completely independent of age and sex. We collected or observed blond males and brunet males and blond females and brunet females at all stages of development from infancy to old age.

When I returned to Chicago and began to study the specimens and other data that we had collected, I became curious about color variation in other subspecies and species of gibbons. From one source or another—published

A blond *H. lar entelloides,* an asexually dimorphic subspecies. Photo by Saul Kitchener.

zoological literature and also previously collected museum specimens—I found information about color for all of the seven known species of gibbons. I learned that some are like the kind we collected in Thailand—that is, the animals have different colors independent of age or sex; in others, all individuals of one sex are one color and all individuals of the other sex are a different color; and in still others, all individuals are the same color. But this information apparently had never been brought together and analyzed systematically. My subsequent study of the available information revealed a fairly clear pattern of coat color variation in gibbons.

These three major categories of coat color variation just mentioned can be designated by the somewhat formidable technical terms *asexual dimorphism, sexual dimorphism,* and *monomorphism.* These terms could, of course, apply to other characters as well as coat color.

The term *asexual dimorphism* implies that both males and females may be either blond or brunet, as in the populations I encountered in Thailand. The term *sexual dimorphism* indicates that coat color is correlated with sex. The term *monomorphism* implies that all members of a species or subspecies at any given place—any local population—have essentially the same coat color.

The seven species of gibbons that zoologists usually recognize have the following scientific names: *Hylobates lar; H. agilis; H. hoolock; H. concolor; H. moloch; H. syndactylus;* and *H. klossii.* Mostly the respective geographic ranges of these species are adjacent to one another and do not overlap. In Sumatra and Malaya, however, two species of gibbons inhabit the same forests.

The first species mentioned, *H. lar,* has four subspecies: *H. lar entelloides,* the gibbons I collected; *H. lar lar; H. lar pileatus;* and *H. lar vestitus.* So far as coat color is concerned, this species

Mother and infant of the *H. syndactylus* species, brunet and monomorphic. Photo by Saul Kitchener.

as a whole is different from the other six, and the four subgroups must be considered separately. Although most of the other six also have recognizable subspecies, the pattern of coat color variation is constant within each species.

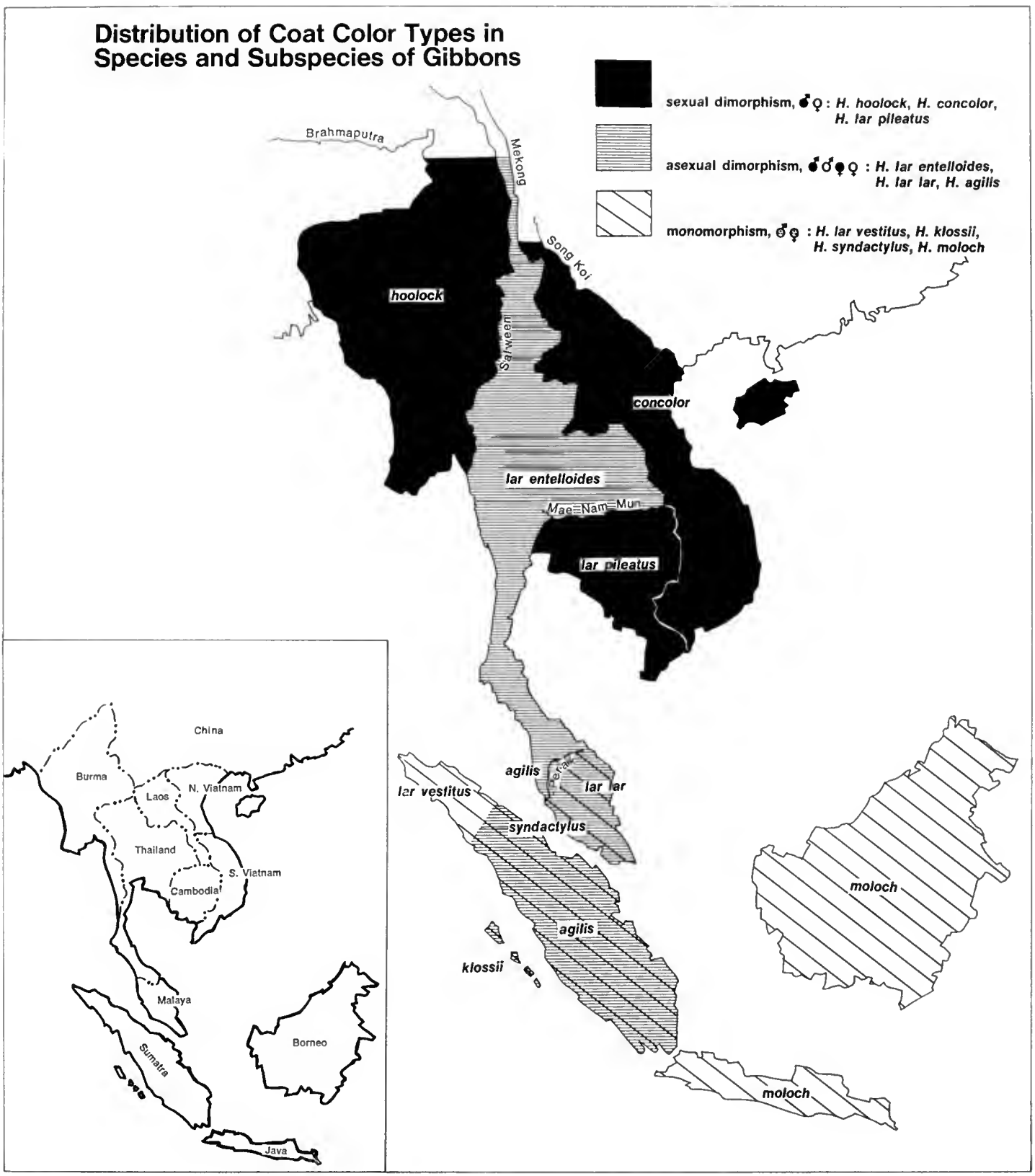
H. agilis, like *H. lar entelloides,* is asexually dimorphic—that is, both males and females may be either blond or brunet. So is *H. lar lar.* The *agilis* species inhabits all of Sumatra except the northern tip and inhabits also a small area on the western coast of Malaya. Adjacent to it on the north lives the *lar entelloides* subspecies, which inhabits part of the Malay Peninsula plus northern and western Thailand. And also adjacent to it on the east is the *lar lar* subspecies, in Malaya. All these species' territories are shown on the map.

The two species *H. hoolock* and *H. concolor* and the subspecies *H. lar pileatus* are all sexually dimorphic—that is, coat color is correlated with sex. In each of these three groups all adult males are brunet and, whether or not these gibbon gentlemen prefer blonds, that is what they get, because all adult females are blond. Surprisingly, all *hoolock* and *concolor* infants are pale colored at birth and turn dark before they are one year old. Males remain dark from then on, and females turn pale again when they reach sexual maturity, at about six years of age. In *lar pileatus,* all infants are born pale; males turn dark as they mature; and females apparently develop only dark patches, with most of their body remaining pale.

These color changes are a normal part of development and are unique to sexually dimorphic gibbons. Asexually dimorphic and monomorphic gibbons remain whatever color they are at birth. All three of the sexually dimorphic groups—*hoolock, concolor,* and *lar pileatus*—inhabit the Indochinese Peninsula. In Assam and Burma west of the Salween River is *hoolock; concolor* is east of the Mekong River in southern China, Laos, Vietnam, and Cambodia; with *lar pileatus* adjacent to the west and south, in Cambodia, Laos, and Thailand.

The three species *H. moloch, H. syndactylus,* and *H. klossii* and the subspecies *H. lar vestitus* are all monomorphic—that is, all members of each group at any given place have essentially the same coat color. The *moloch* group inhabits both Java, where all individuals are pale grey, and Borneo, where all individuals are brown. All *syndactylus* individuals are blackish, in both Sumatra and Malaya. The dwarf gibbon *klossii,* which is restricted to four small islands off the western coast of Sumatra, is also blackish. And *lar vestitus,* in northern Sumatra, is always medium brown.

Viewed overall, the color variations in gibbons present a fairly simple and regular geographic pattern, as indicated by the shadings on the map. The monomorphic species and subspecies (*moloch, syndactylus, klossii,* and *lar vestitus*) are restricted to the southern part of the total range of gibbons. The asexually dimorphic


Distribution of Coat Color Types in Species and Subspecies of Gibbons
sexual dimorphism, ♂♀ : H. hoolock, H. concolor, H. lar pileatus
asexual dimorphism, ♂♂♀♀ : H. lar entelloides, H. lar lar, H. agilis
monomorphism, ♂♀ : H. lar vestitus, H. klossii, H. syndactylus, H. moloch
Brahmaputra
Mekong
Song Koi
Salween
Mae=Nam=Mun
hoolock
concolor
lar entelloides
lar pileatus
agilis
Perak
lar lar
lar vestitus
syndactylus
agilis
klossii
moloch
moloch
China
Burma
N. Vietnam
Laos
Thailand
S. Vietnam
Cambodia
Malaya
Sumatra
Borneo
Java

species and subspecies (*agilis, lar lar,* and *lar entelloides*) inhabit the middle part of the range. The sexually dimorphic species and subspecies (*concolor, hoolock,* and *lar pileatus*) inhabit the northernmost part of the range. This simple geographic distribution suggests that there may be a simple evolutionary relationship among the three major categories of color variation.

One problem in formulating an evolutionary interpretation of coat color variation in gibbons is to decide what the probable ancestral or primitive color state may have been. Because about 45 of the 50 known major groups of primates are monomorphic with respect to coat color, it seems probable that monomorphism is the primitive color state in gibbons. Accordingly, the simplest interpretation of color evolution in gibbons is that monomorphism is the ancestral condition, that monomorphic gibbons gave rise to asexually dimorphic gibbons, and that these in turn subsequently gave rise to sexually dimorphic gibbons. The present geographic distribution of these color states suggests that the postulated transition from monomorphism to asexual dimorphism took place in the southern part of the range and that the transition from asexual dimorphism to sexual dimorphism took place in the northern part of the range.

If the hypothesis presented above correctly interprets the direction and geography of the evolution of color variation in gibbons, the next question to be asked is, Why did these evolutionary changes occur? In other words, what is the selective force or survival value that is responsible for the presumed change from monomorphism to asexual dimorphism and finally to sexual dimorphism? Although there is no comprehensive answer to this question as yet, there are some clues that seem to indicate possibly productive directions for future research.

First, at least part of the genetic basis of color evolution in gibbons seems to be clear. From study of families of asexually dimorphic gibbons that I observed in Thailand and from information provided by other observers, it appears that two blond gibbon parents virtually always produce blond offspring, whereas two brunet gibbon parents may produce both blond and brunet offspring. This pattern of hair color inheritance is essentially the same as in human blonds and brunets. Blondness in gibbons, as in humans, appears to be a genetically recessive trait, and brunetness a genetically dominant trait. In the sexually dimorphic species and subspecies of gibbons, the genetic factor that controls coat color evidently has somehow become linked to the genetic factor that determines sex.

Another fragment of evidence that bears on the evolution of color variation in gibbons is the fact that in the asexually dimorphic species and subspecies the proportion of blond and brunet individuals varies from place to place. In the *agilis* species, brunets constitute about 50 percent of populations observed in Sumatra and about 75 percent of those observed in Malaya. In *lar lar* and *lar entelloides*, brunets constitute about 80 percent of populations in the southern part of the Malay Peninsula, about 10 percent in the northern part of the Malay Peninsula, and about 50 percent in Thailand. This also is reminiscent of the situation with respect to human hair color, if we consider, for example, the percentage of blonds and brunets in local populations in Italy, Switzerland, Germany, and Sweden.

A juvenile white-cheeked male *H. concolor*, necessarily brunet because the species is sexually dimorphic. Photo by Saul Kitchener.

It seems probable that color variation in gibbons may play a role in territorial relationships between adjacent troops. It is known that in some gibbons self-display is an important part of establishing territorial rights. This is evident in a report published by the American primatologist John Ellefson, who studied wild populations of *H. lar lar* in Malaya for about eighteen months.

> Adult males [from neighboring troops] in a conflict hang by one arm and swing back and forth, and twist around 360 degrees in either direction without changing the hand grip; they change hands every few seconds; they appear to be making themselves conspicuous, advertising their position. They look in all directions and conflict-hoo [a characteristic vocalization] as they swing and dangle.

It may only be coincidence, but territorial vocalizations are also prominent in the behavior of South American howler monkeys, which constitute one of the few other primate groups that exhibit coat color sexual dimorphism. Perhaps vocalization and coat color display are functionally interrelated forms of territorial behavior.

It also appears probable that color variation in gibbons may be significantly related to differences in troop size. The French zoologist Pierre Pfeffer recently reported that troops of the sexually dimorphic *lar pileatus* subspecies that he observed in

Painting in Osaka Fine Arts Gallery entitled *Ch'ü-yüan-t'u*, "Picture of a group of gibbons," by I Yüan-chi, 11th century, done on a horizontal silk scroll about 30 cm. high and 120 cm. long. Printed by permission of Municipal Gallery of Fine Art, Osaka, Japan.

Cambodia were very much smaller than troops of the monomorphic *moloch* species in Borneo. If these two groups of gibbons differ in troop size, they probably also differ in the internal social organization of troops. Color variation may well function as some sort of social signal within a troop.

Another intriguing fact is that coat color is related to mate selection in asexually dimorphic gibbons. Gibbons of the *agilis* species in Sumatra tend to select mates with coat colors opposite to their own. In almost all troops in this species, blond adult males are mated to brunet adult females, and brunet males are mated to blond females. But in the *lar entelloides* subspecies, the situation apparently is exactly the reverse. In the vast majority of troops observed by myself and others in Thailand, mated pairs were either both blond or both brunet. In sexually dimorphic groups (*concolor*, *hoolock*, and *lar pileatus*) males and females are of course oppositely colored in all matings because all adult males are brunet and all adult females are blond.

Dr. Robert van Gulick's book *The Gibbon in China*, mentioned earlier, provides western zoologists with previously unavailable evidence concerning the probable past distribution of gibbons in eastern China, far beyond their present geographic range. This versatile Dutch diplomat's systematic search for references to gibbons in ancient Chinese literature and art covered the period from 1500 B.C. to the end of the Ming dynasty (A.D. 1644). His research indicates that as late as 1,000 years ago gibbons ranged northeastward in China as far as the Yellow River, southwest of Peking, which is about 800 miles northeast of their present northern limit of distribution. The disappearance of gibbons in China during historic times presumably is the result of deforestation of their habitat, which is correlated in China, as elsewhere, with development of advanced agricultural civilization.

The early depictions of Chinese gibbons in scroll paintings are lifelike, detailed, and apparently zoologically accurate. To judge from these paintings, the gibbon that formerly inhabited eastern China was *agilis*, the asexually dimorphic species now confined to Sumatra and northwestern Malaya, 1,000 miles south of China. If this identification is correct, the puzzling geographic history of asexually dimorphic *H. agilis* is one more element that eventually will have to be incorporated into a comprehensive account of the evolution of coat color variation in gibbons.

Although the direction of gibbon coat color evolution now seems fairly clear, at present we are still a long way from understanding the possible function of color variation and the forces of natural selection that may be responsible for its evolution. Perhaps future comparative study of the behavior of gibbon troops which represent different categories of color variation may help to clear up some of the unresolved problems. Of course we can anticipate that new answers will in turn open up new questions. But that is part of what keeps museum zoologists interested in the study of animals and their evolution.

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Were you here?

Members' Nights

May 6 and 7

7,205 members were.

Photos by
Ray Burley
and
Frad Huysmans

Forward and backward glances

Construction, May 11, 1917.

May 2, 1971 marked the fiftieth anniversary of the opening of Field Museum's present building to the public. The Museum had moved the year before from its first home, the Palace of Fine Arts Building in Jackson Park, erected for the World Columbian Exposition of 1893. The moving operation had been both unique and somewhat spectacular because of its size and the nature of the material. When before had anyone seen the head of an elephant riding rampant on the deck of a railroad flat car? The vast collections, exhibits, and library had been transferred to a substantial, carefully designed and elegant new home that fully expressed the ideals, dreams, and best judgment of experienced museum officers and staff.

Three days before, Carl Sandburg, in an article in the *Daily News,* had written under the title "World Wonders are in Field Museum:"

> The navy recruiting slogan for young men is, "See the World." An older admonition is, "See Rome and die." But the one heard most often in this country in recent years is, "See America first." Before starting, however, to see either the world or Rome or America first, a few good long trips around the Field Museum are worth while. The museum has a number of specimens and articles rather difficult to find even in a trip around the world. Also there are a few bits of paraphernalia not to be found anywhere in whatsoever rambles a tourist might choose to make between the equator and either of the poles.

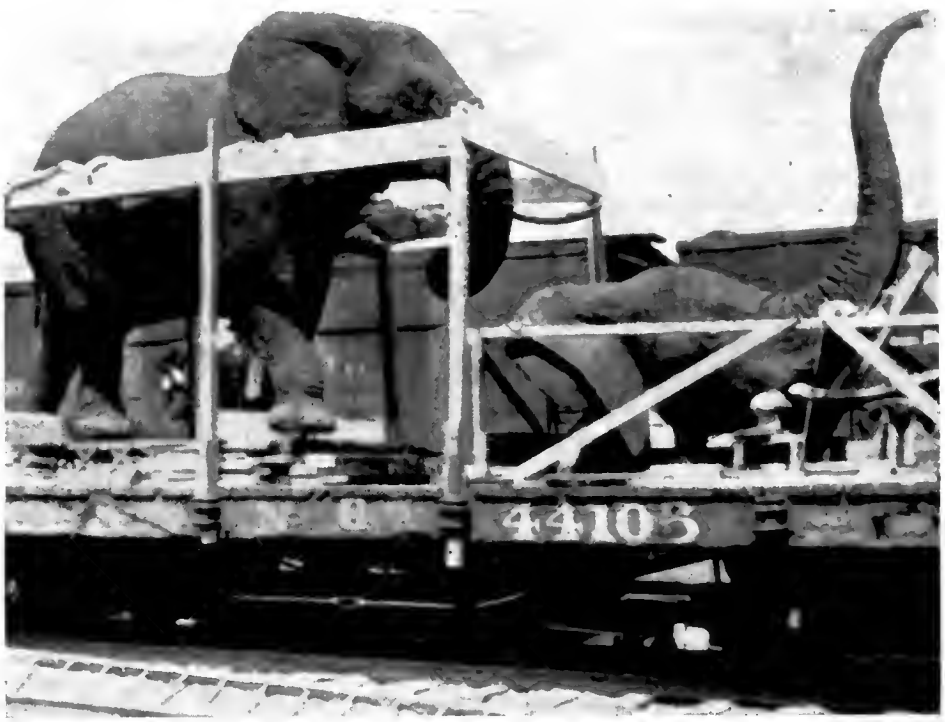
The 8,000 or more people who visited the Museum on May 2, 1921, journeyed over unpaved roads, cinder paths, and board walks to a magnificent white marble building set apart in a kind of no-man's land surrounded by hummocks of ungraded fill containing a great deal of trash and populated by a fair number of rodents. There were no other buildings. Shedd Aquarium, Soldier Field, and Adler Planetarium came much later.

On opening day the exhibits were essentially the same in appearance as when on view in the Jackson Park building. Case interiors were black and crowded with specimens; exhibition labels were black with silver gray lettering. There was a variety of furniture, some of which was obsolete even then. There seemed to be a vast amount of space. Some departments fitted rather loosely in the area assigned to them. The large exhibition halls were intended for daylight illumination. Alternate interior halls on the first floor had glass skylight ceilings. There was no individual case lighting. On dark days ceiling fixtures hardly dispelled the gloom as black case interiors absorbed all available light. There were no built-in habitat groups or exhibition cases.

But almost as soon as the spacious building was occupied, things placed

There were no other buildings. Shedd Aquarium, Soldier Field, and Adler Planetarium came much later.

according to plan, and the Museum once more open to visitors, a new and vigorous growth began like that of a seedling tree in spring. There ensued a period of unusually active field and expeditionary work in all departments made possible by an enlarged scientific and preparatory staff and the generous financial support of a number of individuals, especially Mr. Stanley Field, president, Mr. Marshall Field III, and other trustees of the Museum. Central and South America, Africa and Asia, as well as various areas of the United States and subarctic Canada were the locale of numerous expeditions that resulted in large scientific collections as well as studies and specimens for exhibition. With this impetus an accelerated program in all manner of Museum activities followed—research, publication of scientific reports, exhibitions and education—that continues to the present.



When before had anyone seen the head of an elephant riding rampant on the deck of a railroad flat car?

Along the way numerous changes have been made in the physical plant, in storage facilities and in exhibits. The ground floor, which was largely earthen and unpaved in 1921, was completed and made into exhibition halls, storage and work areas. The flow of steam for heating was radically rerouted by moving the main pipes from the ground floor to the third floor to obtain a more even distribution of heat and to rid the newly created exhibition halls of unsightly pipes. With the exception of Stanley Field Hall, all skylights in exhibition halls have been covered and nearly all windows closed. Exhibits were then individually lighted. Even this change went by stages beginning with incandescent lamps, followed through the years by various kinds of fluorescent lights as technological developments in industry made better lamps available. Now inadequate, obsolete wiring limits progress in further improvements that require more electrical power.

The continuing effort of the staff to improve the content, organization, and appearance of exhibits has produced many changes. There is no exhibition hall in the Museum that has not been renovated at least once since opening day; some have been revised several times. Four large halls have been cleared, the material retired or transferred to other halls, and the space vacated is being used for work areas, the storage of study collections, and for temporary exhibits. The result has been the creation of a number of exhibits for which the Museum is world famous. Likewise study collections and library resources have grown to an importance and usefulness that compel consideration as source material by students and researchers in several areas of the biological sciences and anthropology. Published reports based on studies of Museum materials have added much to knowledge of our world as it was, is, and conceivably as it may become.

Anniversaries invite forward as well as backward glances whether they are taken singly as annual reports or in decades or multiples thereof for the longer view. The slogan of the fiftieth anniversary of the founding of the Museum in 1893 was, "A living museum is a growing museum." Growth in a museum implies change, certain kinds of institutional "growing pains," and outmoding of vesture. A living museum is never finished. It serves its community and the natural sciences as no other social institution can and to continue this service is the purpose and function of Field Museum of Natural History.

John R. Millar is former deputy director of Field Museum and former chief curator of botany. He joined the Field Museum staff in 1918. Although now retired, he works as a volunteer in the care of the economic collections in the Department of Botany.

the campo del cielo meteorite

Edward J. Olsen

When the early Spanish settlers slowly pushed their way into the Gran Chaco region of north-central Argentina, some of them encountered huge masses of meteoritic iron scattered over a large area. The first written report mentioning the find was in 1576 by Hernan Mexia de Miraval, who had found a mass that weighed about one ton. Much later, in 1788, Don Rubin de Celis wrote of finding a huge mass that he estimated to be about 15 tons. So it went through the 18th, 19th, and on into the 20th centuries, piece after piece being found. Pieces over a ton were seen and found fairly readily, but as time went on the newer finds were generally of pieces in the range of several hundred pounds. The last piece of any size was found in 1937—and little of any consequence has been found since. As is the practice with meteorites, all these pieces, which are the broken parts of a single, prehistoric fall, have been named after the local region where they were found—*Campo del Cielo,* "field of heaven" in Spanish.

In 1966 and 1967 Drs. Theodore Bunch and William Cassidy, both of the National Aeronautics and Space Administration, visited the region with modern metal-detecting equipment. They located three additional large pieces, which were buried from view under the soil. These were excavated and one of them, weighing 103 pounds, was crated and shipped to the United States.

To do any research at all on a meteorite specimen it is necessary to cut it open and grind flat surfaces. Very little useful information can be gained from the outside alone. With any large piece of iron there is always the problem of how to cut it. Since most meteorite specimens are under 50 pounds, laboratory sawing equipment is usually small. During a meeting in Virginia in October of 1970 Dr. Bunch asked me if the Field Museum had large enough equipment to cut slices from an iron of this size. We don't. But we thought

International Harvester Co. machinery slices the *Campo del Cielo* meteorite.

possibly the Chicago-based International Harvester Co. might be willing to cut it in their shops where they frequently slice large metal stock prior to machining.

The question was put to Museum Director E. Leland Webber and he contacted Mr. Harry Bercher, chairman of the board of International Harvester. They agreed immediately. Last March we received the crated iron meteorite at the Museum, marked it for the cuts, and sent it on to Harvester's plant in Hinsdale, Illinois.

Slicing up meteoritic iron is generally a bit tougher than slicing man-made steels. Steels are usually chemically compounded (alloyed) to make them harder and somewhat more brittle than meteoritic iron. Also, steels are made of numerous microscopic metal crystals. Iron meteorites, however, commonly consist of only a single huge metal crystal, which causes them to be more tenacious than steels. Consequently meteorites cannot be cut quite as fast as man-made steel. As a rough comparison, it is like the difference between hand-sawing a wet board as opposed to sawing through a crisp, dry one.

A large band saw with hardened steel blades was used first, but the meteorite wore out several such blades. Then a switch was made to a super-hard carbide-tipped blade, which completed the job nicely. We got two good flat slices from the middle plus the two end pieces. The slices were machined smooth on one side so they can be polished and acid-etched for study.

Normally an iron meteorite does not excite so much effort. This one has become a subject of interest because it is not just another common iron meteorite. Several years ago it was found that some portions of *Campo del Cielo* contained, within the metal, masses of stony material which are not like the stony matter that makes up most stone meteorites. Whenever there is the chance of uncovering something different from other parts of our solar system the extra effort is well worthwhile, so this mass of iron was cut with the hope it would contain some of those unusual foreign inclusions. We were pleased to see as the slices came off that each one contained two large stony masses.

The pieces of *Campo,* as the meteorite is fondly called, are now going to permanent homes. One end piece and one slice will be returned to Dr. Bunch at the NASA center in Moffett Field, California. One end piece will go to Dr. Cassidy at the University of Pittsburgh, where he is now located. And one slice will stay here in the growing meteorite collection of the Field Museum, as a gift "for services rendered." The most important services were, of course, rendered by International Harvester Co., and Field Museum owes them a debt of gratitude for their skillful help.

Dr. Edward J. Olsen is curator of mineralogy in the Department of Geology at Field Museum.

BOOK REVIEWS

The Year of the Seal

By Victor B. Scheffer. New York, Charles Scribner's Sons, 1970. 205 pp. $7.95.

The Year of the Seal is a month-by-month chronicle of birth; growth rate; maternal care; breeding; behavior of mature bulls, young bachelors, mothers, and pups; feeding habits of mature seals; and herd social hierarchy.

The story begins in July with the arrival of the "Golden Seal," a female with a rare yellowish coat who has come to bear her pup and to breed again, like thousands of other Alaska fur seals, on St. Paul Island, the most northerly of the Pribilof Chain.

A few days after the whelping, the females are ready to breed again with the mature bulls who had returned to the rookeries in June to fight for breeding territory and await their harem. The pups remain on the island until November, as do their mothers, who until then leave only for periodic hunting trips in the Bering Sea.

The Golden Seal migrates southward in November and remains at sea until her return to St. Paul Island to begin the annual cycle anew. Her pup and other yearlings, no longer sheltered by adults, set out to sea on their own. The seven months from December through June are covered by an account of the adaptive characters of seals which enable them to survive and reproduce: the delayed implantation of the fertilized egg; the migratory route of the Golden Seal; the fish she eats; and the predatory sharks, killer whales, and humans she meets and fears.

The background is filled with interesting facts about commercial sealing, naturalists who devote their lives to the study of seals, the role of the government in controlling the seal fisheries, and the history of native Pribilof Islanders, whose lives are bound up in sealing under the watchful eyes of the United States Fish and Wildlife Service.

An excellent map on the inside cover shows breeding sites and migratory routes to aid the reader in following the story. The line-drawing text figures are adequate, but photographs of the seals and their rookeries would have been welcome. An appendix includes a brief history of seals, their origin and evolution, and a selected bibliography. The comprehensive index provides quick access to a wealth of information on seals.

The author is an outstanding authority on marine mammals. Although guilty of some anthropomorphisms, he uses the facts—many of them of his own discovery—to weave a sound, sober, highly readable, fascinating, and factual story designed for the layman.

by Barbara Brown, volunteer assistant, Division of Mammals, Field Museum.

The White Dawn

By James Houston. New York, Harcourt, Brace, Jovanovich, 1971. 275 pp. $6.95.

James Houston's novel about Eskimos and one early, tragic contact with white men is an exciting, moving tale set along the isolated, windswept coast of Baffin Island, where the author served the Canadian government as an area administrator for many years. .

The narrative begins with extracts from the log of a New England whaling ship that describe how, on a spring day in 1896, several men in a small boat become missing while being towed by a harpooned whale. The scene then shifts to the winter camp of a band of Eskimos who are excited and amazed by the arrival of three strangers, who are near death from starvation and exposure. The families in this camp, led by the elderly and strong-willed Sarkak, a renowned hunter, have heard of such foreigners, whom they believe to be descended from dogs, but most have never before seen such wondrous beings. The three whalers, a sensitive white officer, a black harpooner and a hot-tempered white seaman, are nursed back to health and gradually accepted into the small community of igloos.

Houston's absorbing novel, a Book-of-the-Month Club selection, is based on actual events which have become part of Eskimo folklore. Avinga, a crippled member of the camp who thus cannot participate fully in an Eskimo man's arduous activities, tells the story. Since the Eskimos cannot understand their language, the white strangers are presented only as the Eskimos see them and as Avinga recounts the tale. Yet their personalities emerge as we see them through Eskimo eyes and as they clash, out of ignorance, with Eskimo traditions.

At first, all goes well as the whalers, each in his own way, attempt to adjust to this new, difficult and, at times, totally mysterious life. They form liaisons with willing young girls and this is encouraged by Eskimo hospitality. Eventually, however, misunderstanding and distrust arise out of the pride, greed and lust of both Eskimos and whites. Once these forces are freed, the protagonists careen toward inevitable destruction as carefully balanced interpersonal relations disintegrate and basic conflicts between the two cultures are revealed.

The compelling narrative is set against a background of Eskimo life on Baffin Island that is authentic in virtually every detail. You experience the isolated, self-sufficient world of the Eskimos and rapidly come to appreciate the precarious nature of their existence as they move from spring to fall to winter camps in a never-ending search for food. Hunting techniques, the facts of life and death, entertainment and religious ceremonialism, all are woven skillfully into the story.

At intervals, the artist-author (who introduced the successful marketing of Eskimo stone-carvings to Canadian and American cities, to augment the income of needy Eskimo villages) provides accurate drawings of Eskimo artifacts as they appear in the story. Through his narrator, a sympathetic and sensitive young man, Houston not only evokes the Eskimo life-style, but creates the special atmosphere of a culture where man and nature exist in harmonious balance.

James Houston has given us a dramatic novel—but his achievement is greater than that. He has created a vibrant microcosm within which his characters, Eskimos and whites, enact to the bitter end the tragic consequences of culture-contact whenever it has occurred. For this little band of Eskimos, as it was for all the native peoples of North America, the "white dawn" truly meant the beginning of the end for respected values and meaningful life-ways that were as cherished and deeply rooted as life itself.

by Dr. James Van Stone, chairman, Department of Anthropology, Field Museum.

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FIELD BRIEFS

Hugo J. Melvoin Elected Trustee

Prominent Chicago attorney Hugo J. Melvoin, a partner in the law firm of Mayer, Brown & Platt, has been elected a Trustee of Field Museum. Remick McDowell, Museum president, made the announcement following a recent meeting of the Board of Trustees.

Mr. Melvoin received his L.L.B. from Harvard Law School in 1953, where he was winner of the James Barr Ames award. He is a 1950 honors graduate in accounting from the University of Illinois.

Active in national, state, and local bar associations, Mr. Melvoin is a member of the Executive Council of the Chicago Bar

Hugo J. Melvoin

Association Committee on Federal Taxation and vice chairman of Division A, dealing with estate and gift taxes and related problems.

In addition, Mr. Melvoin lectures to bar associations and tax conferences, including the University of Chicago Tax Conference, the Illinois Institute for Continuing Legal Education, and De Paul University, and writes articles for law reviews. He is a member of Beta Gamma Sigma, commerce honorary fraternity.

Field Museum Building Fifty Years Old

Floyd Catterton of Moline, Illinois and Darrell Sutton of East Moline, Illinois accept congratulations from Museum Director E. Leland Webber (right) upon winning free memberships in Field Museum.

Field Museum celebrated the fiftieth birthday of its present building recently with a public birthday party in Stanley Field Hall. A giant seven-tiered cake, a gift from Burny Bros., was enjoyed by Museum visitors and ten free memberships were awarded through a drawing.

Mr. David Goldberg of Benton Harbor, Michigan, whose name was drawn first, became the 64,397,029th visitor to the present building, which opened its doors to the public on May 2, 1921. The nine other people to win free memberships to the Museum are: Mrs. James Barushok, Evanston, Illinois; Terri Castleberry, Joliet, Illinois; Floyd Catterton, Moline, Illinois; Antonio Cuevas, Chicago, Illinois; Kitty Petry, Delphi, Indiana; Reed Scudder, San Francisco, California; Darrell Leon Sutton, East Moline, Illinois; Lisa Simonson, Chicago, Illinois; and Duane H. Willhard, Springfield, Ohio.

An article by John Millar, former deputy director and former chief curator of botany, recalling the past fifty years in the present Museum building, is featured in this issue of the *Bulletin*.

NSF Grant for Teacher Training Program

Field Museum has been awarded a grant of $47,200 from the National Science Foundation for support of a program entitled "Instructional Use of Community Resources." Its purpose is to help thirty teachers from Chicago public schools design curricula that make use of Museum exhibits as resources.

School use of Field Museum facilities is increasing, and both new and experienced teachers feel a growing need to learn how they can interpret the Museum's exhibits to their classes, and how their field trips to the Museum can be made an integral part of their curricula. Field Museum is assuming leadership in training teachers to prepare pre- and post-field-trip instruction that uses visual aids, written materials, and actual objects or models of specimens from the Museum.

The participating teachers will be selected jointly by Museum staff and Chicago public school administration personnel. Donald C. Edinger, chairman of the Museum's Department of Education, will direct the six-week workshop program, which begins June 28.

Successful Bid for Museum Associate Membership

Mr. and Mrs. William J. Puda, successful bidders for the Museum associate membership auctioned recently on WTTW-TV, learn how plant material is prepared for the herbarium from Botany herbarium assistant Ronald Liesner (left). The occasion was Members' Nights, the once-a-year opportunity when all members of the Museum can go behind the scenes into the scientific research areas. The associate membership auctioned on television was the gift of Mr. Edward J. De Witt of Chicago. It extends membership benefits for life to Mr. and Mrs. Puda.

Children to Hunt Dinosaurs

A Dinosaur Hunt is the Summer Journey for Boys and Girls this year. Perhaps no more fascinating prehistoric creatures ever lived on Earth than the dinosaurs. They roamed every continent but Antarctica between about 200 million years ago and about 65 million years ago, and ranged in size from the largest land-dwelling animals to no bigger than a chicken. Not all are represented in the Museum, of course.

The Journey is designed to let youngsters try to find those we do have, either as actual fossils or in the Charles Knight paintings in Hall 38. A question sheet gives the necessary clues by describing significant features of each animal. When the youngster then locates the fossil or painting, he can answer the questions by studying the specimen or painting.

"Dinosaur Hunt" is Journey number 66 in a series which the Museum and the Raymond Foundation began in the spring of 1955. After a child successfully completes a series of four Journeys, he or she is presented with an award at a special program the Museum holds each spring. Write to the Museum's Education Department for more information about the Journey program and awards.

This summer's Journey runs from June 1 to August 31. Journey question sheets may be picked up at both the north and south entrances and at the information booth near the north door. When completed, the question sheet should be deposited in marked receptacles near the north or south doors. There is no charge for taking any of the Museum Journeys.

New Fieldiana Publications

The following issues of *Fieldiana* have been recently published and are available for purchase from the Museum's Publications Division.

Botany: Volume 34, No. 2. "Re-evaluation of *Syagrus loefgrenii* Glassman and *S. rachidii* Glassman," S. F. Glassman, professor of biological sciences, University of Illinois at Chicago Circle and research associate, Field Museum. Publication Number 1122. $1.00.

Geology: Volume 23, No. 2. "Amphispongieae, A New Tribe of Paleozoic Dasycladaceous Algae," Matthew H. Nitecki, associate curator of fossil invertebrates, Field Museum. Publication Number 1124. $.50.

Zoology: Volume 59, No. 1. "Report on Primates Collected in Western Thailand, January—April, 1967," Jack Fooden, research associate, Field Museum and professor of zoology, Chicago State College. Publication Number 1123. $3.00.

Fieldiana is a continuing series of scientific papers and monographs dealing with anthropology, botany, geology, and zoology published by Field Museum. Prices cited above do not reflect the 30 percent discount available to Members of the Museum. Publication Number should be used when ordering.

New Membership Rates

Effective July 1, new Museum membership rates will be $15 for annual membership and $150 for associate membership. This is the first increase in membership fees since the founding of the Museum in 1893.

Persons who are presently members may renew annual membership for one year at the current rate of $10 or may obtain a permanent associate membership at the current rate of $100 up until December 31. The life membership rate will remain at $500 and contributor membership at $1,000.

Museum membership now totals 20,189.

CNA Foundation Support for Afro-American Exhibit

Visiting Afro-American Style from The Design Works of Bedford-Stuyvesant exhibit in the Museum's Hall 9 are from left E. Leland Webber, director of Field Museum; David Christensen, executive director of CNA Foundation and vice president of CNA Financial Corporation; Mark Bethel, president of The Design Works; Remick McDowell, president of Field Museum; and Anthony Jackson, a director of CNA Foundation and staff assistant to director of personnel, CNA/Insurance.

Silk-screened textiles produced by The Design Works, a new community-rooted company in Brooklyn, are exhibited in conjunction with African art from the Museum's famous Benin collection which inspired many of the textile designs. CNA Foundation provided financial assistance in support of the exhibit.

LETTERS

To the editor:

In the 10 years we have belonged to the Field Museum I am sure that I've nodded off reading the *Bulletin* many times.

Not so with the May issue! It's *great!*

The new format is excellent—contemporary while much more readable. The content and style of writing is suddenly so much more communicative.

And the liberal use of really fine color photography makes it handsome enough to keep on our coffee table for many weeks to show guests.

Someone—most likely you and your immediate staff—deserves to be congratulated and encouraged.

You have done everything right. Add a center-fold "Animal of the Month" and Hugh Hefner will have some real competition in this town!

Thank you.

Eugene A. Peterson
Chicago, Illinois

To the editor:

While on a fossil hunting expedition in our alley, I found this item which appears to me to be a tooth of some kind.

I would appreciate it very much if you can more definitely identify it for me. Enclosed is a stamped envelope, for your reply, and if you don't mind please return the tooth.

Thank you for anything that you may be able to do for me in this matter.

Matt Pesch. Age 9
Plymouth, Indiana

Dr. Eugene Richardson replies:

I congratulate you on finding such a tiny fossil in your alley. I'm sure that most people wouldn't have noticed it at all.

You thought that the fossil was some kind of tooth. When your letter was put before the members of the Geology Department this morning, at least two of the men remarked, "It seems to be a tooth of some kind."

Actually, when we had a look at it with the microscope, it turned out to be a fossil coral. I am quite unable to say what kind of coral, since it is such a small fragment, but coral it is. I suspect that you will find other pieces of coral in the same area if you continue looking, and you will find that hardly any two of them will resemble each other. To begin with, there are many different kinds of fossil coral that can turn up in limestone gravels in Indiana—and then, to make it more difficult, the corals can be broken or dissolved in many different ways.

As you have already discovered, there is a great deal that can be seen if you keep looking, and it is not necessary to go far places to find interesting specimens.

Eugene S. Richardson, Jr.
Curator of Fossil Invertebrates
Field Museum

Matt Pesch replies:

Thank you for your reply. I enjoyed getting it.

When I grow up I want to be a geologist.

It wasn't hard not to see it because I was on my hands and knees.

Then I went out in my alley after I got your letter and found these croinds or what ever you call them for you. Thank you.

p.s. Tell the members of the Geology Department that I say thanks.

Matt Pesch

To the editor:

Following the wave of Congressional support to save the wild horses and burros of Western America from harassment and slaughter, hearings were held in the House of Representatives and in the Senate on April 19 and 20, 1971, respectively. This was accomplished through the efforts and dedication of Senator Henry M. Jackson of Washington, chairman of the Senate Insular and Interior Affairs Committee, and Congressman Walter S. Baring of Nevada, chairman of the Public Lands Subcommittee of the House Interior and Insular Affairs Committee, who had introduced almost identical bills.

Representatives from a large number of interested and affected groups testified before both Committees. Though one would expect widely diverse opinions, nearly all those who gave testimony agreed that legislation must be enacted to protect, manage, and control the wild horses and burros in the public interest and as a symbol of the freedom that is our heritage.

This does not mean, however, that victory will be easily won, for powerful and unidentified opposition surfaced through a few key legislators. That is why *it is so urgent that you continue letting your views be known to the lawmakers.*

If you have not already written to your two Senators asking their support of the Jackson Bill, S. 1116, and to your Congressman asking his support of the Baring Bill, H.R. 5375, please do so immediately so that they will vote for passage when the bills come to the floors of both houses of Congress.

All Senators may be addressed: c/o Senate Office Building, Washington, D.C. 20510

All Congressmen may be addressed: c/o House Office Building, Washington, D.C. 20515

Velma B. Johnston (Wild Horse Annie)
President
International Society for the Protection of Mustangs and Burros

Editor's note:

Patricia M. Williams' article "Canning a Legend" in the February issue of the *Bulletin* called attention to the fact that wild horses are rapidly being extirpated in North America. Many of our readers have since indicated that they wanted to be kept informed of progress toward legislation to help save them.

Please address all letters to the editor to

Bulletin
Field Museum of Natural History
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

The editors reserve the right to edit letters for length.

CALENDAR

HOURS

9 a.m. to 6 p.m. Saturday-Thursday
9 a.m. to 9 p.m. Friday

June 26 to September 6
9 a.m. to 9 p.m. Wednesday, Friday, Saturday, and Sunday

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday

CONTINUING

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world around us, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using specimens from the Museum's huge collections. Through November 28. Hall 25.

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of textiles blending classical African motifs and contemporary design. Artifacts from Field Museum's Benin collection, which inspired many of the designs, are also shown. Financial assistance for the exhibit was received from the CNA Foundation, Chicago. Through September 12. Hall 9.

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day.

75th Anniversary Exhibit: A Sense of Wonder, A Sense of History, A Sense of Discovery, offers a many-dimensioned view of Field Museum's past and present, and some of its current research projects. Continues indefinitely. Hall 3.

A Specimen of the "Glory of the Sea," one of the world's most famous and rarest sea shells *(Conus gloriamaris)*, shown in the South Lounge. Acquisition of this perfect specimen was made possible through the generosity of Mr. and Mrs. Arthur Moulding. Through July 11.

Free Natural History Film "Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturday, and 11 a.m., 1 p.m., and 3 p.m. on Sunday in the second floor Meeting Room, through September. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

DINOSAUR HUNT
SUMMER JOURNEY FOR BOYS AND GIRLS

BEGINS JUNE 1

"Dinosaur Hunt," Summer Journey for Children, acquaints youngsters with prehistoric animals in Museum exhibits and paintings through a free, self-guided tour. All boys and girls who can read and write may participate. Journey sheets are available at Museum entrances. Through August 31.

COMING IN JULY

Free Guided Tour of Field Museum exhibit areas leaves from the North information booth at 2 p.m. Monday through Friday, beginning July 6. A color motion picture, "Through These Doors," focusing on behind-the-scenes activities at the Museum, is shown at 3 p.m. in the Lecture Hall following the tour. Through September 3.

Free Summer Children's Movies at 10 a.m. and 1 p.m. on Thursdays in the James Simpson Theatre.

July 8—"Zoos Around the World"
a visit to some world-famous animals in world-famous zoos

July 15—"Adventures of an Otter"
the delightful story of a mischievous otter

July 22—"Living Jungles"
animals and plants of a tropical rain forest

July 29—"The Red Balloon"
the adventures of a big red balloon and his pet, a little boy

Deerskin Jacket with painted decoration depicting warriors on horseback, displayed in the South Lounge July 12 through September 5. A recent gift of Mrs. Richard D. Stevenson, the jacket was collected by her grandfather, Carter H. Harrison, III, in the early part of this century from the Sioux, probably of the Pine Ridge Agency.

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Field Museum of Natural History

BULLETIN

BULLETIN

Volume 42, Number 7
July/August 1971

Cover: The carbon 14 technique of dating archaeological material invented by Dr. Willard F. Libby is based upon the known disintegretion rate of this radioactive element, which is called its "half-life." New evidence from growth rings in bristlecone pine trees, which can live for thousends of years, confirms the method and corrects the dates.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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Radiocarbon dating—twenty years later

Willard F. Libby

The new method of radiocarbon dating, developed by Dr. Willard F. Libby at the Institute for Nuclear Studies of the University of Chicago, promises to revolutionize dating problems in archaeology. This method determines the age of things that lived during the past 20,000 years by measuring the amount of carbon 14 they contain.

Carbon 14 is an unstable (radioactive) heavy form of carbon with an atomic weight of 14. Normal, stable carbon has an atomic weight of 12. The half-life of carbon 14 is about 5,500 years. This means that an ounce of carbon 14 is reduced by decay to half an ounce in 5,500 years, that half the remainder decays during the next 5,500 years, leaving a quarter of an ounce, and so on.

Carbon 14 is constantly being formed in the earth's upper atmosphere as the result of the bombardment of nitrogen-14 atoms by cosmic rays (neutrons). The carbon-14 atoms thus created combine with oxygen to form carbon dioxide, which becomes mixed in the earth's atmosphere with the vastly greater proportion of carbon dioxide containing ordinary carbon atoms. The carbon 14 then enters all living things, which, through the life process, are in exchange with the atmosphere. This exchange is carried out through photosynthesis in plants. . . .

When a plant or an animal dies, it ceases to be in exchange with the atmosphere and hence there is no further intake of carbon 14. But the carbon 14 contained at death goes on disintegrating at a constant rate, so that the amount of carbon 14 remaining is proportional to the time elapsed since death. Given the carbon 14 content of contemporary living matter and the disintegration rate of carbon 14 (the half-life), it is possible to calculate the age of an ancient organic sample from the amount of carbon 14 it contains.

—from "New Radiocarbon Method for Dating the Past" by Donald Collier, *Chicago Natural History Museum Bulletin*, January, 1951.

One of the first publications on the radiocarbon dating method was by Donald Collier in this magazine twenty years ago. It described in clear, lucid language the newly born physical technique for determining the lapse of time since death of living organisms. Donald Collier and I were firm collaborators during the gestation period and he helped deliver the baby. He served with Richard Foster Flint, the geologist of Yale, Frederick Johnson of the Phillips Academy, and Froelich Rainey of the University of Pennsylvania Museum to guide Dr. Arnold, Dr. Anderson, and myself in the actual research.

Furthermore, he developed the technique of persuading museum keepers that they should give us materials to measure. This was no small achievement since our method is destructive—a sample from the material to be dated had to be burned—and at that early date we were requiring samples as large as one ounce for measurement.

I recall well when he gave us a sample from the deck plank of the solar boat at the Field Museum, the funeral ship of the Egyptian Pharaoh Sesostris III, which we dated at 3,750 years using the half-life we had then adopted of 5,568 years. We now know that the half-life should be 3 percent longer as the result of further studies by others, so something like a century should be added to the time to make it perhaps 3,875 years. I understand that the solar boat is being redated at the Applied Science Center for Archaeology at the University Museum in Philadelphia by Henry Michael, and I am told that a portion of the same plank used twenty years ago and again now is being reserved for future radiocarbon daters who may want to check the age of this priceless artifact.

During the past twenty years several things have happened which have modified the radiocarbon dating method and brought out its latent capabilities more clearly.

A basic assumption which we made in developing the method was that the cosmic rays that created carbon 14 had bombarded the earth's atmosphere at fixed intensity for the last 50,000 years or so, and that we would be justified in assuming that at the time of death the material being measured had the same proportion of radiocarbon content as does modern wood or any living modern material. It has been found, however, that this is not strictly true.

The first hints of discrepancy were disagreements with the Egyptian historians. Dr. Paul Damon at the University of Arizona noted that even with a lengthening of the half-life of carbon 14 from 5,568 to 5,730 years, the dates for the First Dynasty were later than the historians would have them be from their historical records. Of course, their dates were quite uncertain since these records were among the oldest written history on earth.

There was no proof that a correction was necessary until a new development occurred and Dr. Damon and Dr. Hans Suess of the University of California at San Diego and workers at the Douglas Tree Ring Laboratory in Arizona, Wesley Ferguson in particular, applied a new method of checking. This new method assumes that the wood in an ancient tree which constitutes a single ring is itself datable by radiocarbon. In other words, it assumes that the wood has not been altered since the rings were laid down during growth and that, with chemical purification to remove humic acids and other soluble materials, it can be burned and successfully dated by its radiocarbon content. Thus, by systematically measuring the radiocarbon content in ring after ring of trees of consecutively greater and greater age, both living and dead, this new way to check has already been carried back more than

8,000 years. The bristlecone pine trees in California and Nevada, which can live for several thousand years, have provided the material to work with.

We now know that there is a correction to be made in the direction that modern radiocarbon is less abundant by several percent than it was in these ancient times. Apparently at that time the cosmic ray bombardment rate was higher and caused the concentration of radiocarbon in all living matter throughout the world to be several percent higher than today. A 1 percent change corresponds to 83 years, so this amounts to several centuries. A correction curve has been deduced from this tree ring research. With it in hand and used to recalculate the Egyptian problem, we now find that the historical dates fit well with corrected radiocarbon dates.

A second major result is that the corrected dating seems to require some fundamental changes in archaeological evaluation in prehistoric Europe and the Middle East. This result is just coming out in the open, as I learned from Professor Colin Renfrew, of the Department of Ancient History at the University of Sheffield in England. Two lines of thought in European prehistory have come into conflict recently. One adheres to the diffusion explanation for the spread of skills; the other postulates independent invention. The corrected dates at present point strongly in favor of the latter view. In other words, as I understand it, Professor Renfrew is maintaining that even though writing was invented in Mesopotamia and Egypt, such matters as the development of copper and bronze metallurgy may have developed independently and have coexisted in the prehistoric period in several places. Previously it had been thought that metallurgy came first from Egypt and the ancient Sumerian civilization of

A portion of the same plank from this solar boat used twenty years ago and again now is being reserved for future radiocarbon daters.

Mesopotamia to the Aegean and then north and west through the Balkans to the rest of Europe. Likewise, the custom of burying the dead in monumental tombs was thought to have traveled a similar route. But the whole matter is apparently up for reassessment in view of the corrected radiocarbon dates.

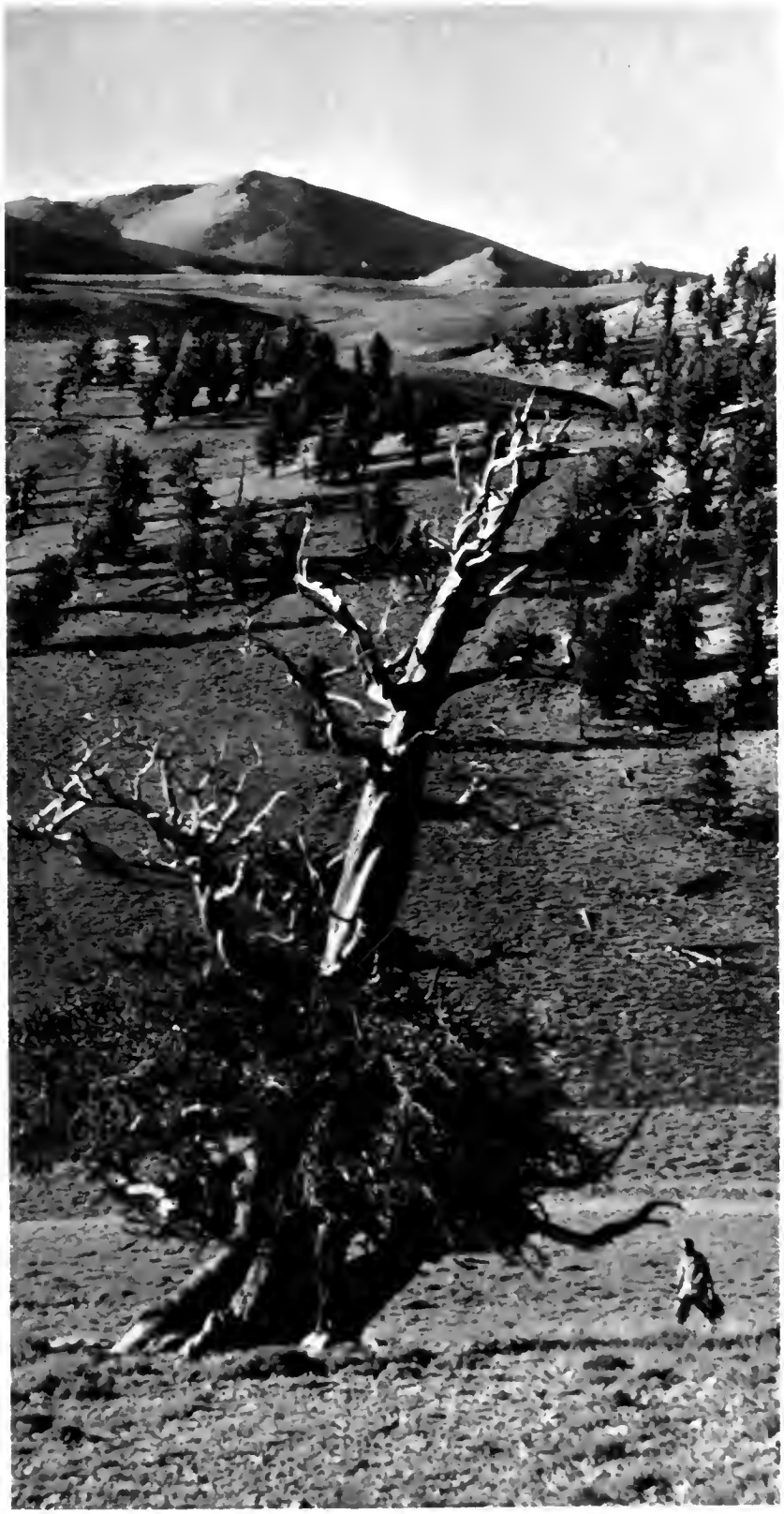
A third point is the value of the corrections themselves for the understanding of geophysical phenomena. Something caused the cosmic rays to vary—and we now have a record of the extent to which they did vary—for the only way the concentration of radiocarbon could have changed was that its rate of production in the atmosphere must have changed. The volume of the ocean is known to have varied only to a very slight extent over the last several tens of thousands of years, and the ocean is the main diluting reservoir of the atmospheric radiocarbon.

There are several possible explanations for cosmic ray variation. One is that Earth's magnetic field was somehow weakened, letting more cosmic rays hit the atmosphere. At the present time about half the cosmic rays which would otherwise hit Earth are deflected away by Earth's field because cosmic rays are charged particles. So if Earth's field became weaker, more would come in and produce radiocarbon and thus raise the modern concentration.

Another possibility is that the sun was somehow less active in emitting solar wind. Studies in recent years with space satellites and space probes have shown that the sun is constantly emitting ionized matter which is racing outward, and cosmic rays are deflected to a considerable extent by this solar wind.

Most cosmic rays originate outside the solar system in an as yet unknown source, so we have the exciting possibility of relating our climate to the deviations if there be a correlation between the total emission of energy from the sun and the strength of the solar wind, which seems entirely reasonable on physical grounds. Of course, such a correlation has yet to be established, but it seems reasonable, in fact almost certain, that such a correlation must exist.
Some evidence has been obtained by studying the magnetism induced in ancient brick kilns which have been radiocarbon-dated. The magnetic minerals in the bricks were oriented in direction by the magnetic field then present when the bricks were last fired. So by studying the bricks, the direction of the ancient magnetic field can be obtained. Its intensity also can be obtained by the intensity of the magnetization, at least roughly. Now, the direction of the magnetic field has little bearing on the question since radiocarbon mixes over Earth's surface quite rapidly, in a matter of a few hundred years, but the intensity is indeed a serious question, as was pointed out many years ago by Elsasser and others. At the present time the source of Earth's magnetic field is unknown, though we have begun to suspect that Earth's field must be connected somehow with its rotation. This suspicion is based on the fact that Venus, which in other respects is very similar to Earth, has no magnetic field and does not rotate. Of course, we know that the rotation of Earth has not changed abruptly in the last several thousand years, so if there was a

A single specimen of bristlecone pine, *Pinus aristata*, growing at an elevation of 10,800 feet in the White Mountains of east-central California. Photo from Laboratory of Tree-Ring Research, University of Arizona.



weakening of Earth's magnetic field, we are essentially in the dark as to the geophysical mechanism.

But the important point is that radiocarbon dating has given an additional set of data on the history of the intensity of Earth's magnetic field, if it indeed can be shown that this is the cause of the variation in cosmic rays; or, alternatively, it has given additional data on the history of the sun. It is difficult at this point in time to know which the true explanation of the variation is, but we have every reason to hope that further research will settle this uncertainty. It may well be that both factors are involved, as Dr. Suess has suggested.

Another benefit which has come out of the twenty years' experience with radiocarbon dating is the clear demonstration of the ability of the physical scientist and the archaeologist to collaborate wholeheartedly and successfully; of the ability of each to learn the other's trade and to understand the difficulties in the other's field. It is clear that interdisciplinary science and interdisciplinary collaboration throughout all fields of knowledge are essential for the problems associated with the protection of our environment, and I take pride that radiocarbon research was one of the first collaborations to demonstrate in modern times that this melding together of specialists in widely different disciplines can be done successfully.

Dr. Willard F. Libby is now at the University of California, Los Angeles, Department of Chemistry, and Institute of Geophysics and Planetary Physics. He won the Nobel Prize for Chemistry in 1960 "for his method to use carbon-14 for age determination in archaeology, geology, geophysics, and other branches of science."

Museology—meeting the relevance problem

Jonathan Taylor

Field Museum was faced with the problem of how to determine what kinds of exhibits would be most exciting for high school students. Many institutions have attacked this "relevance" problem by inviting their audiences to communicate with one another via the modes of communication of those institutions. Newspapers and TV, for example, have been used by high school students to speak to other students. Could this approach be equally effective in exhibition? Field Museum is finding out through a recently initiated program entitled "Museology" which involves Chicago high school juniors and seniors in using the exhibition medium to communicate with other high school students.

The program actually developed from a wedding of a number of related ideas. In October of 1969, Donald Edinger, chairman of the Department of Education, Elizabeth Goldring of the Raymond Foundation, and I started extensive discussions and evaluations around a series of questions: Could we involve high school students in the Museum? How do we produce exciting traveling exhibits for high schools? Can high school students act as consultants for these exhibits? Could high school students be trained to make a museum exhibit? Gradually we came to recognize that all these questions added up to a unique idea for museums. The outcome of our discussions, strugglings, and searchings was Museology.

In January 1970, while we were still refining the plans, six seniors from Francis Parker School came to our Department of Exhibition to ask if they could make an exhibit. The interested members of the Education and Exhibition departments met with the six students in a long, smoky, productive session which concluded with the Museum agreeing to teach a pilot course in museology and the students agreeing to act as guinea pigs for the test run.

Traveling exhibit produced by high school students in pilot Museology course given by Field Museum's Department of Education, in 1970. The exhibit was designed and constructed by Francis W. Parker School students Lawnin Crawford, Hal Gerber, Bill Lawton, Peter Lewis, Steve Prins, and Mindy Schirm.

If the original meeting was smoky, the course was a forest fire in comparison. As with many pilot projects, the time devoted to this one expanded far beyond our expectations, for both Exhibition and Education. The students spent four months trying to refine their own ideas to an exhibitable level, and finally compromised on a spin-off exhibit from the Museum's temporary exhibit "Illinois by the Sea." They rewrote a segment of this exhibit, then designed and constructed their final product. In June 1970, "Death by Crowding," a traveling exhibit designed for high schools, was finished and went on display in Field Museum.

The exhibit then traveled to several Chicago high schools and to Malcolm X College during the 1970-71 school year, and was very well received by both students and faculty. High school students recognize it as a communication from their peers and respect it. An index of this respect is the excellent condition of the exhibit after a year's use—much better condition than one might reasonably expect. It is a walk-in exhibit with every part exposed, yet it has remained completely clean of any scratches or markings.

After the 1970 pilot run of Museology, Donald Edinger and I began some extensive redesign of the course. Objectives were outlined and arranged in sequence, and appropriate instructional materials were written for each step. The final plan for a full school-year course was then considered by various educational agencies in Chicago. The Chicago Public Schools' Programs for the Gifted liked the plan and sponsored Museology for the school year 1970-71. They selected students from a diversity of ethnic backgrounds and from different parts of the city and arranged credit in both Social Studies and Science for the course, which runs nine hours per week. They assigned Mrs. Sue Maxwell to assist me in teaching it, and this past year's experience has prepared her well for teaching any subsequent offerings of Museology.

This second group of students started last October with a complete outline of the course they were to follow. First they observed and analyzed the Museum from a number of points of view: the types of audiences which come here; where most visitors go within the Museum; what disciplines are represented in Museum exhibits and the percentage of exhibition area devoted to each. Each student then studied, analyzed, and evaluated one exhibit by identifying its intended message, writing an audience test, and applying the test to an actual audience to determine the "success" of the exhibit.

The next step was a month of work in a department of the Museum for each

of the students, with two objectives. One was that each student experience directly what working within a specific scientific, exhibition, or educational discipline is like. The other was that each student record and assess the "functions of his particular department on a basis of observed activities" plus any other means he could devise to obtain this information. Three of the students were placed outside Field Museum, two in Shedd Aquarium and one in Adler Planetarium. Following this month of "apprenticeship," the students reconvened as a class to pool their information and construct from that a description of the Museum. This was an important assignment, for the exhibit which they were ultimately to produce must be consistent with the functions and disciplines of Field Museum. The students then wrote a schedule of the sequence of events necessary for production of an exhibit, including defining the limits of a traveling exhibit—size, weight, number of pieces, durability, etc.

Only at this point were they ready to start the long process of painstakingly planning and constructing their exhibit. Following their own sequence, they identified their exhibit topic, researched the subject, wrote the script and labels, got photos, designed and finally built the exhibit. This last segment of the course, the most arduous and time-consuming, takes more than half the school year. For thirteen highly intelligent, individualistic young men and women from a diversity of backgrounds to come to a consensus on an exhibit topic, on design, and on the content of that exhibit might well be one of the most difficult tasks they have ever attempted. But their reward is an ultimate product—a traveling exhibit—that is a very satisfyingly tangible communication of their ideas to other people—in this instance, "the establishing of masculine and feminine roles in contemporary society." To get feedback from this communication, they must also write an evaluation instrument to test whether the exhibit is successful in evoking the intended response from the audience.

Students in the 1970-71 Museology program working on their exhibit. From left to right: Walter Whitford, Lindblom High School; Kathy Gunnell, Fenger; Mrs. Susan Maxwell, teacher from Chicago Board of Education; Alisa Swain, Lindblom; Leslie Biernat, Kelly; Jonathan Taylor, teacher from Field Museum. Students in the class not shown: Robert Brown, Hyde Park; Susan Fleishman, Waller; James Hisson, Kelly; Gail Isenberg, Kenwood; Joan Iwataka, Senn; Judith Nelson, Harlan; Nia Parfenoff, Waller; Felica Shiroma, Senn; Thalia St. Lewis, Tuley.

Our rewards are several. There is the satisfaction of working out an exciting cooperative program with Chicago Public Schools plus the satisfaction of sending contemporary and "relevant" exhibits to high schools in Chicago. In addition, our Museology course can now provide a continuing output of high school students who have had very real and in-depth experience with a museum, and who might seriously consider museum careers as a result.

We would like to see this program expanded in at least two ways. It could be duplicated by other institutions interested in establishing meaningful contact with their high school communities. It could also be broadened within Field Museum to include other educational agencies.

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Editor's note: The Museology course has been included in a compendium of museum outreach programs compiled by "Museums Collaborative," sponsored by the New York Council for the Arts, which will be published this summer. It can be obtained from: Assistant Director, Museums Collaborative, Department of Cultural Affairs, 830 Fifth Avenue, New York, N.Y. 10021.

New pride in black Africa

Phil Clark

Winds of change are creating not only new political and economic forms in the free countries of black Africa—they are also stimulating refreshed creativeness in traditional arts and handicrafts and a new pride in the great mammals, colorful birds, and unique plants of this fascinating continent. This was the stand-out impression of my recent study trip in Nigeria, Cameroun, and Kenya.

The impression was based on the number of new game reserves being established, on the growing official support for traditional arts, and on comments by leading black and white zoologists, a sultan, taxi drivers, men and women in markets, and student youths. Government and private tourism officers stressed the contribution to their developing economies from the increasing numbers of tourists, who are attracted largely by the exciting animal life and local handicrafts. "The independent East Africa governments," says zoologist John G. Williams," are more active in wildlife preservation than the colonial governments were." British born and trained, Dr. Williams is the author of the principal guides to birds, mammals, butterflies, and game reserves of East Africa. (He is a former curator of birds at the Kenya National Museum, Nairobi, and has been in Kenya since 1945.) "The strides forward in conservation made since independence [in Kenya, 1963] are very, very remarkable. The three East African nations have set a good example to all of Africa." Williams added that Nigeria, Cameroun, and Ethiopia are now developing new game reserves.

In part this interest in conservation was triggered by the success of East Africa in attracting tourist dollars. It is also a result of the burgeoning national pride all over free black Africa in the uniqueness of their wildlife and in the attention it receives from travelers and the world's press, Dr. Williams continued. "More important, though, the African is fundamentally interested in nature," he said. "To build on this innate interest, there is an urgent need for introductory books on natural history subjects. That is one of the main reasons I've concentrated on production of field guides." He hopes to publish Swahili editions of his books.

I talked also with James Gathuka Gachuhi, a leading black zoologist, of Kikuyu background, who has worked and studied under Williams. For Gathuka, wildlife is more than a natural resource of economic value; it is a spiritual resource. He is happy over increasing official support for nature preserves, but worried by threats to them. These, I learned, reading the Nairobi press, come from poachers seeking pelts for the European and American markets, from hard-pressed Masai herdsmen whose cattle also need the reserve grasses for food, and from poor squatters who have moved in on some reserve areas.

The study of birds and mammals, in fact of all wildlife, is a way of life for Gathuka. His interest in nature began in childhood, but deeper knowledge came with work in Uganda with a German zoologist and collector of animals for zoos. Later, because of his wife's nostalgia for Kenya—"she said she would go back to her parents"—Gathuka returned to Kenya. There he met and worked under Williams, guiding safaris for persons interested in wildlife photography. He has a sharp eye for birds and mammals, even when their camouflage makes them invisible to the untrained. Knowing their habits, he also knows where and when to find them for revealing, candid photos. With his help, I was able to photograph a nauseated lioness being sick, a pair of lions mating, a gaggle of reticulated giraffes huddled under an acacia tree during heavy rain, and a timid dik-dik peering nervously from thornbushes a few feet away. Progress is real—it seems to me—when the pith-helmeted "white hunter" is replaced by a gentle zoologist leading a photo safari. Gathuka, looking ahead, hopes his son, Gachuhi, will be a zoologist too.

Photos by the author.

Dr. Louis S. B. Leakey, the noted paleontologist, with whom I talked in Nairobi, pointed out that East Africa's great game reserves are vital to newly developing knowledge about animal behavior. This study based on intimate observation of reserve animals is beginning to reveal whole dimensions of animal intelligence that had not been suspected.

In West Africa, my strongest impression is the human—so spontaneous, outgoing, smiling, and colorful. This excitement carries through to archaeology, anthropology, and the related arts, crafts, and customs. The artist Picasso credits an exhibit of West African art in Europe with triggering the whole abstract art movement, so vital were the African sculptures. They are still vital and are helping black Africans to rediscover themselves even as they helped white Europeans to express themselves.

I talked about arts and crafts with the Sultan of Bamoun, El Hadj Seidou Njimoluh Njoya, who visited Field Museum in 1964. Our talks were in the Sultan's capital city of Foumban, set in the sere, red clay hills of middle Cameroun. The Sultan expressed to me his conviction that growth of traditional handicrafts is a key to both cultural and economic development in his Sultanate. Bamoun has for centuries been a source of unique folk art, which stems from the vigorously individual hybrid black Cameroun and Arab culture. With the Sultan's encouragement, a whole street of artisan establishments has sprung up —foundries for the lively brass figures, looms for colorful textiles, kilns for potters, and shops for woodcarvers and furniture makers and those who deal in hides and antiques. Besides providing jobs, pride in local arts, and cash income, the artisan street is intended to draw tourists to this still little known section of Cameroun. So intense is the Sultan's interest in the artisan project that young and handsome Prince Zounedou occasionally takes a visitor to Bamoun personally from shop to shop. He showed me some of the expressive brasses, with pride almost approaching that of the sculptors themselves. These Muslim brassworkers make figures of sprightly musicians, pendant heads of past sultans, and crucified Christs, which, besides having the Semitic features appropriate for Jesus of Nazareth, are vividly the Man of Sorrows.

Traditional dance is another of the arts flourishing in Bamoun. During celebrations at the Feast of Ramadan, which marks the end of the long Muslim period of fasting, I saw at least eight different folk dance groups—sword dancers clashing flashing blades; warriors with feathered headdresses and old muskets which were dangerously discharged at a dance climax; spearmen in a dancing charge.

Prince Zounedou impressed me as part of the new Africa—as did his royal father also. Both were vitally concerned with progress for their land—ruled by the Sultan's line since 1431—but at the same time are equally intent that change not uproot the essential qualities that make Bamoun Bamoun.

In Lagos, Nigeria, that capital of the arts for black Africa, handsome traditional African dress is dominant—colorful flowing robes and many exotic caps and hats. This too is an indication of the revitalized national spirit surging in the arts. No matter what the class—worker, farmer, businessman, government official, or student—the long gown, or at least the colorful shirt, is worn.

At Ibadan and Ife, heartland of the Yoruba, I found carving in the style of the twin figures still being done and some antique figures available as well. The museum at the University in Ibadan, one of Nigeria's most modern, emphasized the Yoruba music, arts, and crafts in its curriculum. And, of course, at Ife Museum it was possible to join crowds of Africans to see the

magnificent and mysterious brass and terra cotta heads, the oldest probably sculptured in the eighth century. These works are as sophisticated as anything created in the ancient worlds of Europe and the Middle East, yet they are an enigma because they are an isolated African flowering of naturalistic sculpture rather than the more abstract style typical of other black African cultures. They include lifelike replicas of the heads of Onis (Ife kings) and members of their courts. The latest were believed sculptured in the thirteenth century.

In the market of Ibadan I delighted in that charming cultural charcteristic so conspicuous in West Africa—the "body talk" that adds to communication a dimension at least as important as the verbal; the conversations are punctuated by the hand-slapping, shoulder-clasping, and hand-holding gestures that maintain a sense of physical communication. This is as true in the lobbies of the prestigious hotels as in the markets—another indication of a people again at home in their own land. It is part of the warm humanness that continues among American blacks —most of whose ancestors came from this part of West Africa.

There is a reverse cross-fertilization evident in Nigerian and other West African popular music: it is clearly influenced by musical styles originating with American blacks, yet has its own uniquely African flavor. While I was in Nigeria, concerts given by the American black musician James Brown were everywhere attracting immense crowds.

Benin, seat of a culture which achieved a high level between the fourteenth to seventeenth centuries, so impressed a Dutch visitor in 1602 that he compared it to Amsterdam: rare praise from a Netherlander of any day. Its art, particularly the carved ivories and cast bronzes depicting the Obas and their warriors, continue to astound art specialists today.

Another indication of the awakening

pride in indigenous culture is the new museum just being completed in Benin City; it is a round tower with a snail spiral exhibit area within, similar to the Guggenheim Museum in New York City.

In the form of wood carving, work in the same and in modern naturalistic styles is coming from the presentday shops in Benin. Here again tourism and local pride, each stimulated by the other, encourage more development, more renewal of old cultural styles, and their evolution into changed but related forms.

Nigeria also has an outstanding literary culture, contributed to by numerous writers of various tribal backgrounds. I was especially impressed by the novels of Chinua Achebe, an Ibo. His *Arrow of God* (Anchor, 1969), which won the New Statesman novel award in 1965, I discovered at a bookshop in Lagos. It is not only some of the finest English prose in contemporary writing, it provides a gifted and lively ethnographic presentation of the Ibos. Like the excellent book *The River Between* (African Writers Series, Heinemann, 1965) by James Ngugi (of Kikuyu background), Achebe's novel tells the story of the shock waves which shook traditional African life with the coming of the white colonialists. It is through such understanding and re-agonizing through what happened to their societies that Africans are rediscovering themselves. Novels of this kind help Africans to evaluate the foreign patterns that were imposed on them and to revivify and continue the evolution of their traditional ways of life.

As a botanist-horticulturist, I was also naturally much interested in Africa's flora. It was thrilling to see many of the wild ancestors of plants which originate in Africa. *Clerodendron splendens*, that flame-flowered vine popular in tropical gardens, grows wild on hillsides in Cameroun. In the lush, heavily forested areas near Benin in Nigeria and in western Cameroun, the stag-horned fern (*Platycerium sp.*) flourishes as an epiphyte on the tree trunks. Several species of *Erythrina* make scarlet patches in the jungle that can be seen from the air. Africa's most beautiful species of this coral tree group, *E. abysinica*, with flame-red balls of bloom, is particularly common at Samburu in Kenya.

It is clear that the African governments are concerned about protecting plants as well as animals. The damage to trees by elephants is sad, though—particularly to the impressive, fat-boled baobob (*Adansonia digitata*). The great pachyderms delight in tearing off the outer bark in order to eat the inner layer. And sometimes, apparently just for fun, they push over these shallow-rooted trees.

Phil Clark formerly directed Field Museum's Natural History Tours. He is now heading his own tour business at 520 North Michigan Avenue, Chicago, Illinois 60611.

ecology & economics

robert f. inger

In olden times—about five years ago—before ecology became popular, it was detined by biologists as the study of the relations between living things and their environment. That typically stuffy academic definition was probably designed to keep the bums out of the park. In my opinion, it is more interesting to refer to ecology as the study of the natural economy of living things. I prefer that definition because the word "economy" often stimulates an idle ecologist into all sorts of wild speculation—he can become for a while an armchair economist. You will soon see where that can lead.

The first part of this article concerns some current ideas in ecology. In the second part a strictly amateur economist takes over and speculates about parallels between these ecological ideas and human economics. My musings will be unfettered by the usual restraints imposed by knowledge. But it's relatively harmless speculation.

Many ecologists devote their research time to investigating the structure of natural communities and trying to understand the factors that account for differences between communities. A natural community is simply an assemblage of plant and animal species that occur together—the group of species that live, for example, in a typical farm woodlot in the Midwest, or in a patch of prairie, or in a lake, or along a rocky coast. These species interact in set ways repeated in all communities.

For example, there is a network of relations in every community called a food web. Green plants produce food, animals feed on the plants, other animals feed on those animals, and scavengers clean up the dead and dying. The food web is part of a system of cycles within a community. Plants convert carbon dioxide into food and give off oxygen as waste, which animals breathe, giving off carbon dioxide as waste, which the plants use, completing the cycle. Chemical nutrients (nitrogen, sulfur, etc.) are also essential for proper growth of plants and animals. All these materials are similarly cycled, with bacteria playing a key role in the process.

The cycles are not perfect. That is (all materials circulating in a given community do not remain within the community. There is some leakage, some movement of material from one community to another, across both space and time.

One community differs from another in various ways. The most profound difference, in the sense that it affects so many other features, is in internal diversity. Diversity, though it can have many meanings, usually refers to the number and relative abundance of species. A cornfield, though it is man-made, qualifies as a plant-and-animal community. It is a very simple one with very few species of plants, one of which is abundant and others not at all (if the farmer is tending to business). Its few species of animals show the same pattern of relative abundance—one or two kinds of insects are very numerous (pests, in fact) and others are scarce. An old, abandoned pasture nearby will have more species of both plants and animals and no single one will be dominant. A hardwood forest in the same area will have still more species of plants and animals and a still more even distribution of numbers.

Communities that differ in diversity also differ systematically in other ways. The species that live in communities of low diversity have higher reproductive rates and shorter life cycles than do the species that live in communities of high diversity. The old pasture has more annual plants than does the more diverse forest, and the perennial non-woody plants and shrubs of the pasture do not live as long as the trees in the adjacent forest. The same patterns apply to the animals in these communities.

In a simple community there is more basic production of food by plants per unit of living material than in a complex, diverse community. Picture for a moment the old pasture at the end of winter—there are a few shrubs and some seedling trees and below ground relatively shallow small roots; the dead leaves and stems of the non-woody plants do not amount to much. Then picture the same field in September near the end of the growing season—virtually all the mass of vegetation one sees was produced that season. The ratio of that mass to the amount of living vegetation present in March is very large. Now, let's go through the same procedure with the mixed forest. By September an enormous mass of leaves has been produced. But the ratio of that mass to the great weight of living vegetation—trunks, branches, and large roots —present at the start of the season is much smaller than the same ratio in the less diverse old pasture.

If we think of the living material present in March as biological capital,

production relative to capital is low in the more diverse community and high in the less diverse one. Very little of each season's production becomes converted into capital in the less diverse community.

The final ecological quality associated with diversity that I want to discuss is stability. Communities of low diversity are less stable than those of high diversity. Although no natural population is constant, those in complex, highly diverse communities experience relatively minor variations from year to year. Populations in simple communities, on the other hand, tend to oscillate radically over short periods of time, and thus be exposed to local extinction. This fundamental difference is related to another feature of natural communities, namely, the existence of feedback systems.

Imagine a community with one species of plant, one species of herbivore, and one species of predator. These three links form a feedback loop. As long as the numbers of herbivores and predators remain within certain bounds, the community as a system will work. That is, enough plants will be eaten to allow room for growth and reproduction, but not too many. Enough herbivores will be killed to prevent them from eating up their food, but not too many. Let one population—say the herbivore (a jackrabbit—get out of balance by a sudden increase, and the feedback loop begins to have an effect. The predator —a coyote (unless some federal agency in its infinite wisdom has poisoned them all)—begins to kill more and its population begins to increase. In a short while the herbivore population decreases, which then causes a drop in the population of predators. If these checks and balances did not operate, the herbivore population would soon increase to the point at which it would literally eat itself out of house and home and the entire population would starve to death. The predator population would then become extinct.

Each successive increase or decrease is not perfectly geared to the preceding change. Consequently, a community that has only a single feedback loop is subject to an occasional over-response by one population that may cause disruption of the entire system. But if a number of feedback loops exist, they may intersect to buffer over-response by a single link in one loop. If, for example, jackrabbits become scarce, coyotes will start concentrating on mice, giving the rabbit population a chance to recover.

Each species has its own characteristic way of life, using certain resources in a particular fashion and providing resources in turn for certain other species. Therefore, the more species existing in a community (that is, the more diverse it is), the more complicated the relationships among species. This is another way of saying that increasing diversity increases the number and connections among the feedback loops. And, as we have just seen, that in turn increases the stability of a community. This is why highly diverse communities are more stable than less complex ones.

Now for the armchair, amateur economics. I hope that everyone who reads beyond this point will keep several things in mind. First, these ideas are tentative. I offer them, not because I think they are "true," but because they are interesting. Maybe a genuine economist can demolish them. But supposing . . .? Secondly, even if my generalizations are reasonably close to correct, there are certain to be exceptional cases. Not even genuine economists can claim absolute universality for their concepts. Finally, I intend no moral judgments in my statements. Of course, like any other person I have feelings about the ways in which people interact. But those are personal matters, and I will try to prevent them from obtruding here.

Human communities, whether we mean neighborhoods or entire cities, differ among themselves in diversity just as do natural communities. One city might be dominated by a single type of industry, say aerospace, as in the case of Seattle. Another might have a number of kinds of industry with no one of them dominant in the sense of being the major base of the community's economic life.

Or suppose we compare smaller human communities. Let's take two samples from a large city, each typical of certain kinds of neighborhoods. And instead of talking about species of plants and animals, we will use occupations to give us a measure of

diversity. Combining neighborhoods, we find production line workers, clerical workers, shopkeepers, managers, lawyers, physicians, real estate brokers, teachers, etc. Suppose that in the first neighborhood almost every employed person falls into one occupation category—the production line worker—whereas in the second neighborhood there is a more even distribution of occupations. The first community has low diversity and the second high diversity. Since neighborhoods differing in these ways differ in terms of average individual income, we can (and usually do) refer to them as poor and rich, respectively.

We said earlier that in natural communities of low diversity reproductive rates were higher and life cycles shorter than in communities of high diversity. And where in human communities do we find high reproductive rates and reduced life expectancy? In the poor ones, the communities with low diversity. Regardless of our feelings about these things, women in poor neighborhoods bear children at an earlier age and tend to have more children than do women in rich communities. Infant mortality rates and morbidity rates from a variety of diseases are higher in poor, low-diversity communities, leading to reduced life expectancy—shorter life cycles.

In natural plant and animal communities we found a high ratio of production to capital associated with low diversity. The same is true of human communities of low diversity: most of the income (the equivalent of production) is expended and converted into things that are consumed—food, clothing, rent—and very little is accumulated as capital—savings in one form or another. On the other hand, in more diverse human communities, the richer ones, a higher proportion of income is converted into capital—savings, stocks, equity in property, etc.

Another aspect of the same relationship is to be seen in the contrast between small businesses operating in the two kinds of communities. It is my impression from personal observation and reading that the ratio of profit to capital investment is higher for most businesses operating within poor neighborhoods than is true for businesses in richer communities. A shop or housing unit in the more diverse, richer neighborhood usually provides more services, more maintenance, and fancier interiors (which reduce the margin of profit) than its counterpart in a poor neighborhood.

More diverse natural communities have greater stability than less diverse ones. Similarly, human communities of high diversity have greater stability. An economic disturbance that hits primarily one industry, say aerospace, will have a far more serious effect on a single-industry community than on one having a diverse economy. The people of Seattle are all too aware of this phenomenon. A country that exports essentially one commodity suffers more frequent and more radical economic ups and downs than a country that exports a variety of commodities and products. It is true that a general recession affects an entire economic network, but the neighborhood or city or country of low diversity is usually affected first and usually experiences more unemployment, more disruption, than the more diverse community.

We do not yet understand all the underlying causes of the economic relationships within and among natural communities. This problem area is increasingly attracting the active attention of ecologists. The concern of these men and women is with a set of problems in basic science. Their motivation is a desire to understand more about the rules that govern nature's economics. If the parallels between natural and human communities stand after close examination, then it will be important for economists (in the usual sense) and ecologists to work together in an attempt to understand the basis of the parallels.

Dr. Robert F. Inger is chairman of Scientific Programs, Field Museum.

BOOK REVIEWS

The Lunar Rocks

By Brian Mason and William G. Melson. New York: Wiley-Interscience, 1970. 179 pp. $8.95.

Whether scientifically inclined or not, one is bound to be at least curious about the results of the costly current Apollo lunar program. Most taxpayers fail to see that the main purpose of the program is simply to demonstrate the successful engineering systems that permit us to send men to the moon and bring them back alive. This was the original impetus and motive of the program—to show that it could be done technically. Thus it is similar in its purpose to the climbing of Mt. Everest, which was done "because it was there."

It seemed desirable to have the men do something on the lunar surface once they got there, and the sampling of lunar rocks was the most obvious something. Originally the geological profession was overjoyed with the whole idea. It could not have been foreseen that years later, when criticism of the cost of the program would arise, the geological results, although secondary in the project, would have to bear the brunt of the scrutiny of critics, who would ask questions like "What are the results worth?" On earth, geologists have always been able to point to practical achievement in petroleum and mineral production. With lunar geology, any such practical results must obviously be lacking.

Be that as it may, Drs. Mason and Melson (both of the U.S. National Museum) have succeeded very well in distilling the thousands of pages of technical data that have been published in several journals on the Apollo 11 and 12 specimens. Their book hits the middle ground between a popularized account of the science writer and a highly technical report of the specialist.

Descriptions of all individual minerals determined in all lunar samples and of the several rock types, solid rocks, microbreccias, and "soils" are treated in detail in separate chapters. Clear comparisons and contrasts are made between the somewhat different rocks of the two different collection sites, 11 and 12. The verbal descriptions are augmented by many well-chosen figures, both graphs and photos. The latter are printed with a very fine screen which makes for excellent definition and detail. Chemical abundances and known isotopic abundances are laid out by increasing atomic number over the whole stable portion of the periodic table. Finally, the several hypotheses regarding the interior makeup of the moon and how it formed as a sister planet to Earth are reviewed and evaluated in the light of the evidence from the rocks.

The book has only a few shortcomings. The puzzling large discrepancies in ages between the solid rocks and the fine-grained "soils" are treated only briefly; there is no discussion of the several theories which attempt to resolve this serious difficulty. The original worry over organic forms and compounds in lunar materials necessitated the elaborate and much-publicized isolation period for both astronauts and samples, but the results of organic studies, though admittedly all negative, are treated only cursorily within the discussion of the element carbon. The geophysical experiments and puzzling seismic properties of the moon are not discussed at all, nor are the interesting thermoluminescent and related optical features.

The book is an excellent distillation of the voluminous geological-geochemical data which make up the bulk of the Apollo reports thus far. It serves as a concise reference for persons in the geological profession, and for those in physics, chemistry, and astronomy who are willing to wrestle with a few new terms. The very astute and deeply involved amateur rock and mineral collector will also be able to glean some useful material here. The general reader, unfortunately, will find it tough sledding, and might do better to go to other books such as *Moon Rocks* by Henry S. F. Cooper, Jr. (Dial Press, 1970, 144 pages, $4.50).

by Dr. Edward J. Olsen, curator of mineralogy in the Department of Geology, Field Museum.

Baboon Ecology—African Field Research

By Stuart A. Altmann and Jeanne Altmann. Chicago: University of Chicago Press, 1970 (publ. date, Feb. 23, 1971). 220 pp. $12.

I would recommend this book to certain kinds of readers as an example of how good scientists think. It is unlike most papers in technical journals today, in which publication costs force editors and authors to eschew tentative models, historical reviews, and educated guesses. In the Altmanns' book, the basic materials are succinctly offered, but are also subjected to statistical analyses, model fitting, and comparisons with general behavioral and ecological principles. Questions for the future are noted throughout the book, and a chapter at the end speculates on a few special topics. The book could be a considerable education to many a student confident that all is known or predictable, and to young researchers unsure of where to start in a field.

I would not recommend this slim volume to the general reader as a comprehensive treatise on baboon ecology, for it is not, despite the title. It is, rather, a detailed technical account of the yellow baboons of the Amboseli Reserve in Kenya and their relations to the environment. Topics covered include population dynamics, activity cycles, group movements, water and food, predators, and other associated animals. A goodly amount of material from the literature on other baboons is sprinkled through the text. The book is essentially a by-product of the main thrust of the authors' field studies, the social behavior of the baboons, an account of which the authors promise will be forthcoming.

Primatologists are apt to finish the book with a highly stimulated appetite for more data and answers. Presumably the authors will provide more material as a result of work following their one-year period (1963-64) at Amboseli that is the core of this study. Since this initial research, the area and the animals have come under a set of stresses that should be most interesting for a long-term dynamic view of the ecology. The stresses include the decimating effects of virus diseases on the baboons and predators, a salt-brush succession in Amboseli with a rising water table, and mounting human environmental pressures, increasingly meaning those from tourism.

The present-day situation potentially could tell us much about limits of the yellow baboon's ecological niche. Presumably the animals do have considerable evolutionary resilience, but a combination of adversities may outstrip their capacity for adjustment. For such a fuller understanding we need further studies at Amboseli comparable to this sophisticated baseline and to complementary work elsewhere (like the investigations of the Transvaal baboons in South Africa by Stolz and Saayman).

by Dr. George Rabb, associate director, research and education, Brookfield Zoo, Brookfield, Illinois, and research associate at Field Museum.

FIELD BRIEFS

Who's Where This Summer

Dr. William Burger, associate curator of vascular plants, leaves for Costa Rica in early July to continue collecting the flora of that country. The expedition is financed by a National Science Foundation grant.

Dr. John Clark, associate curator of sedimentary petrology, is studying biostratigraphic structures and the environment of deposition in South Dakota, Utah, Wyoming, and Colorado. Orville Gilpin, chief preparator, is accompanying Dr. Clark.

Dr. John Kethley, assistant curator of insects, will be conducting field trips in Illinois and the central Midwest area to collect mites found on millipedes. He will also give some lectures at Ohio State University while taking a course there in parasitic mites.

Dr. Paul Martin, curator emeritus of anthropology, is in Vernon, Arizona continuing his "New Perspectives in Archaeology" summer program for high ability college sophomores and juniors, conducted under a National Science Foundation grant.

Dr. Matthew H. Nitecki, associate curator of fossil invertebrates, will be doing biostratigraphic and paleoecologic collecting of Receptaculitids in the Midwest and Southwest in August and September.

Dr. Alan Solem, curator of invertebrates, will attend the Fourth European Malacological Congress in Geneva, Switzerland September 5-12.

Dr. William Turnbull, associate curator of fossil mammals, will continue his collecting of fossil vertebrates of the mid-late Eocene in the Washakie Basin of Wyoming and Colorado.

Dr. Bertram G. Woodland, curator of igneous and metamorphic petrology, will collect data pertinent to the unraveling of the deformational history of a structurally complex metamorphic area in central Vermont.

Dr. Rainer Zangerl, chairman of the Department of Geology, and Dr. Eugene Richardson, curator of fossil invertebrates, will present a paper on paleoecology at the Seventh International Congress of Carboniferous Stratigraphy and Geology at Krefeld, Germany August 23 to Sept. 3.

Enjoy, Enjoy

Summer is an especially good time to see what's happening at Field Museum—special exhibits, films, guided tours. Please take note of our special long summer hours for both the Museum and cafeteria, listed in Calendar. Be sure to bring your membership card. Remember that admission is free at all times to Museum members, their families, and guests.

This is a combined July/August issue of the *Bulletin*. The next issue will be published in September.

Workshop for the Blind

Fifty individuals from the Illinois Visually Handicapped Institute recently visited the Museum to explore some of the artifacts in the Department of Education's teaching collection. They discovered such objects as lions' teeth, talking drums,.and shells. Above, a young lady interacts with a contemporary African talking drum from Ghana. "Thank you," said one of the visitors, "I have never seen these things before."

Atlantic Richfield Gift

Edward J. Gazelle, Manager of Public Relations, Midcontinent Area, Atlantic Richfield Company, shown with Museum Director E. Leland Webber (right) following presentation of a check for $2,500 representing an unrestricted gift from the Atlantic Richfield Foundation to Field Museum.

Atlantic Richfield, a New York based firm, is now active in the Chicagoland area following a merger with the Sinclair Oil Company.

Unrestricted contributions totaling $616,000 are needed by Field Museum to meet its operating budget of $3,919,000 for 1971. This amount is over and above anticipated income from tax support, memberships, admissions, and other available funds.

Phil Clark's Natural History Tours

With termination this summer of Field Museum's Natural History Tours, Phil Clark, who has headed the program since its inception in 1967, will set up his own program, Phil Clark's Natural History Tours, at 520 North Michigan Avenue, Chicago, 60611.

Mr. Clark led tours for Field Museum to Guatemala, Mexico, Brazil, northeast India and Nepal, British Gardens, the Andes and Galápagos Islands, and Scandinavia. He also served as Public Relations Counsel for Field Museum from May 1966 to the fall of 1969. Before coming to Field Museum, he served as Public Relations Officer for the New York Botanical Garden, as Editor of *Horticulture Magazine*, and as Garden Editor for Mexican publications.

He will lead tours for his new firm this fall to South India, and in winter 1972 to Africa, East and West.

LETTERS

To the editor:

As a life member this past year (and former annual one) I get the *Bulletin* and enjoyed the recent issue [March], especially the long article by Paul S. Martin. After reading it and turning thru the rest of the publication, I came to "Fieldiana" by Patricia M. Williams.

Your reference to G. A. Dorsey (whose first name I recall as George) brought back old memories. While he may never have been on the faculty of the U. of Chicago, his name was well known there, especially in the Department of Anthropolgy and related sciences. I took two courses there, between 1910 and 1913, from Frederick Starr, an associate professor since 1891 in that field, who was never made a full professor because, it was generally said, he was more of a character than an acknowledged authority. He had brought some of the aboriginal exhibits to the World's Fair 1893 on its famous "Midway." Maybe that led to his appointment in 1893 and not 1891.

Starr was a lovable man and his wise sayings on innumerable subjects may have been worth more than what he was supposed to teach. His courses were generally considered "pipe" ones, havens for members of the football team, etc. (Shades of hymn-singing Amos Alonzo Stagg!) No one was ever flunked by Starr, and he would stand for everything but downright rudeness by a student. Then he would wither his taunter, but otherwise he would laugh at any honest joke or light flippancy. He gave parties in Haskell Hall at the end of each course (entertainment by himself and volunteer students), and always served cake and ice cream at the end of the evening. The ice cream, made by a local well-known outfit named Morse, was always the same, bricks of five colors and flavors to resemble, as he said, the five races of Man. (I could never figure out more than four.) When he retired in the 1920's, his former students got together and gave him a cash purse of $15,000. No more tangible evidence of devotion was ever shown than that. With the money he bought a home in Seattle, where he lived out the rest of his days. I used to hear from him almost annually, a card sometimes from far places, from the time I graduated in 1913 until near his end. All other former students got the same communications

But to return to Dorsey. He wrote a weekly column in the *Sunday Tribune*, and when World War I started in August, 1914, he analyzed the causes in one of his first articles thereafter. As he put it, it was a struggle between Pan-Slavism and Pan-Germanism. That was from his own particular point of view. Actually, it was a struggle between "Who gets, or wants, what" as Dorothy Thompson was to say in a speech I heard, about World War II. All wars are for such ends, no matter what "idealistic" claims are made by the contenders. We entered World Wars I and II only when they began to hurt us. The Lusitania was sunk in 1915 and we did nothing. Wilson told us to remain neutral. But when our money, already loaned, was seen likely to go down the drain, we got into the fray. The same 25 years later. Hitler's atrocities did not force us in, but his victories and consequent ultimate threats to us. So much for poor old Dorsey and his narrow theories of causes.

Alan D. Whitney
Winnetka, Illinois

To the editor:

As a veteran visitor of the halls of the Museum of many years' enjoyment, I want to compliment you and your staff on the recent improvement of the format of the *Bulletin*. I note from the letters that you have had many compliments, and I affirm that they are well-earned.

For some time I have been holding the March *Bulletin* on my desk as a reminder to write. I first was struck by the brilliant spread on the photography show. I like the calendar—I immediately found what I was looking for—an evening I can meet my daughter at the Museum.

Cliff G. Massoth
Director of Public Relations and Advertising
Illinois Central Railroad
Chicago

Please address all letters to the editor to

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Field Museum of Natural History
Roosevelt Road and Lake Shore Drive
Chicago, Illinois 60605

The editors reserve the right to edit letters for length.

CALENDAR

Exhibits

Begins July 12

Deerskin Jacket with painted decoration depicting warriors on horseback, displayed in the South Lounge. A recent gift of Mrs. Richard D. Stevenson, the jacket was collected by her grandfather, Carter H. Harrison III, in the early part of this century from the Sioux, probably of the Pine Ridge Agency. Through September 5.

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Through November 28. Hall 25.

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of textiles blending classical African motifs and contemporary design. The original Field Museum Benin artifacts which inspired many of the designs are also shown. Financial assistance for the exhibit was received from the CNA Foundation, Chicago. Through September 12. Hall 9.

John James Audubon's elephant folio, *The Birds of America*, on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day.

75th Anniversary Exhibit: A Sense of Wonder, A Sense of History, A Sense of Discovery, uses dramatic display techniques to explore Field Museum's past and present, and some of its current research projects. Continues indefinitely. Hall 3.

Children's Programs

Free Movies at 10 a.m. and 1 p.m. on Thursdays in the James Simpson Theatre.

July 8—"Zoos Around the World"
A visit to some world-famous animals in world-famous zoos.

July 15—"Adventures of an Otter"
A delightful story about a mischievous otter.

July 22—"Living Jungles"
All about animals and plants in a tropical rain forest.

July 29—"The Red Balloon"
The adventures of a big red balloon and its pet, a little boy.

"Dinosaur Hunt," Summer Journey for Children, acquaints youngsters with prehistoric animals in Museum exhibits and paintings through a free, self-guided tour. All boys and girls who can read and write may participate. Journey sheets are available at Museum entrances. Through August 31.

Film and Tour Program

Continuing

Free Natural History Film "Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturday, and 11 a.m., 1 p.m., and 3 p.m. on Sunday in the second floor Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit. Through September.

Begins July 6

Free Guided Tour of Field Museum exhibit areas leaves from the North information booth at 2 p.m. Monday through Friday. A color motion picture, "Through These Doors," focusing on behind-the-scenes activities at the Museum, is shown at 3 p.m. in the Lecture Hall, following the tour. Through September 3.

Meetings

July 14: 7:30 p.m., Windy City Grotto, National Speleological Society

August 11: 7:30 p.m., Windy City Grotto, National Speleological Society

Coming in September

"Between the Tides," Fall Journey for Children beginning September 1, takes them shell hunting for exotic and beautiful specimens in the Museum exhibit areas. All youngsters who can read and write are welcome to join in the activity. Journey sheets are available at Museum entrances. Through November 30.

Hours

9 a.m. to 6 p.m. Monday, Tuesday, and Thursday; Museum cafeteria open 9 a.m. to 2 p.m.

9 a.m. to 9 p.m. Wednesday, Friday, Saturday, and Sunday; Museum cafeteria open 9 a.m. to 7:30 p.m.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday

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Field Museum of Natural History

BULLETIN

BULLETIN

Volume 42, Number 8
September 1971

Cover: Montage of photos taken by Dr. Phillip H. Lewis in New Ireland in 1954 and 1970. Above photo from montage shows strong Western influence on *malanggan* ceremonial art of 1970.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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new ireland:
coming and going 1970

phillip h. lewis

An anthropologist's view of the people he studies is complex. First of all, he comes to them with previously acquired scholarly knowledge of their history and their culture, both material and nonmaterial. Second, the anthropologist has often learned more about certain aspects of their life than many members of the society themselves know. This is particularly true when he has gained an historical view of their culture or a regional overview, neither of which is usually possible for people who live in a small, nonliterate, and isolated society. Third, the personal relationships the anthropologist develops while living with a people may lead to knowledge and feelings that differ from his prior scholarly knowledge and expectations.

For these reasons (and many others) an anthropological field trip is often an emotionally moving, even trying, experience. Perceptions shift as abstractions and personal involvements must be accommodated. Besides this difficult intellectual adjustment, the anthropologist must also adjust from living an urbanized Western life to living in a tiny village in a culture close to subsistence level. During my stay in New Ireland last year I had to make these adjustments and at the same time compare my current observations with my recollections of life in New Ireland in 1954 when I had last been there.

My feelings about these adjustments seemed most acute during two particular periods. One was the first few days of arrival; the other, the last few days as I left to return home. These were periods of heightened sensitivity for me, in that they were like passing through rites of transition between our two cultures.

From January 3, 1970 until December 7, 1970 I lived in Lesu (official spelling, "Lossu"), a village on the northeast coast of New Ireland in Melanesia in order to continue my study of New Ireland art and its social context. I had begun this work in 1953-54, when my wife and I lived in Lesu for seven months. In the intervening years, I had studied collections of art and other cultural objects from New Ireland found in museums in several parts of the world. When I returned to New Ireland in 1970, sponsored by the National Science Foundation and Field Museum, it was with a suitcase full of photographs of those specimens to show to New Irelanders, in an attempt to learn more about this fascinating art and the social and ceremonial system within which it functions.

Karake, left, and Biga, right, performing Pondewasi dance at author's farewell party. Their *kapkap* breast ornements, formerly made of shell, are now made of paper.

New Ireland art consists mostly of fantastic, filigreed, painted wood sculpture representations of human, animal, and supernatural beings, often intertwined with floral designs. They range from relatively simple figures to exceedingly complex multiple images carved on "totem-pole"-like columns to masks and various minor accessories such as dance paraphernalia, musical instruments, canoe ornaments, and house ornaments. All this is known to the Western world through over 15,000 objects in various museums, most of which were collected while New Ireland was a German colony from 1884 to 1914. The majority of New Ireland art objects are in German museums, the largest collection in Berlin's Museum für Völkerkunde, and second largest in Field Museum.

It is too soon to write here of the results of showing the museum photographs. I have yet to complete analyzing the many responses, searching for the meanings of the many different statements about specific objects, sorting out and reconciling contradictions, correlating responses from the various informants and data from the published literature, and relating everything to my ideas of how the whole system worked.

I was also able to observe present-day survivals of the *malanggan* ceremonials (memorials for the dead, for which much of the art was made) and to study social change since 1953 and earlier in my home village, Lesu.

As I drove toward Lesu my feelings were a mixture of excitement and anticipation at seeing the village and its people again after sixteen years and some apprehension about possibly unpleasant changes. I hadn't written ahead, and no one knew that I was returning. I wasn't particularly worried about that—I knew that I could just arrive and be welcome—but I wasn't sure about what temporary difficulties would arise; for example, in the kind of housing I could obtain, and the kind of life I'd have to lead in the first few days. In 1953 I hadn't had a car, and my wife and I had arrived with many cases of supplies on a truck owned by a local villager. We lived in the *haus kiap* (Pidgin for government rest house). By 1970 the system of administration had changed in that the government official, the *kiap,* drove everywhere, making rest houses obsolete. I knew that there was a Women's Clubhouse in Lesu in which I might be able to live, but that had not yet been arranged. I had been in Kavieng, New Ireland's principal town and port, for a few days, where I took delivery of the car I was to use and bought supplies, before heading for Lesu down the East Coast Road.

The road had been built in German colonial times, before 1914. In 1953 it was narrow and barely passable, with deep ruts and potholes. The eighty-mile trip to Lesu then seemed like a day's uncomfortable drive. In 1970, however, I found myself passing the villages of Tandes and Libba (eight and six miles north of Lesu) in under two hours, so improved had the road become.

I drove by these villages I had known thinking the houses looked small and weatherbeaten. Was Lesu going to look

that way, too? I thought glumly of the possibility of Lesu with rusting iron roofs and other unlovely results of "progress." Would the people still be as cheerful and positive and outgoing as I remembered them, or would they have become reserved, withdrawn, sullen, perhaps even hostile? I had seen some signs of that in the bigger towns such as Port Moresby and Rabaul.

Soon I was passing the entrance to No. 2 Lesu (the Catholic half of the village), just north of No. 1 Lesu (the Protestant United Church half). There was the new brick primary school and finally there were the houses of No. 1 Lesu itself. I stopped at the side of the road and looked. Nothing looked as I remembered it. The layout of the village was different and the houses all seemed to have shifted position. Tree-bordered paths had changed to an open treeless plaza. In 1953 many of the houses were raised a few feet off the ground on piles. Now they looked tiny, squat, close to the ground, only a few of them raised on short posts.

I had just traveled through many large metropolitan centers—Honolulu, Auckland, Melbourne, Adelaide, Sydney—and had come from Chicago. In contrast, Lesu looked tiny, its houses seemingly too small to house full-sized people. The houses did seem mostly to be made in the style I remembered from 1953, with peaked, sago-leaf-thatched roofs and split bamboo walls nailed to sapling frameworks. That hadn't changed, although I saw a couple of houses with flat, sloping iron roofs.

I pulled into one of the openings in the low stone wall between the village and the road, unwittingly using the very one I would use often during the coming months, the one leading to the Women's Clubhouse. I stopped the car and got out.

Some people approached, and I began to regret not having written ahead to say I was coming as I scanned their faces, not recognizing anyone. Could they all have changed so that *everyone* was unrecognizable? I began talking in rusty Pidgin English, casting about in memory for names. Faced with a half dozen Lesuans, I couldn't think of a single one. Suddenly the name Biga came to mind, possibly because I had turned into Lesu right where his house had been in 1953. I asked for him. Some children indicated him approaching. It was indeed Biga, tall, spare, bespectacled (nickname, Eyeglass). He had been the Methodist minister of No. 1 Lesu in 1953, and here he came, walking over to see who was coming to visit Lesu. I involuntarily glanced at his eyeglasses, even before greeting him, to see if they were the same pair I had left with him in 1954, when he had complained of poor eyesight and had asked for my spare set. These were different, I was relieved to see. But it was Biga, marvelously recognizable, and as we greeted each other, with tears in our eyes, I knew I was home again in Lesu. Soon other old friends came forward and the welcome deepened. My wife, Sally, and I had been especially friendly with a group of high school boys in 1953-54—Kuba, Karake, Marangot, Emos, and others—and here they were, young men in their thirties.

Where was Sally, many people asked? I showed photographs of my family, which proved to be a favorite subject for the next few days. But the openness, amiability, and hospitality of Lesuans came to the fore. No arguments or recriminations. (Why didn't you write? What were you doing?) They knew it was rather a long time since I had been there, but here I was again and they seemed pleased at the idea.

Other people began to appear, and I began to recognize old friends, especially younger men and women who looked in 1970 not unlike the way they did in 1954. People who had been infants or young children were much more difficult to recognize, as were persons who had been of middle age in 1954.

My perceptions were rapidly shifting. The anticipated difficulties in recognizing the village and the people, in arriving too suddenly and unexpectedly, were fading in the warm glow of friendship and hospitality. I found that I had been reacting to superficialities in the village, the houses, and the people. The village plan had changed somewhat, but was beginning to look familiar again. I found later that the shifting was simply the result of continuous replacement of the ever-and-quickly deteriorating houses. Each new house was built next to the existing old one, which was destroyed when the new one was completed. The houses, which at first glance seemed so tiny and battered, began to assume a more reasonable appearance. They didn't seem so small as I got closer and could measure their size against their occupants, and as the memories of American and Australian skyscrapers began to fade from my mind. Indeed, the whole village was large and spacious, and house sizes and land coverage would compare favorably with many an American suburban town plan. In the days and weeks to follow I could not account for my initial view that Lesu was other than the neat, clean, and beautiful village which it was.

Similarly, my initial perception of the people changed. I had plunged directly into the village, unannounced and unexpected, in late afternoon, when many people were just returning from their gardens and had not yet taken their daily dip in the sea. Many were wearing their working clothes, not their better clothing. Also, before I recognized many people, I had been scrutinizing their exterior appearance in a way one does not see a friend or acquaintance. One does not look at debris or leaves or dirt in the hair or on the clothing or faces of people one

knows. One looks instead at the expression of the face, listens to what they are saying, or notices their gestures. And so indeed did it go. As we became reacquainted, as we began to recall old times and to talk about those not present, my family in Chicago, Lesuans away at school or working or who had died since 1954, we found ourselves responding to each other as people with shared experience. Lesu and its people were beginning to conform to the basic image I had taken away with me in 1954, and which I had maintained over the years—a lovely place, with friendly, warm people.

I asked where I could stay, at least for the night. I was told I could use a room of the Women's Clubhouse as a bedroom, and I saw that the veranda could be used as an office where I could interview people. The room at the other end was in use as a store, but beyond it, on a lower level, was a room which could be used as a kitchen. I was shown the latrine, located on the bush side of the road. The main thing that remained to be done for that evening was to unload my gear and supplies from the car.

Many people pitched in, and in a short time the veranda of the Women's Clubhouse had all my gear and supplies on it. I got out my cot and bedding and set them up in the bedroom. The kerosene lamps were filled to light the fast-approaching dusk, and the pressure lamp was unpacked from its carton and prepared also. What would in later days be accomplished by me in a routine way—filling lamps and stove, checking the various parts and controls of the pressure lamp, keeping house without benefit of running water, electricity, or gas—that first evening all had to be done at once. I felt then what I remembered from 1954, the pleasant feeling of being helped, freely and generously, by Lesuans. The lamps were lighted, some of the gear and supplies stowed away. We turned on the battery-powered radio and tuned to Radio Rabaul, which furnished a background of string-band music. Among the groceries I had brought with me from Kavieng was a case of beer, which I had naively thought to consume slowly during the following weeks. But the occasion seemed to demand otherwise, so I opened it up and it was all gone in a few minutes. In 1953 alcohol had been forbidden to the native population, but that was definitely not so in 1970. So we all sat around and talked through the evening, recalling Lesu of sixteen years ago. A steady stream of people kept coming up to say hello—old friends, and some people I had never seen before.

We agreed that I would pay rent to stay in the Clubhouse, that a shower room would be built at one corner of the house, some guttering would be run along the edge of the roof to catch rain water, and a 55-gallon drum set under it. A garage *(haus kar)* would be built to protect the car, and the latrine would be refurbished. All this was roughly settled in the evening, and I retired to spend my first night in Lesu. I didn't sleep well, what with the excitement of arriving, the new surroundings, and thinking ahead to the completion of settling in so I could get to work.

The next day was Sunday, and since the Sabbath is strictly observed in Lesu, none of the proposed building projects could proceed until Monday. So I spent the day unpacking and stowing supplies and talking to people. Cameras and film were put into tins with silica gel to protect them from the very humid atmosphere.

On Monday morning, the 5th of January, all the available manpower of No. 1 Lesu was mobilized, and by mid-afternoon the car was under a roof and the rest of the construction had also been finished. I hung my bucket shower in the shower room and began to consider the work ahead.

The main task was to begin showing photographs to informants who, I hoped, could tell me something of the objects pictured. Since most of the objects in my photos were collected in German times—that is, prior to 1914—that meant that ideal informants would be people who were adults at that time, who could have seen similar objects (or maybe even the very objects I had studied in the museums), so they would now be almost eighty years old. Secondly, younger informants, people in their thirties to sixties, could know something too, by hearsay from older people or by having seen similar but later objects made and used in ceremonies. The people to look for would very likely be men rather than women, since the men would have been more directly involved with the ceremonials, although women would not be completely ruled out. Women tend to be somewhat retiring in New Ireland society, especially when talking to strange Europeans. The kind of people to be considered first were those called "big men," the Melanesian Pidgin English term for traditional leaders in New Ireland and other Melanesian societies.

Chieftainship is not much developed in Melanesian societies, and in New Ireland very little. Instead, certain men emerge as leaders, to direct work projects, to organize ceremonials, and in former days, in war. Accession to such leadership positions was informal and based on ability and force of personality, qualities obviously not easily transmitted by inheritance. Thus every village had one or more "big men." Sometimes they were the oldest men in a clan; at least, the oldest in a clan would be thought of as the most likely candidates. But if for reasons of personality and ability such a man was unable to muster a following and actually organize and lead the various necessary enterprises, he would not long be thought of as really a "big man," and someone else more able would come to the fore. Thus, seeking out informants knowledgeable about

malanggan—the major memorial ceremonial of northern New Ireland, and the main social context for much of the art—meant seeking out "big men," the organizers and patrons of such ceremonials. Everyone, even children, knew who was a "big man," not only in Lesu and nearby villages, but in far-distant ones also.

I was thus able to set out for visits to other villages armed with lists of names of such men. But then it was often hard to keep them aimed at my photos and problems and to get information about *malanggan* ceremonials and its art. These "big men" varied in their knowledge of the past, and in their attitude toward being interviewed by a stranger. Some were outgoing and eager to share their knowledge, others were suspicious and closemouthed. Some simply couldn't understand exactly what I wanted of them and continued through interviews focused on ideas and knowledge other than what I was interested in. But the main problem was that no one man in any locality really knew very much about *malanggan* in general. Some tended to be concerned with the affairs of their own small areas. Others, not having had much recent experience with *malanggan* ceremonials, had simply forgotten much and were unable to give the kind of detailed information I was seeking.

"Big men" were often deferred to. I might ask to speak to an individual whose name I had, and that person would think that there was another, "bigger" man, or more knowledgeable one, but who was unfortunately not around that day. The man I was talking to would then decline to say much, in deference to the absent expert.

Different attitudes toward Europeans came into play also. Most relationships with Europeans are not close, are frequently suspicious, and sometimes even hostile. It was a rare and very confident New Irelander who could immediately enter into an intimate, knowledge-sharing relationship with a strange European just because he dropped in off the road and wanted to know about *malanggan*. It was possible to get onto such a footing with some individuals, but not quickly or easily. At best, my drop-in visits would produce over-formal but informative interviews. At worst, I was greeted with suspicion, which was manifested by minimum information being divulged.

Carvers were potentially a good source of information, and, indeed, one of the best interviews was with a carver. But so few carvers were around in 1970 that I didn't learn much from them. The few I met were usually more interested in the photos than was anyone else. They seemed better able to appreciate what they were looking at—remarkable examples of art from the past—for they were the men who had actually tried their hand at making the carvings, even though in recent years the resultant works were not qualitatively the equal of earlier work. In contrast, the patrons, although they were more important socially in the organization and implementation of the *malanggan* ceremonies, and although they too were knowledgeable about names and designs of *malanggans,* were not involved with the art objects at the level of form, style, technique, and execution of the objects as art. A patron would leaf through the photographs looking for "his" *malanggans,* while a carver seemed to be more aware of and interested in the craftsmanship of the pieces.

The main part of my research plans yielded less satisfying results than I had hoped for. The quality of informants often turned out to be different from what I had expected, and I found that structuring the interviews around the photographs was both good and bad. It was good when the informant recognized the objects and knew something specific about them. It was bad if an informant felt he had to say *something* when faced with a photograph, whether accurate or not. Most informants had an uncritical view of the quality of the pieces they saw in the photographs. They had seen these art objects only in context—that is, made to order for each occasion, and then destroyed. They had not seen many objects at one time, never any *series* of objects, and so had no basis for making esthetic comparisons. They had never seen a series through time or a series from different areas. Not only did the photo interviews rarely elicit judgments of esthetic or artistic value, I felt lucky if there was mere recognition of motifs. It was all rather sad, that the present-day descendents of the people who had commissioned, made, and used the marvelous art of New Ireland should know so little about it.

Opportunity for another kind of work, which I had little hope of pursuing, loomed far beyond my expectations, however. This was the chance to observe on-going memorial ceremonials for the dead, which are the modern successor to the traditional *malanggan* ceremonials. In 1954, when a person died, he got a Christian burial, and a few days later a concrete slab was poured over the grave as a marker. Then about a year later a *malanggan* ceremonial would be staged which would feature a carved *malanggan* object. In 1970, I found that after the burial the grave marker was not immediately constructed; rather, it was delayed so that its construction and erection took place at the same time as the *malanggans* of the past, about a year later. Also, the 1970 grave markers were constructed in a series of group work projects, each one celebrated by feasts and distributions of food, just as *malanggans* used to be. In fact, the scope of the ceremonies had grown, so that much larger amounts of money, foodstuffs, labor, and cement were going into the new grave-marker system than had gone into the

Christian-burial-*malanggan* system. In 1954 the largest *malanggan* celebration I had seen featured the killing and distribution of twenty-two pigs; in 1970 two different celebrations I saw had seventy pigs each.

I attended all funerals and associated and related memorial ceremonials I could get to. Sometimes I went as a stranger, along with other strangers who came to see the large-scale festivities and dance presentations, but mostly I followed the lead of Lesu people as they frequently were drawn into participation in such affairs by their social and kinship relationships. It was best to go with Lesuans, because I could then better observe and understand the system of contributions of food and money and involvement as it all came alive in terms of real people whose social and kinship relationships I knew. For Lesuans, there was the advantage that if I went along my car furnished transportation, especially for the women, who often had to carry their baskets of contributions to the feasts and distributions for distances of up to ten miles; and then had to bring back heavy loads of distributed foodstuffs. With the increased ownership and use of trucks in 1970, often villagers hired trucks to do that, especially for longer distances, but a free ride was always appreciated.

I had many opportunities to observe this kind of funeral-memorial complex in 1970, the surviving social context of *malanggan,* which, instead of declining, was still very much alive and apparently expanding.

A third kind of study I found myself drawn into was of social change in Lesu itself.

One great change was population growth. Population decline in the Pacific has been a long-term concern for many years, to the point that in the 1920s and 30s there was worry that it was irreversible and that populations were decreasing to dangerously low levels. Not so in 1970. Pacific area populations are now on the rise.

In Lesu the population is now about 67 percent greater than it was in 1954. The increase between 1929 and 1954 was only about 5 percent. However, a dysentery epidemic in 1948 made the population lower than it would otherwise have been. In 1954 it was rare for a family to have more than two or three children, and there seemed to be many childless couples who said that they wanted children but didn't have any. In 1970 there were families with four, five, even seven or eight children, all alive and well, and beginning to make their presence felt in society.

The population increase must be partly explained by better health resulting from better nutrition and medical services. In 1970 general health seemed better and the younger people seemed larger and heavier. A number of years of malaria control and mosquito eradication were apparent, for far fewer people seemed to be suffering from malaria. Increased and more efficient motor transport (better roads, more cars and trucks, and a daily bus service) made the hospital in Kavieng and the several other medical facilities on the island much more available than formerly for treatment of illnesses and accidents.

Another change was that the people of Lesu were wealthier in 1970 because of increased cash crop production. More copra was being produced and sold, cocoa was coming into production, sale of timber was beginning, and there was greater involvement in wage and salaried employment of various kinds. More European foodstuffs are used, such as tinned fish and meat, rice, sugar, tea, and coffee. Consumption of tobacco in the form of cigarettes, trade (stick) tobacco, native grown tobacco, and newspaper (for rolling "cigars") has increased. More European style clothing was worn, such as shorts, shirts, tee shirts, rubber sandals, hats. A number of battery-operated transistor radios were owned and used, also more kerosene (wick) lamps and some pressure lamps were in daily use. A number of people owned bicycles. Three trucks were owned in Lesu in 1970, and a fourth was paid for and on order at the time I left. Considerable amounts of money circulated in the memorial ceremonial system and in bride-price payments, and undoubtedly money was being saved. The local government council has built two large school buildings of brick. A private entrepreneur has built a number of brick houses and a brick church in No. 2 Lesu. The United Church congregation in No. 1 Lesu wants to construct a brick church building, and some individuals would like to build brick houses for themselves.

There was much more interest and participation in education in 1970 than in 1954. The Territory government has spent more money on education, teacher training, and construction. One consequence of the increased level of education is that many Lesuans can speak and read English and are more aware of the rest of the world. The increase in radio broadcasting has also helped to broaden the horizon for Lesuans. On their radios they hear local and world news among other offerings, in Pidgin English, English, and sometimes in their own languages.

Political activity has increased too, in Lesu as well as the rest of New Ireland. The government-appointed native officials of 1954 have given way to elected officials with considerable power over the conduct of local affairs. In 1970 there was much discussion of rapidly approaching self-government and ultimate independence.

New Irelanders thus find themselves drawn increasingly into the modern wider world. In 1954, although they had already considerably changed from a pre-contact condition, they lived close to subsistence level and

knew very little of the outside world. By 1970 there had been a considerable and qualitative leap into the world community. For purposes of my study this meant that they were much further away from the part of their past I was interested in—their art and ceremonial life—but, paradoxically, a flourishing ceremonial life continued.

These changes seem one-way and irreversible. There remain possibilities of various syntheses between the indigenous culture and that of the wider world, so that as New Irelanders push into this world, they may yet retain elements of their traditional culture too.

Thus my work continued through 1970, seeking out and interviewing informants about the old art, attending the ceremonies still carried on, and observing the changes in Lesu society during the recent past. I was living in the present-day Lesu, but my inquiries were aimed at a period from the past, going back from 1970, through 1954, 1930 (when Powdermaker had been there), and to the German colonial period, back to before the turn of the century.

Finally, the last weeks of November arrived and I began to prepare for the return journey—to disengage myself from Lesu in order to go home again.

If my arrival at Lesu had been abrupt and without warning to the people of Lesu, my departure was anything but that. Everyone knew that I was going to leave December 7th. Weeks ahead of time planning started for farewell parties, and various suggested affairs shook down to two: a large general feast and program, and a smaller, private party scheduled by Karake, to symbolize our friendship. In earlier times there were no going-away parties, because no one went anywhere. Now more and more New Irelanders go away from home to work or attend school. To mark such occasions, farewell parties are given, consisting of feasting, oratory, and singing.

The main party began on the evening of November 27th, a Friday, at about 8 p.m., with a string band from Lamussong, a village about eight miles south of Lesu. String bands are a very recent phenomenon in the Territory of Papua and New Guinea, and seem to have sprung up in the wake of spreading radio broadcasting in the area. A string band consists of men playing guitars and ukeleles—both purchased ready-made and homemade of bush materials—plus various other homemade instruments. No traditional instruments are used in these bands. Formal dance presentations and informal participation in the dancing are part of the string band complex. The music is simple but engaging, and the songs are in Pidgin English and local languages and tell stories of love, friendship, and everyday happenings. The dancing looks like a joyous blend of the Twist and the Hula. The Lamussong band played constantly for thirteen hours, joined for a while at night by two other bands. *Tu-lait* (dawn) saw many onlookers departing but the band played till 9 a.m. After one hour's rest the main program began. Feasting, speeches by friends in Lesu, traditional dancing, and food distribution are characteristics of Lesu celebrations and marked this party as well.

On the 3rd of December I had another busy day, delivering the last two crates to the shipper in Kavieng, turning over the car to its purchaser, closing my bank account, picking up my return air ticket, and returning to Lesu on a truck owned by a Lesu man, Patrick De. My friends had urged me to stay in Lesu until after midnight of the 6th and let them accompany me to the airport by means of Patrick's truck. I agreed to do that because it seemed appropriate to leave New Ireland directly from Lesu.

Karake's party was December 4th at his house. It started with presentation of gitts, many for my family in Chicago, especially the children, each gift being offered while shaking hands goodbye. We then had a feast and spent the rest of the night singing songs, which I recorded on the tape recorder. *Tu-lait* was more easily reached this time, it seemed, after the practice at the big party previously. I slept a few hours on Saturday morning, and during the day took photos of people I had missed in earlier photography. On Saturday evening I talked to friends, with the sad feeling that this was the next to last evening I would see them for a long time. Finally I retired to spend what turned out to be my last night of sleep in New Ireland, for Sunday night proved to be far too busy for sleep.

Sunday, December 6th, was obviously the last day for packing, or for anything else. A recurring question was, "Do you think you'll come back another time?" I thought over the elements of an honest answer to that question, such as research possibilities, financing, and the like, and fell back on the lame position that I hadn't known I would come back when I left in 1954, and I did come back, so maybe I would be able to come again in the future. It was suggested not altogether jokingly that my son David (now 13) could come back and live with them as a second generation anthropologist and study their succeeding generations. But none of this talk really convinced any of us that I thought I would be able to return soon.

The problem of disposing of my household gear hadn't really been tackled yet, and as the afternoon wore on, I began to dismantle my living arrangements so I could give away the various items. Through the evening, many people came and stayed with me and helped in the packing. It was not unlike the vigil carried out traditionally for a person thought likely to die. About midnight a group of men

came from Tandes, to shake hands and sing a few songs. They left and I distributed my gear, and finally I was left with only my luggage, and began to await the arrival of the truck to take us to Kavieng.

The truck was to be driven over from No. 2 Lesu at about 3:30 a.m. so that the drive to Kavieng would get us to the airport before 6 a.m. We began to await the arrival of the truck, for at that time I would have to say a final goodbye to the majority of the Lesuans, since only a few would come with me to the airport.

But my sadness at leaving soon began to be replaced by anxiety about the arrival of the truck and the beginning of my fear that I would miss the plane! 3:30 came, but no truck. At 3:45 I began to fear that I would miss the plane. 4 o'clock came and still no truck, but finally at 4:20, headlights appeared and soon the truck pulled up before the house.

We shifted my luggage down the stairs and into the truck. People crowded around to shake hands. Tears were in many eyes, and those who were to come with me climbed in the truck. Sau, one of my best informants and a close friend, was crying openly. Last goodbyes were shouted and the truck pulled out at about 4:30 a.m.

I rode in the cab of the truck, grateful for the chance to be relatively alone. Fortunately Talawe, in the cab with me, chose not to say much either. We concentrated on smoking cigarettes and watching the night-time East Coast Road unreel before us in the glare of the headlights. At about 5:30 we passed a village I knew to be half way to Kavieng, and thus knew that we had a chance of making the airport on time.

At about 6:05 with the sunrise cheerily spreading, at a point about fifteen miles from the airport, we stopped for a few minutes to wash up and toilet some of the children at a nearby beach. Before that the people had been huddled in the open rear of the truck, with their flimsy shirts buttoned up against the wind and they had looked cold and bleak. But now with the tropical sun rising rapidly and the familiar warmth again beginning to be felt, everyone seemed in better spirits. The children scampered back to the truck. We all climbed back in and went on, to turn in at the airport at about 6:40 a.m.

We pulled up to the terminal, I checked my bags and I turned to my friends. We said our last goodbyes and I walked onto the plane.

As the plane took off, and headed south toward Rabaul, I tried not to think of them there waving and watching the plane vanish. I wondered if I would ever see them again. Lesu was so far from Chicago, in miles and in difference in culture. But their lives would go on and so would mine. We would think of each other often, but communication would be slow and incomplete.

And what of my work, what had I learned in a year? That eliciting the past, even the relatively recent last seven or eight decades, is not readily done, that there is much that I don't know of New Ireland art and ceremonial. I considered the work ahead, the task of shaking down, abstracting something significant from the minutiae in my notes. The still functioning memorial ceremonials, the new-style cement grave markers, could be considered to be part of the system of art and ceremonial. Also my corpus of photos of museum specimens provided evidence that there really had been a rich and fantastic world of art in New Ireland and that it had flourished as recently as forty years ago.

Their new interests and activities such as politics and cash cropping were signs of New Irelanders "emerging" into "our" world and away from their traditional culture. My feelings were mixed about that; I hated to see the riches of the traditional past abandoned, but on the other hand the people of New Ireland liked many aspects of their new life, and I shared their pleasure.

The plane angled away from New Ireland, and the island shrank in size so that what I remembered of the luxuriant vegetation, dotted with peaceful villages of calm and pleasant people faded away in the distance into misty blue shapes. The petty routines of air travel began to assert themselves. I thought ahead to the transits through the various increasingly large and complex and bustling air terminals, Rabaul, Lae, Port Moresby, Brisbane, Sydney, then Honolulu, Los Angeles, and finally Chicago. In 9 hours I landed in Sydney, and in about 17 hours more at O'Hare Field in Chicago. I thought of the problems of lag of one's biological rhythms after being hurled thousands of miles from the other side of the world, but knew that such adjustment was going to be much, much easier and quicker than learning to adjust to living away from Lesu.

SUGGESTED READINGS

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Why was William Jones killed?

Barbara Stoner

William Jones was born March 28, 1871, on the Sauk and Fox Reservation in Oklahoma. His mother was an English girl, Sarah Penny; his father, Henry Clay Jones, was the son of a Fox Indian mother and an English father who had gone west with Daniel Boone and fought in the Black Hawk War. William Jones died in April of 1909, killed by the Ilongots of Luzon in the Philippines, while on an anthropological expedition for Field Museum.

Sarah Penny Jones died when her son was one year old. Henry Milner Rideout, in his biography *William Jones* (1912) quotes him:

"My dear old grandmother used to tell me that I was born in the springtime, when the bluebirds were coming from the south and were looking about in the dead trees for holes to build their nests in. Grass was just coming up, and with it the flowers. She used to tell me how she would carry me about, and a whole lot more things which I sometimes live over, though more often they seem but a tale. Then the summer went by, and the winter followed, and the next spring they laid my mother to rest. This is the way she recorded time, and that is the way it has always come to me."

Jones lived with his grandmother, Katiqua, a "medicine woman" of the Fox tribe, until her death when he was nine, and it was from her that he first heard the legends he was later to collect. He then lived first with his father's new family and later with his mother's people until his father sent him to an Indian boarding school in Wabash, Indiana, maintained by the Society of Friends, for three years. There followed three more years as a cowboy on the Great Plains, a period which ended with the spring round-up of 1889 when Jones was 18. After schooling at Hampton Institute in Hampton, Virginia, he went on to the Phillips Andover Academy in Andover, Massachusetts in 1892.

Jones began his career at Andover with an idea that he might study medicine and go back to his people as a healer. The idea remained just that. He graduated from Phillips Andover in the spring of 1896 and spent that summer with his father canvassing the tribes of the Great Plains for students to send to the Indian school in Carlisle, Pennsylvania. In the autumn of 1896 he began his studies at Harvard.

One of his first mentors at Harvard was F. W. Putnam, Peabody Professor of American Archaeology and Ethnology, and under Putnam's influence, Jones' thoughts about the future turned more and more away from medicine and toward Indian ethnology. Every summer was spent on the western plains, collecting stories and observing and noting down customs and festivals.

Recommended by Putnam, Jones entered Columbia in the fall of 1900 and became President's University Scholar in his first year. He received his A.M. degree in June of 1901. In July he was appointed University Fellow in Anthropology for the following year under Franz Boas, then Professor of Anthropology at Columbia, as well as Curator of Anthropology at the American Museum of Natural History. During the summer Jones again did field work among the Fox and Sac, and on returning to New York announced his engagement to Miss Caroline Andrus, of Hampton, Virginia.

The summers of 1902 and 1903 were spent in field work and on June 8, 1904 he received his Ph.D. degree. Summer of 1904 found him back on the Great Plains, but the following year there was no further work among the Indians. He was ready now for permanent employment in his chosen field and had wanted very much to go to Labrador to work with the Naskapi Indians, but no positions in this direction were open. In 1906 Dr. George A. Dorsey of Field Museum offered him his choice of three expeditions: to Africa, the South Seas, or the Philippines. He chose the Philippines, and in June of 1906 Dr. William Jones came to Chicago.

Rideout quotes Jones on the city:

"You know, . . . the part of the city I am in is like an inland country town with lots of open air and space; and so I never go down town into the dust, cinders, rush and noise, only when I have to. The Museum, you know, is on the Lake. There are green plots, with trees often. For example, a maple comes up to my window. To smoke I must go out of doors, which in one way is a hardship, but in another is quite a recreation; for the lawns and groves and lagoons, and big Lake are all there."

At that time the Museum was housed in its original quarters in Jackson Park, now the Museum of Science and Industry.

Jones made a last visit to the Great Plains in the summer of 1907, then said goodbye to his friends and Miss Caroline Andrus, and sailed from Seattle in August on the *Aki Maru* bound for Manila.

His route from Manila lay, according to Rideout, "round the north end of Luzon, by sea, to Aparri at the mouth of the Cagayan River, in Isabela Province; thence up the river, southward, among the hills and the wild hill-people." Jones' diaries and letters, now in the archives of the Department of Anthropology of Field Museum, tell the rest of the story.

Reaching Echague on the Cagayan River in November of 1907, Jones spent the rest of that year and the early months of 1908 investigating the area around Echague and making preparations to go upstream to the country of the Ilongots.

The Ilocanos living in the Echague region were at first less than cooperative. In March of 1908 a head was taken, and Jones photographed the headless body, which was in a cave. April 6 he wrote of the Ilocanos: "These people here are also warning me not to go to the Ilongots, saying that we are going to certain death." And later: "The Ilocanos here are pretty badly scared; they fear lest the Ilongots come any time to attack them."

Right, William Jones, photographed in Chicago, 1907. Left, three Ilongot men taken into custody for the murder of Dr. Jones.

The Ilocanos were acculturated migrants from the Ilocos province and were no longer headhunters. They depended upon the constabulary for protection and did not make retaliatory raids against the Ilongots. On April 9 a military expedition against the Ilongots was undertaken by the constabulary in connection with the missing head. On the 11th the soldiers returned, having set fire to a deserted village and seen no one.

On April 15, 1908 Jones was at last on his way upstream to the country of the Ilongots. The next day he reached Dumubatu, and here he first encountered the people with whom he was to live for the next year. "At present everything looks extremely rosy. The people have fetched me rice, camote [sweet potatoes], chickens, and honey in bamboo tubes. I am sharing this food with my Christiano Yogads, and the Ilongots who gave it have invited themselves to help eat it." The Ilongots complained somewhat about soldiers but were not unpleasant about it. Here he first observed the way the Ilongots made a formal contract—by each party tying knots in a string called "bitäls." The making of this contract or promise was referred to as "making bitäls."

Generally, Jones got on well with his hosts, and always referred to them as his "friends." Jones ate with them, slept with them, and hunted with them.

> Do you know the wild carabao, sometimes called the wild buffalo? That animal offers the best sport of anything out here. It is a fighter all the time, will often give chase like the grizzly on general principles. It's all day with a man if he wounds one and the animal is between him and a tree or a place of refuge. I had the great pleasure of killing a whopper one day. It would take pages to tell of the thrilling joy an Ilongot and I had in doing it.

His diaries are full of descriptions of the appearance and behavior of many individuals, and it is clear that he saw them and valued them as individuals. Through most of his stay with the Ilongots Jones exhibited kindness and a willingness, if not always the ability, to understand. For the first few months his diaries relate almost daily his observations of near-nudity and the open performance of natural functions, as well as of the bantering back and forth on sexual subjects. He did not judge this behavior, but the frequency with which it is mentioned in the diaries suggests that he obviously needed to adjust to it. Only when the behavior of the Ilongots infringed on his ability to carry out his work and made frustrating demands on him did his discipline break down and cause him to make mistakes.

After leaving Dumubatu, he spent some time in the hamlet of Panipagan and then left for Kagadyangan. Panakat, headman of Panipagan and his former host, was much put out and begged and bribed Jones to stay. Jones, however, insisted on going and was made welcome in Kagadyangan in the home of the headman there, Takadan.

Wherever he went, the Ilongots soon became jealous over every little gift Jones made, and they were also jealous of his attentions to the sick. As soon as one person was given an ointment or medicine, a dozen others developed the same symptoms. On July 4 a man whose arm Jones had treated previously died, apparently of heart failure. Jones went back to Panipagan to examine the body at Palidat's house, and explained that the medication had had nothing to do with the man's death. The explanation that the man had died of too much basi (a local wine) seemed to be accepted, and on the advice of Romano (Jones' manservant) Jones returned to the house of Takadan. On July 7 he wrote: "I find that I had made a big mistake by coming away from Palidat's when

I did." The mistake is not clear, but it seems to have had something to do with etiquette. As we will see, a man named Palidat is mentioned by Rideout as the one who struck the first blow when Jones was later attacked and killed. It is probable, although unsubstantiated, that this is the same man.

The year was wearing on and Jones' patience was wearing thin. He began to make more mistakes, lost his temper more often, and tried to teach the Ilongots "lessons" in ethics. On July 29 the following incident took place when a man did not like the comb Jones had given him as well as one given another man:

. . . I told the people what I thought of Magiern, that instead of being a man he was yet a little boy; that though he was the son of Käpunwan—leading man—yet he did not know how to act like one; that he threw the comb at the teniente (Palidat) as he would a stick at a dog; and that his whole behavior was most unbecoming even of a good man, not to mention that of a Käpunwan. The father, uncle, Gatma and others at once came forward offering excuses, saying it was only a joke, just for fun. I refused to take it as such.

On August 25, 1908 Jones wrote to Dr. Franz Boas:

I am writing from the country of the Ilongots at a place in the mountains of Southern Isabella . . . an Ilongot district called Tamsi . . . There is a nominal peace among the four districts, but it is not of a kind to establish much confidence . . . The Ilongot easily gives expression to his emotions . . . I have seen little that would make me think that they ever steal. But they lie as easily as they breathe . . . They say it is nothing, that it is the way with all men everywhere . . .

"Lying" occurred mostly in terms of time. The Ilongots had a poor sense of time in the Western sense. Theirs was a day-to-day existence, and the importance of meeting on the river bank with banquillas (dugout canoes) by such an hour on such a day was a concept which they poorly understood.

Further light is thrown on Ilongot lies to white men by the entry for Friday, October 2, 1908: "Inamon [headman of Tamsi] has explained to me why he lied to Captain Bowers. First concerning the trips to Panipagan and Kagadyangan. Inamon said that the Captain was anxious to go there, and when Bowers asked him if it would be all right to go he gave him the answer he wanted to hear; that the Captain did not care to hear anything else . . ."

Jones visited other Ilongot settlements, although he did not become as well acquainted with the inhabitants of those villages as he did at Dumubatu, Panipagan, Kagadyangan, and Tamsi. His diaries contain many pages of ethnographic descriptions of houses, tools, procedures and living habits. He was always bothered by begging. The people were very jealous over his presents to them and tried nearly every trick at their disposal to obtain as much as they could. It is quite understandable that they would. It must also have been a terribly frustrating situation for Jones to deal with.

The next few months were spent visiting and revisiting the Ilongot villages, making notes and gathering material for the collection. On February 25, a last letter to a friend ends on a wistful note: "And may the Lord be merciful to your sinful soul, and bring you safe to Manila, where we can open a cool bottle and another in memory of other days and of friends 5,000 miles or more away."

Rideout's biography states: "Balsas—bamboo rafts—were needed to bring Dr. Jones and his ethnologic freight down river to the friendly huts at Dumubatu and the Christiano town of Echague. Two hamlets, Panipagan and Kagadyangan, had promised and failed to bring these balsas, had promised again and failed again . . ." Jones' patience grew even shorter. On Friday, March 26, 1909, he wrote from Dumubatu of the promised balsas: "If they fail to show up then on the morning after I will go up to Kagadyangan, and if I go I will make Kagadyangan pay for it."

Sunday, March 28: "Sibley got away this noon. Before he departed, I had him and the Ilongots make a bitäl to meet at Inamatan 10 days hence; they are to leave with me four days from now for Echague . . ."

Monday, March 29: "Nine balsas have come and the men have lashed them together in pairs. The number is hardly enough, but it is about all they have. I may be compelled to go on to Panipagan after all to get other balsas and men."

Wednesday, March 31: "The up-river people have not yet arrived, and now it looks as if I shall have to go after them."

Rideout's biography gives March 29, 1909, as the date of Jones' death. However, the last entry in Jones' diary is dated April 2, 1909. It reads:

It rained far into the night and drizzled awhile this morning. About 8 o'clock it began to clear and at 10 the sun was out. By that time I was on way to Panipagan where I am now. I got Pascual's banquilla and Gonuat and R. poled. At Sanbei I ran into Panakat and 5 of his men. They had been hunting across the river and were probably about to return home. I went ashore and called for them to come down. They knew why I had come and were at first slow about coming. I then went up to a man who continued to work and got behind him. This fetched them all down to the water.

Then I told them in sharp language what I thought about people who lied to me as they had done, that they had better not return but go on down to Dinnabatu [sic] where I would see them tomorrow.

Then I had Panakat get in the banquilla and come on with us to his town. We arrived here about four or little after. Immediately upon my arrival at Cipdut's house I sent for Takadan and Magin to come this evening. In a couple of hours Takadan arrived. A heavy shower was pouring at the time. I then lashed him with my tongue. I tried to shame him for lying to me, for making bitäls with me and not keeping them, for ignoring my requests which he said he would fulfill, and so on. Then I told him to send runners through his district and bring me six balsas and six men by tomorrow forenoon; that if the balsas were not here I would take him down the river with me. He tried to persuade me to let him go home and urge his people to comply with my

Photograph taken at Tamsi, Luzon by Dr. William Jones. Adults in foreground, left to right, Wipat, a hunter from Dumubatu; Takadan, headman of Kagadyangan; Inamon, headman of Tamsi.

wants, but I told him he had lied to me so often that I could not believe him any longer. I told him to go sit down and not leave the house until I gave him permission to do so and to send anyone he wished to carry messages to his people. Tolan was in calling distance and he went off in the rain and gathering darkness with what I had told Takadan.

The next day, according to Rideout, a man named Palidat, "whom Jones had cured of a sickness," drew near, "patted the doctor on the shoulder, and smiled. 'We shall bring more balsas to-morrow,' said he; and at the same instant, reaching swiftly, drew his bolo" and struck Jones on the neck.

Jones' life might have been saved had not his holster flap been fastened. While he was struggling with the button, he was slashed across the arm and then given a mortal spear wound below the heart. Gonuat and Romano Dumaliang, his faithful servants, helped fight the Ilongots off, and eventually were able to get Jones on board the banquilla and push off. Poisoned arrows shot after them as the Pung-gu rapids caught the boat and hurled them downstream. Dr. Jones, still conscious, helped bind the wounds of his companions. Upon reaching Dumubatu, Romano, according to Rideout:

following orders, went up among the hovels and called the people, who came down to the shore and set a guard roundabout; for the doctor's only fear had been that those Ilongots up-river might descend and take his head. About an hour later, Romano put some question to his master, who lay still in the boat. He received no answer. Jones had quietly closed his eyes forever, while the great stream ran silent underneath him and tropic stars burned overhead.

Dr. William Jones was buried in the Municipal Cemetery at Echague. His murderers were captured, tried, and sentenced to death by the Court of First Instance, given clemency by the Supreme Court of the Islands, and allowed by their native constabulary guard to escape. Field Museum assistant curator of anthropology S. C. Simms went out to Luzon to collect the results of Dr. Jones' year and a half of work. Mr. Simms also provided for a suitable monument to be erected at the spot where the body of Dr. Jones was buried.

Why was Jones killed? The evidence does not point to much premeditation, although the decision to kill him may have been made when Jones detained Takadan. Jones had been understandably irritated. Travel conditions in 1908 were not such that he could get down to Manila for a weekend respite. He had spent sixteen long and arduous months with the Ilongots. He had lost his temper before with no serious repercussions. But Takadan was an elder, and the Ilongots had a great respect—almost a reverence—for their elders. Jones, in his impatience to get downstream to Aparri, on to Manila, and then home to his fiancee and his work among the Indians, may have overstepped his bounds, crossed a line which no Ilongot could let go unrevenged. The Ilongots lived in a world of violence. To kill and take a head was a sign of manhood, a sign of a great warrior. Ten years later may have made a difference in their reactions—or in Jones'. Perhaps it was simply an impulse—an old grudge, a new provocation, a quick strike, and then death. It was over. Perhaps we'll never know.

Artifacts from Dr. Jones' Luzon expedition may be seen in cases 20 and 21, Hall A, on the ground floor of the Museum. Thanks go to Mr. Christopher Legge, custodian of collections, and Dr. Donald Collier, curator of Middle and South American anthropology and ethnology, for their help in researching this article.

Barbara Stoner is a member of the staff in the public relations office, Field Museum.

BOOK REVIEWS

The Moths of America North of Mexico, including Greenland. Fascicle 21, Sphingoidea

By Ronald W. Hodges. London: E. W. Classey & R.B.D. Publications, 1971. 158 pp. $24.00.

The first fascicle of the proposed 14 volumes of *The Moths of America North of Mexico, including Greenland* is now available. Hopefully, in a few years the monumental task will be complete.

Aside from numerous articles and monographs dealing with restricted families, genera, and species, there has previously been only one general treatment of North American moths—*The Moth Book,* by W. J. Holland, published in 1905, long out of print, and only recently reprinted in paperback form. This included mostly common species and selected representatives of various families and genera. Although Holland's work was in itself an enormous undertaking, it was incomplete and quite difficult to use. But it was the *only* comprehensive work available. That is, until now.

There are more than 10,000 species of moths in the fauna of America north of Mexico. Every species, as well as major polymorphic forms and subspecies will be illustrated in full color. But the series will be much more than merely a pictorial presentation. The text will consist of a synthesis of all revisionary studies up to the time of publication. New genera and species will be described. It will be in essence a revision of the moths of this region. Information on the biology, ecology, and distribution of the species will be included. The mere thought of such a comprehensive, definitive series boggles the mind.

The Sphingoidea are the subject of this first unit of the series to be published. These moths are also known as Sphinx Moths, Hawk Moths, or Humming-bird Moths to name a few. These are medium-sized to large insects that frequent flowers at dusk or twilight. Most of them look a great deal like hummingbirds when they are feeding, since they hover in front of the flower and extend their proboscis deep into the blossom for nectar. The larvae are quite robust in shape and are voracious feeders. All of us who have grown tomatoes in the summer have probably encountered tomato hornworm larvae contentedly munching away on our plants. The name "hornworm" comes from the fact that most of the larvae have a conspicuous spinelike process or horn on the top part of the eighth abdominal segment.

If this first fascicle of the series is representative of the volumes to follow, lepidopterists have a great deal in store for them. The treatment of the 115 species and 40 genera of Sphingoidea by Dr. Hodges is excellent in all respects. The higher categories are given in outline form, with separate keys to the genera based upon adult, pupal, and larval forms. Keys to the species based upon the adults are given in the respective genera. In instances of sexual dimorphism, both sexes are delineated in the species keys. All species are illustrated in color photographs that have a very high degree of fidelity to the specimens. Although subspecies are figures in the plates, they are not delineated as such in the legends. It is necessary to turn to the text for a discussion of these forms. Key characters are illustrated for many of the species with line drawings. Technical terms are fully explained and illustrated in a section on structural features following the color plates. Many references to more specific works are given at the end of the work. In addition to the taxonomic treatment, Dr. Hodges gives information on the distribution of the species and their relative abundance, and in many cases lists known larval food plants.

The work was designed for use by both the professional and the amateur entomologist, as is obvious from this brief account of its contents. But it is more than this alone. This fascicle on the Sphingoidea is a complete taxonomic revision of the group. There are seventeen name changes presented. Two new genera are created, one new species described, one genus is synonomized, and a total of twelve species are reassigned to their proper genera. This is somewhat amazing, since sphingids are some of the largest and most widely collected of the moths. The only criticism accompanying these taxonomic changes is the lack of any notation to this effect in the general section on classification, plate legends, or index. It is necessary to examine each page of the text to discover any nomenclatural changes. This is only a minor point and cannot detract from this magnificent work. It is merely a matter of style.

It is difficult to avoid the use of superlatives in trying to describe the impact and significance of this series. Each fascicle will be a "must" for serious students of the subject, whether professional or amateur. Since each group of volumes will stand as a complete taxonomic unit, the cost of the entire series (almost $1,000) will not be a serious burden to the specialist desiring only a few of the volumes. It should also be pointed out that the plan of production of *The Moths of America North of Mexico* calls for the publication of three or four fascicles each year. Thus purchase of the entire series would be spread over a period of several years. This would make it quite feasible for many libraries to acquire the series, as indeed they should.

by Dr. John Kethley, assistant curator, insects, Field Museum.

FIELD BRIEFS

New Curatorial Staff

Two new curatorial appointments are announced for Field Museum's Department of Anthropology effective September 1.

Dr. Bennet Bronson, the new assistant curator of Asiatic archaeology and ethnology, received his doctorate from the University of Pennsylvania in June. He was field director of the University Museum/National Museum of Thailand Joint Archaeological Expedition, 1968 and 1969, and the University of Pennsylvania Archaeological Program in Ceylon, 1970. Dr. Bronson's field experience includes excavations in England, Guatemala, Turkey, Iran, Thailand, and Ceylon.

Dr. John Terrell, who recently received his Ph.D. in anthropology from Harvard University, becomes assistant curator of Oceanic archaeology and ethnology. His doctoral research includes archaeological surveys and excavations on the island of Bougainville in the Solomons. Field research by Dr. Terrell includes excavations in England, France, Neo-Indian sites in the United States, New Zealand, the Tonga Islands, and Western Samoa.

Geology Field Trips and Course in Natural History of Chicago Region

Field Museum's Department of Education and the University of Chicago Extension are cooperatively offering this fall:

Geology field trips September 25-26 to Galena, Illinois and environs and October 16-17 to Baraboo Range and Devil's Lake, Wisconsin. Both will be conducted by Dr. Matthew H. Nitecki, associate curator in the Museum's Department of Geology.

A course of four lectures and one panel discussion on the ecology of northeastern Illinois. October 11 Matthew H. Nitecki will explain how the geology of the region is responsible for the present flora and fauna and our economic growth and will discuss the future of the city. October 18 Floyd A. Swink, naturalist, Morton Arboretum, will show how the flora have changed profoundly because of man's activities. October 25 W. J. Beecher, director, Chicago Academy of Sciences, will compare the present ecology of the region with what it was before man disturbed it and with the ecology of other regions. November 8 Loren P. Woods, curator of fishes, Field Museum, will discuss the change of Great Lakes fish and fishing because of man's intrusions. November 15 these four specialists will summarize how conservation measures can influence the ecological future of our region.

Tuition for each field trip is $25 (or $45 for both) and includes transportation on a chartered bus. Tuition for the course is $35. Museum Members are eligible for a 10 percent discount for field trips and course. Call Mrs. Maria Matyas, University of Chicago Extension, FInancial 6-8300, for further information and reservations.

In Sympathy

Carl W. Cotton, Museum taxidermist, died on July 5th after a five-month illness. He was 53 years old. Mr. Cotton joined the Field Museum staff in September, 1947, as assistant taxidermist. He became taxidermist on January 1, 1952. Creative and versatile, Mr. Cotton was equally proficient with both birds and mammals. We extend our sympathies to his family.

Nephew of Malvina Hoffman Visits Museum

Mrs. Edward Byron Smith (left), president of Field Museum's Women's Board, shows Malvina Hoffman's sculpture "The Cockfight" to guests of honor: Malvina Hoffman's nephew Charles M. Hoffman, his daughter Mary Fiske, and Mrs. Hoffman. The occasion was a luncheon given by the Women's Board highlighting the life and works of Malvina Hoffman with a film program and presentation of an informal paper by Mrs. Frenk Meyer. Field Museum's new permanent exhibit, "Portreits of Man," is a selected group of the famous sculptress' work.

Collecting Fossils in Nepal

Dr. Eugene Richerdson, curator of fossil invertebrates, and Reeve Byron Weud axsmine a two-hundred-million-year-old ammonite which Reeve donated to the Museum.

Reeve Byron Waud, seven-year-old Museum Member and son of Mr. and Mrs. Cornelius Waud, recently donated a two-hundred-million-year-old fossil ammonite to the Museum. Reeve collected the fossil in the bed of the Kali Gandaki River between Sikung and Larjung in Western Nepal while on a 300-mile walking trip through Nepal last March with his parents, his grandparents Mr. and Mrs. Lawrence Reeve, and eight Reeve children.

The fossil was one of over thirty collected by Reeve on the trip. "It was hard carrying them," says Reeve, whose total collection weighs over ten pounds. "I picked up as many fossils as I could carry in a day. Usually, I had to carry them in my hat."

A newcomer to rock hound circles, Reeve says he is going to continue collecting fossils now. "If I was just going to keep the fossils," commented Reeve, "I don't see much use in them. But using these to start a collection, there is quite a use. You can look up and learn things from them. You can learn what kind of things were living millions and millions of years ago."

"Dr. Richardson [curator of fossil invertebrates] showed me many drawers of ammonites from the Museum's collection," said Reeve, "but we did not find any other one exactly like mine," which Reeve considers one of his "best fossils." "I thought the Museum should have it," said Reeve, "because it is one of the best places I know of for it."

Before leaving the Museum, Reeve talked with Dr. Matthew Nitecki, associate curator of fossil invertebrates, and Dr. John Clark, associate curator of sedimentary petrology, about his fossil find and about Nepal.

Members' children (or grandchildren) are invited to participate in the Saturday workshops that have become highly popular fall events at Field Museum. The workshops were originated eight years ago by the Raymond Foundation to stimulate interest in natural history through small-group instruction on a variety of topics that appeal to children of different age groups. They offer the children opportunity to get acquainted with our staff members and to work with actual specimens from the Museum's scientific collections. The programs last about one hour for younger children and about one and a half hours for older ones. Extra time should be allowed if the children bring specimens of their own for identification.

Reservations are necessary, and we urge that they be sent in early. The size of each session is limited, and applications will be accepted in the order in which they are received. A child can be scheduled into one program only. Please send a separate application for each child in your family who wishes to participate. Accepted applicants will be sent a confirmation card that will admit them to the workshop.

All workshops begin at 10:30 a.m.

October 2 For ages 7-9
Eskimo Seal Hunt
Edith Fleming, Leader

After viewing the film *Angote*, which shows the life of an Eskimo boy from the time he is a baby until he is old enough to go on his first seal hunt, boys and girls see and handle real hunting equipment used by Eskimos: weapons, goggles to protect the eyes from the sun's glare, and clothing designed to keep out the Arctic cold. Finally, in Museum exhibits, the children seek out the seal in its native habitat, and learn more about the problems of the hunt.

October 9 For ages 9-11
Picture Stories—Plains Indian Style
Harriet Smith, Leader

Children learn the importance of animals and of story-telling by means of pictures in the lives of our western tribes, by viewing a film and examining actual decorated objects made by Plains Indians. They have the opportunity to draw either their own picture-story of a "happening" on a miniature tipi cover or their own dream of the future on a (paper) shield, using Indian symbols.

October 16 For ages 6-8
Boneyard Menagerie
Ernest Roscoe, Leader

Some "family" secrets are revealed in this session as the boys and girls discover and discuss prehistoric relatives of familiar animals found in zoos and aquaria. Children should be accompanied by at least one parent. Be prepared for a few surprises!

Application for Fall Workshops

Program Date

1st choice _____

2nd choice _____

3rd choice _____

4th choice _____

Name _____

Address _____

Membership in name of _____

Cut along dotted line and mail to: Raymond Foundation, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, Illinois 60605

October 23 For ages 9-13
African Drums and Masks
Edith Fleming, Leader

Some original African art and music are examined and then used as inspiration for the boys and girls to create their own. African masks stimulate them to make their own designs with colorful materials, such as seeds and beads. A tape of African drum music recorded in Ghana serves to inspire them to try playing African rhyihms on real African instruments.

October 30 For ages 6-8
Boneyard Menagerie (repeat)
Ernest Roscoe, Leader

See description for October 16.

November 6 For ages 9-13
African Drums and Masks (repeat)
Edith Fleming, Leader

See description for October 23.

November 13 For ages 9-13
A Half-Billion Years of Chicago History
Ernest Roscoe, Leader

Boys and girls learn the history of the Chicago area as it has been deciphered from study of the rocks and fossils of our region. They examine actual specimens of many of the prehistoric plants and animals we can all collect ourselves. Parents are invited to attend.

November 20 For ages 12-15
Animal Art of the "Totem Pole" Indians
Harriet Smith, Leader

A film that illustrates the totemic art of the Northwest Coast Indians plus several actual examples of the art demonstrate the close relationship these people feel with certain animals prominent in their mythology. Each participant then explains why he chooses a specific animal as his totem and stylizes it into symbolic designs he paints on a storage box for himself.

CALENDAR

Do We Have Your Name and Address Correct?

Beginning in October, the *Bulletin* will be mailed by a new system. If your name is misspelled or your address is incorrect or if you do not receive your October issue by October 10, please contact the Membership Office. We need your help in order to correct any errors which may occur in the changeover period from the old to the new system.

Plan Ahead

Visits to Field Museum earlier in the day are recommended for Sundays this fall when the Chicago Bears play home games in Soldier Field.

Since the Southeast parking facilities will be filled, the North lot reserved for Museum visitors will undoubtedly be strained to capacity during the afternoon games.

Dates to remember are September 12 and 19, October 10 and 31, November 7, 14 and 21, and December 19.

Hours

9 a.m. to 6 p.m. Monday, Tuesday, and Thursday, and 9 a.m. to 9 p.m. Wednesday, Friday, Saturday, and Sunday until Labor Day.

Beginning September 7, hours are 9 a.m. to 5 p.m. daily, Saturday through Thursday. Special Friday hours are 9 a.m. to 9 p.m.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday.

Exhibits

Through September 6

Deerskin Jacket with painted decoration depicting warriors on horseback, displayed in the North Lounge. A recent gift of Mrs. Richard D. Stevenson, the jacket was collected by her grandfather, Carter H. Harrison III, in the early part of this century from the Sioux, probably of the Pine Ridge Agency.

Begins September 7

Rare Ancient Numismatic Collection, a highly important group of seven silver Greek coins from the archaic and finest periods, and two Roman medallions dating from the third and fourth centuries A.D., displayed in the South Lounge through November 7. The coins and medallions are part of a collection donated to Field Museum by Jon Holtzman of Madison, Wisconsin, and Paul Holtzman of Las Vegas, Nevada.

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Through November 28. Hall 25.

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of textiles blending classical African motifs and contemporary design. The original Field Museum Benin artifacts which inspired many of the designs are also shown. Financial assistance for the exhibit was received from the CNA Foundation, Chicago, and the Illinois Arts Council, a state agency. Through December 31. Hall 9.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past, and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

Children's Programs

Begins September 1

"Between the Tides," Fall Journey for Children, takes them shell hunting for exotic and beautiful specimens in the Museum exhibit areas. All youngsters who can read and write are welcome to join in the activity. Journey sheets are available at Museum entrances. Through November 30.

Film and Tour Program

Through September 3

Free Guided Tour of Field Museum exhibit areas leaves from the North information booth at 2 p.m. Monday through Friday. A color motion picture, "Through These Doors," focusing on behind-the-scenes activities at the Museum, is shown at 3 p.m. in the Lecture Hall, following the tour.

Continuing

Free Natural History Film "Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturday, and 11 a.m., 1 p.m., and 3 p.m. on Sunday in the second floor Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit. Through November 28.

Meetings

September 8: 7 p.m., Chicago Ornithological Society

September 8: 7:30 p.m., Windy City Grotto, National Speleological Society

September 12: 2 p.m., Chicago Shell Club

September 14: 7:45 p.m., Nature Camera Club of Chicago

September 14: 8 p.m., Chicagoland Glider Council

September 19: 2 p.m., Illinois Orchid Society

Coming in October

Fall Film Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

October 2: "Botswana," narrated by Roy Coy.

October 9: "Railroads are Fun," narrated by Thayer Soule.

October 16: "Norse Adventure," narrated by Hjördis Kittel Parker.

October 23: "Our Glorious National Parks," narrated by Edward M. Brigham, Jr.

October 30: "Ecuador & Darwin's Galapagos," narrated by Hugh Hope.

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BULLETIN

Volume 42, Number 9
October 1971

Cover: Modernization and renovation of Field Museum's building are the purposes for which the Museum hes launched a $25,000,000 Capital Campaign, the first in its seventy-eight-year history.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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About Field Museum Joyce Zibro

Museum staff in 1909. Photograph taken upon the occasion of the visit of Commissioners Wada and Sakai of the Japanese Exposition. *First row, left to right,* Commissioner Wada; Frederick J. V. Skiff, director 1884-1921; Commissioner Sakai. *Second row,* Patrick Brophy, guard, 1894-1923; Charles B. Cory, Zoology, 1906-1921; George A. Dorsey, Anthropology, 1896-1915; unidentified member of the Japanese delegation; Miss Elsie Lippincott, library, 1897-1930; Oliver C. Farrington, Geology, 1894-1933; Charles F. Millspaugh, Botany, 1893-1923; Richard N. Abbey, guard, 1908-1938. *Third row,* Jesse M. Greenman, Botany, 1905-1912; William J. Gerhard, Zoology, 1901-1950; David C. Davies successively served as accountant, recorder, auditor, and director, 1894-1928; Carl E. Akeley, taxidermist, 1896-1909; Edmund N. Gueret, Zoology, 1900-1940. *Fourth row,* Henry W. Nichols, Geology, 1894-1944; Elmer S. Riggs, Geology, 1898-1942; Albert B. Lewis, Anthropology, 1907-1940. *Top row,* Arthur W. Slocum, Geology, 1901-1914.

In his autobiography, Harlow Shapley, the famous astronomer of Harvard University, wrote concerning his early career, "I realized that I could do things other people could not or would not do, and therefore I was useful."

Dr. Alan Solem, curator of invertebrates at Field Museum, applying this statement to natural history museums, asked in the December 1970 issue of this magazine, "What can a natural history museum do that other institutions cannot or will not? Where can we be useful? . . . What are the unique aspects of Field Museum as an institution?"

Dr. Solem answered these questions this way:

Collections, library, trained staff. Our collections of natural history and ethnographic objects bring scientists and students from all parts of the world to study in Chicago and are utilized on a loan basis by scholars in every continent except Antarctica. Our library is equally fine. Our staff of scientists and technicians makes use of these collections and library resources on a daily basis. Their work cannot be done at an institution without these facilities. Only natural history museums provide them. Universities do not, businesses cannot, only museums can.

Sometimes our research involves immediately relevant problems—medically important ectoparasites of Venezuela or a forest resource survey of Amazonian Peru. Usually we work on basic problems whose practical applications may be decades away or undreamt of at the time of study.

But this is not an attempt to justify the research and collection activities of Field Museum. Our acknowledged function is not just to discover, collect and correlate knowledge, but also to disseminate knowledge. This can be through technical literature, through popular writing, but more directly through the parts of the Museum used by the public—the exhibition halls, the school programs, the public lectures, the traveling school exhibits, and university level teaching . . . No one else has the variety of nature and man's work, no one else can show it.

Dr. Solem goes on to suggest, however, that while discovery, collection, and dissemination of knowledge are and should remain prime functions of the Museum, this is not enough. Field Museum can be useful to society in other unique ways. One such unique capability and possibility for Field Museum to further serve society, he suggests, is in the interpretation of the ecology of the earth. "We can show, in environmental exhibits," he says, "how the world functions. How it is based on energy from the sun, converted by plants and either used immediately or stored for future use. We can show with our cultural objects and natural history specimens how climate, soil, water and topography limit the activities and abundance of all species, including man . . . These are things we can do better than others and be useful to society."

In this day when more and more demands are being made on museums in general and Field Museum in particular to serve an ever-increasing and better-educated public, it is perhaps appropriate to review how this great permanent treasure of useful things and knowledge which is Field Museum came to be established in Chicago and how it grew to become one of the four greatest natural history museums in the world.

It is of course the story of people, the human element, which made Field Museum the great institution it is today.

"The human element is the only force which is, in the last instant, responsible for the *combination* of forces which made Chicago not only large, but great," wrote J. Christian Bay (Librarian of John Crerar Library) back in 1929. "Anybody who scans the lists of residents of our early days will stop again and again at names, each of which signifies some important departure in the city's life, some great and generous act or some small beginning of things that grew significant in time."

The idea of a great permanent museum for Chicago was neither suddenly born nor quickly realized. That idea developed from 1890 onward together with plans for the World's Columbian Exposition held in Chicago in 1893 to celebrate the four hundredth anniversary of the landing of Columbus in America.

The first published suggestion that a permanent natural history museum be formed as a result of the Exposition was an article by Frederic W. Putnam in the *Chicago Tribune* of May 31, 1890. Putnam was curator of the Peabody Museum and professor of anthropology at Harvard University and served as chief of the Department of Ethnology and Archaeology at the Exposition. He successfully brought together the most extensive anthropology exhibit of its kind ever assembled, and was also responsible for most of the natural history exhibits at the fair. He advocated that these collections and exhibits should be kept together to form the nucleus of a great natural history museum. In November 1891, in an address to the Commercial Club of Chicago, he outlined the administrative organization of the proposed museum, the organization and activities of its scientific departments (anthropology, botany, geology, and zoology), and the nature of its exhibits. These proposals were to become the blueprint of the future museum.

Putnam's views were shared by many leading citizens, including Edward E. Ayer, Norman Ream, and James Ellsworth. The interest of Chicagoans was aroused and in a public meeting held on August 7, 1893, and attended by about one hundred leading citizens, a committee was appointed "to adopt measures to establish in Chicago a great museum that shall be a fitting memorial of the World's Columbian Exposition and a permanent advantage and honor to the city."

A charter was obtained on September 16, 1893 under the title Columbian Museum of Chicago, with sixty-five citizens as incorporators and fifteen as trustees.

Officials of the Exposition who had become actively interested in the plan

for the museum solicited and procured from exhibitors gifts and transfer of desirable exhibits. Meanwhile, enthusiastic sponsors of the museum instituted a campaign to raise funds. But the country-wide financial stringency which developed to alarming proportions in 1894 was already beginning to be felt, and by the middle of October, in the words of the Museum's first director, Frederick J. V. Skiff, "A period of discouragement came upon those at work for the Museum. Nothing but the faith, devotion, and courage of a few men prevented the disintegration of the preliminary organization and the practical abandonment of the Museum enterprise."

Marshall Field, probably the richest man in Chicago, had been approached several times to give one million dollars. He always responded, "I don't know anything about a museum and I don't care to know anything about a museum. I'm not going to give you a million dollars." Edward E. Ayer, who was to become the first president of the Museum, made one last attempt to persuade Field to change his mind as the closing time for the Exposition approached in late October. "You have an opportunity here," he told Field, "that has been vouchsafed to very few people on earth. From the point of view of natural history you have the privilege of being the educational host of the untold millions of people who will follow us in the Mississippi Valley. There is practically no museum of any kind within five hundred miles; and these children who are growing up in the region by hundreds of thousands haven't the remotest opportunity of learning about the ordinary things they see and talk about and hear about every day of their lives. . . ."

This time Field agreed to go through the Exposition with Ayer before saying no. On October 26, the day following his visit to the Exposition, Field announced he would donate one million dollars to start a museum. As a single

Prince Frederick and Princess Ingrid of Denmark and Iceland visit the Museum on April 25, 1939.

gift for museum purposes it shattered all precedents and ensured the establishment and permanence of the Museum. Other early benefactors of the Museum included George M. Pullman and Harlow Higinbotham, who each gave $100,000, Mrs. Mary D. Sturges, who contributed $50,000, and Tiffany and Company, McCormick Estate, and many others who gave $10,000.

On November 1 the finance committee sent a circular to Exposition stockholders repeating an appeal made in the *Chicago Evening Post* of September 14 for the donation of Exposition stock to the fund for a museum. 1,100 stockholders came forth to donate stock from which the Museum ultimately realized $193,000.

In honor of the man who had made the dream of a permanent natural history museum in Chicago possible, the name was changed in 1894 to Field Columbian Museum, and finally, after several other changes, to Field Museum of Natural History in 1966. Permanent honor is thus given to the Field family, which has been extraordinarily generous to the Museum throughout the years, and particularly to Stanley Field, a nephew of Marshall Field, for more than fifty years (1908-1964) president and chairman of the board.

Marshall Field enjoyed the Museum very much during his lifetime and made contributions estimated at $430,000 toward current operating expenses. On his death in January 1906, he bequeathed a further sum of $8,000,000, of which $4,000,000 was allotted toward the erection of the present building and $4,000,000 toward endowment which to this day helps to sustain the activities of the Museum.

Large and important collections and exhibits that had been shown at the Exposition were purchased. Such purchases included the Ward natural history collection, the Tiffany collection of gems, the Restrepo collection of pre-Hispanic gold ornaments from Columbia, the Montez archaeological collection from Cuzco, Peru, the Hassler ethnological collection from Paraguay, collections representing Javanese, Samoan, and Peruvian ethnology, and the Hagenbeck collection of about 600 ethnological objects from Africa, the South Sea Islands, British Columbia, and other areas.

In addition, collections and exhibits of great value were received as donations in large numbers. Edward E. Ayer donated his extensive anthropological collection of North American Indian material. Special collections made by the Department of Mines, Mining and Metallurgy of the Exposition were donated, together with the exhibition cases, and from the Agriculture, Forestry and Manufactures Departments of the Exposition, collections of timbers, oils, gums, resins, fibers, fruits, seeds, and grains were contributed in so large a quantity and variety as to insure for the first time in any general natural history museum the formation of an adequate department of botany.

The Palace of Fine Arts building (now housing the Museum of Science and Industry) of the Exposition was obtained at the close of the Exposition

Left, the original N. W. Harris Extension truck at the Museum's first home in Jackson Park. *Right,* Harris Extension driver Gerald Hardison loads some travelling exhibits in the present-day truck.

as a temporary repository and became the first home of the Museum.

By June of 1894, with the help of experts from the Exposition staff and individuals with museum training from other institutions, the installation of exhibits in the Museum was sufficiently advanced to permit opening the doors to the public. On the afternoon of Saturday, June 2, 1894, between eight and ten thousand persons assembled at the north steps of the institution in Jackson Park to witness the opening ceremonies.

The *Times* of June 3 reported the opening like this:

> It was all like a memory of the fair. There were the hurrying expectant crowds of people, there were the many flags and the orators, there was the noble art palace itself, the most beautiful of the wonder houses of the white city and the only one untouched by the wrecker, every object within its mazes a memento of the day when the world looked toward Jackson park.
>
> So Chicago has what will be the greatest of all museums, an institution magnificently endowed by the liberality of its own citizens, a permanent memorial of the glories of the summer of '93.

On the day following the opening of the Museum, some 16,000 people flocked to see the great collections and unique treasures of the Exposition that were to be permanently preserved in Chicago.

During that first year, the main lines of future activities were established. Curators were appointed to the various departments and as early as October expeditions and field work to expand the collections, to fill in the gaps, were organized. A series of popular illustrated lectures was instituted on Saturday afternoons from December to May. These lectures continue today as the free Edward E. Ayer Lecture Series, in fall (October and November) and spring (April and May), each of which usually fills the James Simpson Theatre to its capacity of 1,000.

The Library was organized as early as March 1894, with 1,390 titles from the Department of Ethnology, and 350 titles from the Department of Mines and Mining of the Exposition. Before the year was out the Kunz collection of books on geology, gems and metallurgy, and the Cory collection on ornithology (consisting of 587 volumes) were purchased, and the fine ornithological library of Edward E. Ayer was added as a gift. The Museum's exchange program with other institutions began about this time, and has provided the bulk of the Library holdings. Today, the Library contains 175,000 volumes, many of them rare and priceless, all of them important to scientists, students, and researchers in the field of natural history.

Plans for Museum publications were inaugurated, the decision being to confine them to scientific and technical subjects, especially as related to Museum exhibits and collections. The first of the more than 1,100 issues of *Fieldiana,* as the continuing series of scientific papers and monographs dealing with anthropology, botany, geology, and zoology came to be named, appeared in 1895.

A system of memberships was instituted and privileges were established for members similar to those existing today. During that first year 723 members were enrolled, an encouraging indication that the continued support of the citizens of Chicago could be counted on. Today membership numbers over 21,000, a figure which has doubled in the past five years.

From the beginning it was desired to extend the advantages of the Museum

A few members of the scientific staff today. *Left column, top to bottom,* Mr. Hymen Marx (left), associate curator of reptiles and amphibians (with Marx is Shedd Aquarium Director William Braker); Dr. James W. VanStone, chairman, Department of Anthropology; Dr. Phillip H. Lewis, curator of primitive art and Melanesian ethnology; Dr. John B. Kethley, assistant curator of insects. *Center column, top,* Dr. John Clark, associate curator of sedimentary petrology; *bottom,* Dr. Edward Olsen, curator of mineralogy. *Right column, top to bottom,* Dr. Eugene Richardson, curator of fossil invertebrates; Dr. Louis O. Williams, chairman, Department of Botany; Mr. Henry Dybas, associate curator of insects; Dr. Emmet R. Blake, curator of birds.

to all school children by providing free admission at all times and lectures by Museum staff. In 1925, Mrs. James Nelson Raymond became interested in the work for children in the Museum and provided an endowment to develop and broaden the guide-lecture program started in 1922. The guide-lecture division of what was to become the Department of Education was named in honor of her and her husband, the James Nelson and Anna Louise Raymond Foundation for Public School and Children's Lectures. The Raymond Foundation grew rapidly, adding staff and new programs until today the seven-member staff, aided by 27 volunteers, provides guided tours and classroom instruction in the Museum to over 100,000 school children each year, offers children's workshops in the fall, an anthropology course for high ability students in the summer, free children's movies, and many other programs. In all, over 400,000 school children now visit the Museum in organized groups in each year.

The other division of the Department of Education, the N. W. Harris Public School Extension, dates from 1911 when Norman Wait Harris gave the fund which made possible loan service to schools of traveling exhibits. Today over 1,000 traveling exhibits are circulated annually to over 600 Chicago schools, hospitals, and community centers through the Harris Extension.

The early years were a period of growth, organization, and consolidation. Acquisition of one important collection after the other occurred by expedition, purchase, or contribution. In 1909 an important line of work in the Department of Botany was inaugurated in the establishment of facilities for modeling plants, flowers, and fruits in natural colors and permanent form. Frank Boryca, who has been making plant models since joining the staff in 1941, is well known for his expertise by members of the Museum who flock to see demonstrations of this craft on the annual Members' Night.

Long before meteorites became of popular interest the Museum was collecting and studying them. 1913 saw the acquisition of the Ward-Coonley collection of meteorites, then the largest private collection of these celestial bodies in existence. This, combined with other purchases, exchanges, and collections, and most recently with the acquisition of over 75 percent of the Murchison Meteorite which fell in Australia in late 1969, make Field Museum's collection one of the three most important meteorite collections in the United States. Dr. Edward Olsen, curator of mineralogy, who does research work on the meteorites, feels they may ultimately give us a clue to the origin of the solar system and to the existence of life in other parts of space.

The Department of Zoology from the earliest years acquired zoological research collections which now rank among the most important and largest in the world. The Museum's collection of birds, which numbers over 300,000, will make possible the preparation for posterity of the *Manual of Neotropical Birds,* a monumental work now being written by the Museum's curator of birds, Dr. Emmet Blake. When completed, the *Manual* will provide for the first time and under one cover, taxonomic information, descriptions, appropriate keys, and the distribution of more than 3,200 species and over 8,500 races or subspecies of Central and South American birds and will have great potential applied value in the field of tropical medical research.

The period 1896 to 1915, under the leadership of Dr. George Dorsey, who served as chief curator of the Department of Anthropology, was an era of tremendous collection of anthropological materials which cannot now be duplicated. It is to Dr. Berthold Laufer, who succeeded Dr. Dorsey in 1915 and headed the department until his death in 1934, that the Museum owes fame as a repository of one of the most extensive and valuable Oriental collections in the world. Dr. Laufer understood more about the peoples of China and Tibet than perhaps any other man of his time. Under Laufer's leadership the department became distinguished for scholarship and research, and more scientific papers were published during his nineteen years as head of the department than ever before. An obituary article on Dr. Laufer in the October 1934 issue of this magazine paid this tribute to a great man of science:

> From the vast depths of his esoteric knowledge he upset, with quaint narratives and facts gleaned from little-known sources, many a set of smug notions of a too self-satisfied generation. To a world in which knowledge of aviation generally dated little further back than the Wright brothers, he showed that flying had been thought of and attempted for centuries in China, Persia, and elsewhere, and was able to write an entire volume on the subject. The idea of television, still awaiting perfection by modern engineers, he proved had germinated centuries ago in Oriental minds.

From 1918 to 1921, the efforts of the entire staff were devoted to packing the collections and preparing them for transfer to the Museum's new and permanent home in Grant Park. The beautiful structure of white Georgian marble, inspired by the Erechtheum, a temple in Athens which is recognized as the finest of the Ionic order that has been preserved from ancient times, was built over a five-year period at a cost of $7,136,866. The difference between the total cost of the building and Marshall Field's bequest of $4,000,000, plus its accretions during the years from 1906 to 1920, amounted to approximately $828,000. This sum was made available by gifts.

The present building opened on May 2, 1921. Three days before, Carl Sandburg wrote in an article in the *Daily News* titled "World Wonders are in Field Museum":

> The navy recruiting slogan for young men is "See the World." An older admonition is, "See Rome and Die." But the one heard

most often in this country in recent years is, "See America first." Before starting, however, to see either the world or Rome or America first, a few good long trips around the Field Museum are worthwhile. The Museum has a number of specimens and articles rather difficult to find even in a trip around the world. Also there are a few bits of paraphernalia not to be found anywhere in the whatsoever rambles a tourist might choose to make between the equator and either of the poles.

John R. Millar, former deputy director of Field Museum and former chief curator of botany and now retired and a volunteer in the care of the economic collections in the Department of Botany (he joined the Museum staff in 1918), gave this account of the 50 years in the present building (June 1971 *Bulletin,* "Forward and Backward Glances"):

But almost as soon as the spacious building was occupied, things placed according to plan, and the Museum once more open to visitors, a new and vigorous growth began like that of a seedling in spring. There ensued a period of unusually active field and expeditionary work in all departments made possible by an enlarged scientific and preparatory staff and the generous financial support of a number of individuals, especially Mr. Stanley Field, president, Mr. Marshall Field III, and other trustees of the Museum. Central and South America, Africa and Asia, as well as various areas of the United States and subarctic Canada were the locale of numerous expeditions that resulted in large scientific collections as well as studies and specimens for exhibition. With this impetus an accelerated program in all manner of Museum activities followed—research, publications of scientific reports, exhibitions and education—that continues to the present.

To tell the entire story of Field Museum would fill volumes. Many of the exhibits for which the Museum is world famous can only be mentioned in passing: such as dioramas of Stone Age man; seven halls covering the history and cultures of the Indians of the Americas; the world's finest hall of reptiles and amphibians made possible by techniques of mounting developed at Field Museum; the lifelike murals of prehistoric animals painted by Charles R. Knight; the hall of fossil vertebrates featuring the 72-foot Brontosaurus skeleton; the hall of plant life; the great

Dr. Robert F. Inger and Mrs. Inger record frog calls in the Congo in 1960. Dr. Inger was Curator of Reptiles in the Museum's Department of Zoology when this photo wes taken. He is now Chairman of Scientific Programs.

display of Melanesian Art; the construction of the coal age forest of 240 million years ago; the sculptures of Malvina Hoffman; habitat groups of animals in naturalistic settings equal to the best that can be seen anywhere; the exhibit of Benin bronzes from Nigeria; a rare, first edition copy of John James Audubon's *The Birds of America*; the great collection of Chinese jade. The names of the famous scientists who have devoted a lifetime to the collections and research efforts of the Museum, the trustees, presidents and directors, and private individuals who have donated time, money, and great collections to the Museum, would fill many pages.

Even though we have over ten million specimens in our collections, less than one percent of which are on display, we are still collecting, filling in the gaps. The Botany Department, for example, which has one of the largest collections in North America and the finest in the world on tropical America, estimates it will take another 25 years before all the flora of Latin America are described and published for the benefit of generations to come. The demands on the Department of Education are increasing rapidly, and some way will have to be found to enable those demands to be met. Required will be additional staff, new classrooms, ramps for school buses, additional programs. This fifty-year-old building must be repaired and modernized to accommodate the millions of visitors to come in the 1970s and after. We must provide them with adequate cafeteria and rest room facilities and escalators.

Our Department of Exhibition, which has been responsible for the beautiful display and graphic techniques applauded in such exhibitions as the Fiesta Mexicana in 1969 or Color in Nature in 1971 or the continuing 75th Anniversary Exhibit, is anxious to modernize many of the halls which have not been touched for decades.

Millar called Field Museum a living museum. "A living museum is never finished," he said. "It serves its community and the natural sciences as no other social institution can and to continue this service is the purpose and function of Field Museum of Natural History."

Joyce Zibro is editor of the Field Museum Bulletin.

More About Field Museum, or Why We Need $25,000,000

Elizabeth Munger

The objects that a museum collects, organizes, studies, explains, exhibits are of course largely objects from the past. Consequently some people may think that a museum sometimes harbors the attitudes as well as the drama of the past. We do not, even though sometimes we look backward in order to understand our present position as a culmination of the past.

We do have seventy-eight years of solid, impressive accomplishment behind us at Field Museum. We can try to measure our success by any of a number of countable as well as uncountable indexes; like the over sixty-five million people who have visited the museum since 1921; like the shelves of popular as well as scientific publications that we have published directly and that our scientists have published elsewhere; like the millions of specimens in our study collections and the acres of exhibits in our public areas; like the much smaller number of advanced students whose training and subsequent contributions to knowledge Museum scientists as well as Museum materials contributed to; listings like this could go on and on.

There is no doubt that the expectations of our founders and supporters through the years have been far surpassed, and that we have developed to be much more than a "memorial of the glories of the summer of '93," and much more than an "advantage and honor to the city."

But reflection on our past achievements is not cause for contentment about our future. In fact, our very success in the past has created our major problem for the future.

A successful business makes money through the years, but a successful museum can only consume it. Our benefactors in the past understood this fact well and endowed us generously

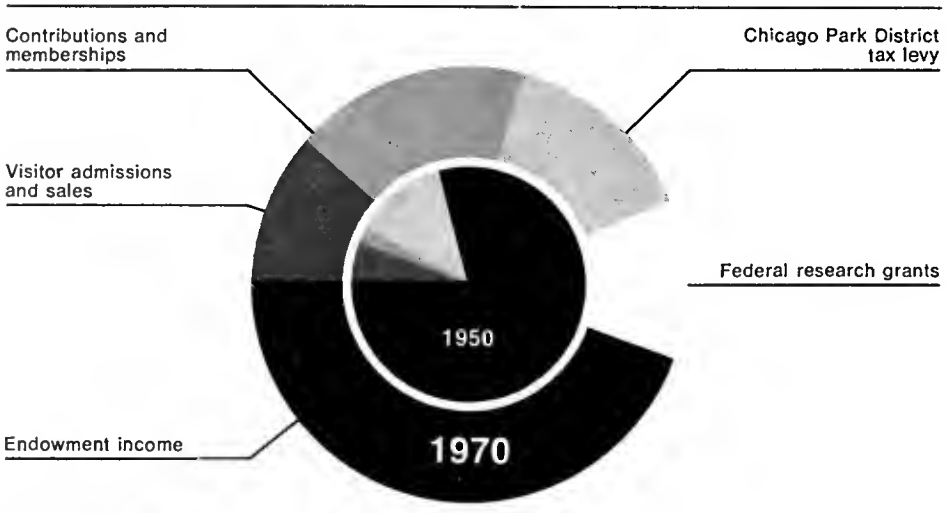
with funds that then seemed ample to yield enough income for all time to come. This public-spirited generosity gave rise to a prevailing folklore that we had limitless sources of wealth. But two kinds of change have effectively frustrated projections from an earlier age. While inflation has been seriously reducing the buying power of our endowment, at the same time the expenses to be supported by these funds have risen far beyond the expectations of even so recent a time as twenty years ago.

For instance, our total operating expenses for 1950 were a little under $1,000,000 but by 1970 were over $3,500,000, during which time our staff increased by only 8 percent. Both inflation and increased activities are represented in those figures, but one crude measure of the increased activities would be the increase in attendance at Field Museum for the corresponding years—from a little over 1,000,000 in 1950 to approximately 1,700,000 in 1970.

The pie-chart diagram for the corresponding years shows several things about our income resources to cover those expenses. Our endowment income in 1970 took care of only about half the proportion of expense that it covered in 1950; some federal research funds entered the picture; the increased attendance plus revised admission fees almost doubled the proportion derived from visitors and sales; and the proportionate support from contributions and memberships increased almost ninefold. In other words, by 1970 we were actively developing additional sources of income.

But these figures do not show that at the same time we had to keep postponing basic maintenance, repairs, and needed improvements to our building—the same kind of decision that many a family has to make when the choice is between college for the children or refurbishing the house.

Another line of attack on our increasingly nagging financial headache was begun in 1969. Field Museum's director, E. Leland Webber, was one of the prime movers behind a report published that year by the American Association of Museums called *America's Museums: The Belmont Report.* This document is in a way a milestone in American cultural history. It narrates the transformation of the country's major museums into integral and necessary parts of national and international education and research, while they have yet maintained their local traditions and identity. About the museum tradition in America it says: "Apparently no other people has engaged in this activity on so vast a scale, over so long a period without a let-up, and in so many diverse fields of human interest." It includes a long quotation from the director of a large museum who was asked to say what goes on during a typical day. We recognize our own museum, our own museum director, in the statement. We digress long enough to include it here because it offers some justification for why we, like a family, chose to allocate our inadequate financial resources, as we did, to our work rather than to our house.



FIELD MUSEUM'S SOURCES OF INCOME	1950		1970	
VISITOR ADMISSIONS AND SALES	$ 57,942	5.8%	$ 360,370	11.0%
CONTRIBUTIONS AND MEMBERSHIP	20,979	2.1	577,914	17.6
CHICAGO PARK DISTRICT TAX LEVY	129,870	13.0	480,605	14.7
ENDOWMENT INCOME	790,209	79.1	1,455,462	44.4
FEDERAL RESEARCH GRANTS			404,820	12.3
TOTAL INCOME	$999,000	100.0%	$3,279,171	100.0%

Anywhere from 10 to 50 people will bring in minerals or butterflies or other objects for identification, for which they are referred to the appropriate research department. A scientist from India may be working in the ichthyology collections. One from Brazil could probably be found there too, because we have the world's most comprehensive collection of fishes from the rivers of Brazil.

A doctor may send the stomach contents of a patient to one of our mycologists to see if the wild mushroom the patient ate is a particularly dangerous kind. U.S. Government people working on plant quarantine duties, or on public health, will come in to have something identified or to use our collections and library.

A staff botanist may be consulting with a scientist from a pharmaceuticals

manufacturer to determine the identity of a potentially useful drug plant. Next door, a curator may be analyzing organic debris that has been found contaminating food products. In the taxidermy laboratory, technicians are sculpting a model of a prehistoric fish for a new exhibit.

In the Division of Insects a curator might be studying the relationship between the peculiar flies that parasitize bats and the distribution of species of bats. In the Division of Mammals a curator might be working on the association between coat development of mammals and climatic variation. Almost certainly in several divisions museum technicians would be assembling material from the collections for shipment to universities in distant corners of our country. Such material as likely as not would be used by graduate students working for their doctorates.

Again, this could have been the day, recently, when the health authorities of Bolivia turned to us for aid. They were faced with an epidemic. The suspected carrier animal was rushed to us for identification. The curator's scientific knowledge enabled him to identify the carrier—a small rodent resembling our common field mouse. The museum's publication describing its habits, habitat and life cycle pointed the way to fast control of the epidemic.

Then, again in words from *The Belmont Report:* "much more than meets the eye goes on in any large museum . . . Much that goes on rests upon research. It is the invisible function of a museum. It came rather late in the evolution of American museums; it is rarely appreciated by the general public and is usually overshadowed by more glamorous activities, but without it the museum's function of interpretation would wither away and a museum's collection would lose value and meaning."

Dr. and Mrs. Karl Weineke of Boardman, Ohio and their children, *from left,* Karl, Jackie, and Mary Beth, were among the 1,700,000 people to visit the Museum in 1970.

The report also documents how "American museums are outstanding in educational programs and service to our educational system," and it points out that "more people go to museums today because more people than ever before have discovered that the arts and sciences which museums exist to serve are both important and exciting"; that "the average American, given an opportunity, apparently has a desire to improve the quality of his life, and museums give him that opportunity."

The immediate purpose of *The Belmont Report* was to demonstrate the need of America's museums for some federal help to respond to the enormously increased public needs and demands that this expanded role in our educational and cultural life implies—needs that greatly overstretched their traditional sources of support. The National Science Foundation had long supported research functions of science museums and some research facilities, but few funds had been available for nonresearch activities. Art and history museums had had no significant sources of support.

One current and encouraging federal response was the establishment by the National Endowment for the Arts of a pilot Museum Program for 1971. Through the program 103 grants totaling a little

under $1,000,000 were made to various museums. This first step toward federal sharing of responsibility to support museum activities was mainly for special exhibition, training, outreach, and acquisition programs. Of course neither these activities nor the amounts involved were designed to reach to the core of our kind of financial problem. The program was designed to help museums in their expanding and innovative efforts to reach even wider audiences than they do now, which museums wish to do, and which public needs and wants require.

Meanwhile, however, our most pressing underlying financial problems remain. The simple fact is that while we have been engrossed in exciting, expanding, and necessary work whose importance has evolved far beyond the expectations of our founders, our physical facilities are becoming more and more inadequate and have even begun to sag beneath us and crumble around us. We earnestly hope that federal recognition of the value of the services we perform will be expressed by increased financial support in the future, but federal help could only be part of the answer for us. Federal funds must be very broadly, and often thinly, spread around the whole country, and we must necessarily be considered one among many, whatever our international prestige may be.

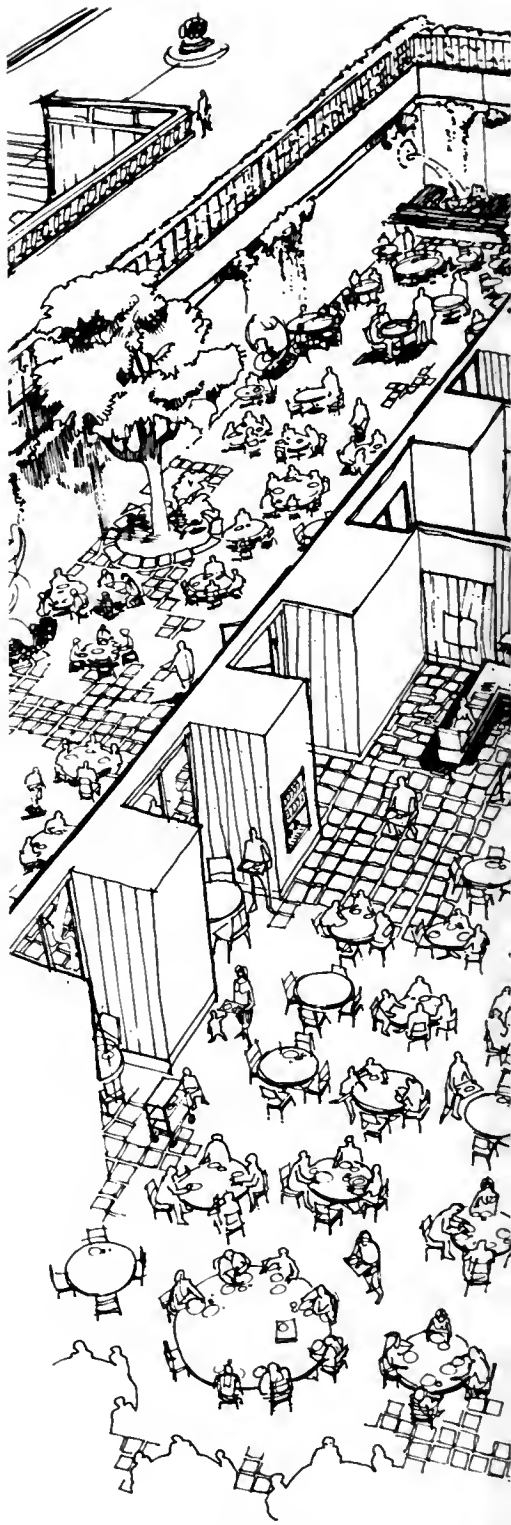
In early 1971 Field Museum and five other museums in the Chicago Park District proposed to the Park District Commissioners that authority be sought from the Illinois General Assembly for the Park District to share in the cost of capital improvements to the museums on a fifty-fifty basis. The Commissioners approved the proposal and legislation was enacted in June and signed by Governor Ogilvie on August 4 authorizing the Chicago Park District to issue $30,000,000 in bonds for museum improvements. Deep appreciation is due the Park District Commissioners and their president, Daniel Shannon, the members of the Illinois legislature, and Governor Ogilvie for this action which will mean so much to Chicago.

Our statement of capital requirements submitted to the Chicago Park District and the General Assembly projected a need of $25,000,000. Based on this projection, we may anticipate approximately $12,500,000 from public funds if we can match them with another $12,500,000 of private gifts.

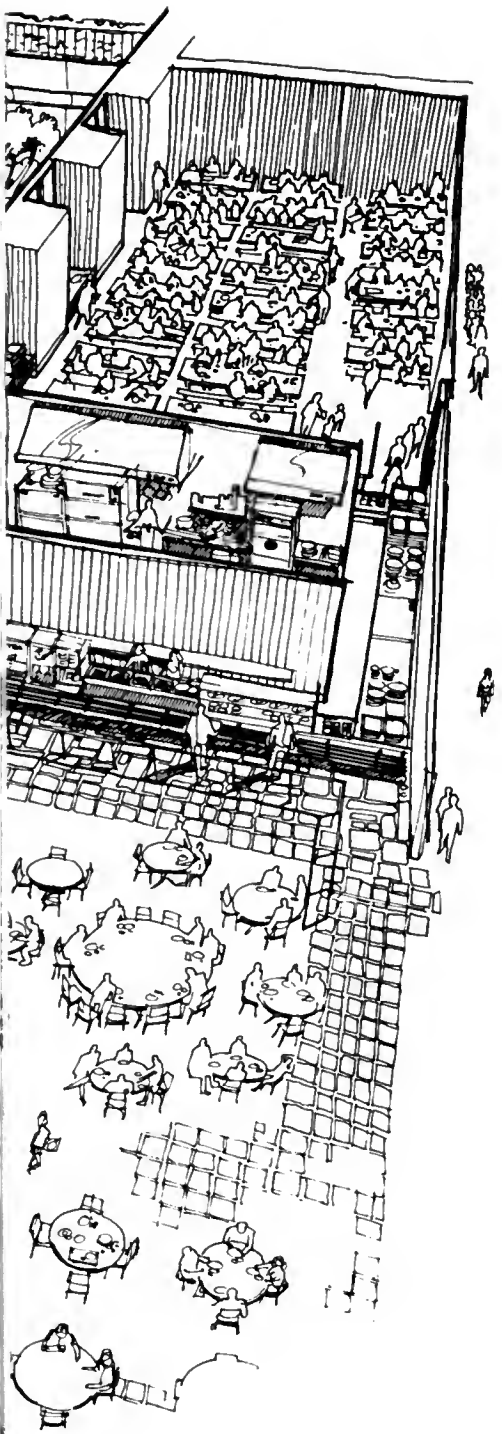
The figure of $25,000,000 was developed by long study by staff, professional consultants, and trustees. The action of the General Assembly and the Park District was based on the proposal submitted after our board's comprehensive study of the basic capital improvements needed to place Field Museum in a position to move ahead in the 1970s.

At the July meeting of our Board of Trustees, final organization of the Museum's Capital Campaign for $25,000,000 was completed. Official announcement of the campaign was made September 20 by President Remick McDowell. The General Chairman of the campaign is Nicholas Galitzine, partner of Bacon, Whipple Company and retired vice president of Commonwealth Edison Company. The campaign Vice Chairman is Marshall Field, publisher of the *Chicago Sun-Times* and *Chicago Daily News*. William H. Mitchell, honorary chairman of Mitchell Hutchins & Co., Inc. will be Co-Chairman of Individual Gifts with Marshall Field. Blaine J. Yarrington, president of American Oil Company, will serve as Chairman of Corporate Gifts and Philanthropic Foundations.

The component parts of our $25,000,000 program are candidly presented here to show how such a large sum of money is arrived at. They also demonstrate the range of our deficiencies. We are certainly not proud of these deficiencies, but we are proud that until now we have been able to accomplish so much in spite of them. Some of these deficiencies are all too



Preliminary schematic rendering of model



teria facilities and dining area.

apparent to even casual public inspection. Others are experienced daily by our staff as the handicaps they have had to work under and around. Some of the most serious and costly are those apparent only to technical experts who have examined our building with great care. But they are all urgent needs which must be taken care of if we are to fulfill our responsibilities to our local community and to the widespread scientific and educational communities that we have become a part of.

—*Electrical system,* $1,775,000. As is generally true of 1920 vintage buildings, the electrical system is inadequate and obsolete in both design and capacity. A completely new electrical system is required for fire safety and to upgrade lighting to modern standards. Sufficient capacity for anticipated future needs and for air conditioning the building is included.

—*Security against fire, smoke, and burglary,* $610,000. The Museum's 775,000 square feet of floor area is without sprinkler protection, except for a few high-hazard areas. In addition, modern fire and burglary detection and alarm systems for all areas of the Museum are urgently needed.

—*Plumbing, drainage, and toilet systems,* $1,050,000. Except for a few sections which have had to be replaced, the Museum's sanitary lines and other plumbing are all more than fifty years old and need total replacement. Additionally, the storm sewer system has been severely damaged because of the sinking ground floor and will have to be abandoned. An overhead collection system at ground floor ceiling height is contemplated. Four critically needed lounge and toilet facilities located strategically throughout the building must also be installed.

—*Exterior windows,* $900,000. Most of the fifty-year-old exterior window sashes are seriously deteriorated and in many cases rotted out. More than 1,000 large windows need to be replaced.

—*Heating system,* $300,000. The present coal-fired heating system must be converted to a combination gas and oil operation to reduce operating costs and minimize air pollution.

—*Food services,* $715,000. Our food preparation and serving facilities are primitive. Modern cafeteria facilities for about 600 persons plus a small dining area for luncheon groups are planned. More than 15,000 square feet of space are needed to provide adequate kitchen, storage, serving, and seating.

—*Floor sinking,* $800,000. The Museum building sits immovable on its pilings but the ground floor floats on uncompacted fill, having been poured about seven years after the building was completed without being tied into the basic structure. In places the floor has settled from 5½ inches to 11½ inches, causing no end of problems to exhibits, partitions, sewers, and plumbing. Soil engineers predict that 90 percent of the ground floor area will settle no more than an additional ½ inch in the next twenty-five years. The remaining 10 percent needs to be tied into the building structure because of past and predicted future settling.

—*Exterior stairs and entrances,* $525,000. The North and South exterior stairs need complete rebuilding to avoid costly maintenance and eventual collapse. Heating coils for snow removal are included. The current building code requires that the Museum's exit capacity be four times greater. Engineers propose cutting new exit door openings for each of the eight stairways and widening the present North and South exits.

—*Visitor entrance facilities and services,* $550,000. Information and admission areas and checking and bookshop facilities need substantial expansion and relocation to provide better public services and to increase the income they produce.

Group attendance of school children has increased 50 percent since 1965 to approximately 400,000 annually.

—*Centralized administrative offices,* $550,000. The Museum's offices are generally inadequate and in many cases isolated. A centralized office is necessary to improve operations, communications, and supervision.

—*Educational facilities,* $940,000. Use of the Museum by school and other groups continues to rise. Group attendance of school children has increased 50 percent since 1965 to approximately 400,000 annually. Moreover, increasing recognition of the Museum as an important national resource has been accompanied by a marked increase in the use of its limited classroom and laboratory facilities by teachers and other groups pursuing studies in ecology and environment. Extensive remodeling of the ground floor West area is required to provide proper orientation, checking, and toilet facilities for educational programs. A bus ramp, canopy, and paving changes for direct access by school groups through our West Theatre entrance to a proposed educational facility are also necessary.

—*Scientific areas,* $3,750,000. With a grant from the National Science Foundation in 1964, the Museum was able to provide expanded space and facilities for the collections and personnel of the Department of Geology. A filled-in lightwell added 250,000 cubic feet of space, all in close proximity to the department's curators. Other grants and restricted funds made it possible to construct storage facilities for the Invertebrate Division in 1971. Now the space needs for collections and personnel of the Anthropology, Botany, and Zoology Departments are critical. The herbarium in the Department of Botany is virtually bursting at the seams. A filled-in lightwell for each of the three departments should take care of their foreseeable growth needs.

—*Escalators and elevators,* $440,000. Installation of escalators will be a great convenience to the public and will also help immeasurably in reducing first floor and ground floor congestion. Escalators will substantially increase the number of second floor visitors since the public must at present climb seventy-three steps from the ground to the second floor. Approximately $50,000 of the total is needed to replace the fifty-year-old elevator which serves our scientific staff located on the third and fourth floors.

—*Sound-deadening,* $275,000. Acoustical treatment was relatively unknown or ignored at the time the Museum was erected. The noise level in certain popular exhibit areas is decidedly uncomfortable and hampers the educational program severely. The most popular and most noisy halls must be sound-treated.

—*Exterior walls,* $750,000. The soft Georgia marble exterior of the Museum has been and continues to be seriously eroded by weather and air pollution. Recently developed technology indicates that a permanent nontarnishing protective coating can be applied to arrest further deterioration. The Museum is currently conducting experiments with the newly developed product.

—*Roof and sky lights,* $200,000. Extensive re-roofing and removal of certain skylights will be required as a part of the Museum's rehabilitation and remodeling program.

—*Ventilation and air conditioning,* $3,740,000. The Museum's ventilation system reflects the burden of excessive wear and tear; it is more than twice the normal depreciation age of such equipment. Much of the system, obsolete at best, reflects a general condition of rusted-out coils and ducts, making its operation virtually impossible. To provide proper temperature, ventilation, filtering, and humidity for the Museum's priceless collections, books, and exhibits (as well as for employees and visitors), a modern air treatment system is sorely

Field Museum's Capital Campaign leadership discuss the Museum's $25,000,000 development program with Daniel J. Shannon, president, Board of Commissioners, Chicago Park District. *From left*, Blaine J. Yarrington, president, American Oil Company and chairman of corporate gifts; William H. Mitchell, honorary chairman of Mitchell Hutchins & Company, Inc. and co-chairman of individual gifts; Marshall Field, publisher of the *Chicago Sun-Times* and *Chicago Daily News* and vice chairman of the capital fund drive and co-chairman of individual gifts; Nicholas Gelitzine, partner in Bacon, Whipple and Company and general chairman of the campaign; and Daniel J. Shannon. In announcing the Capital Campaign, Chairman Nicholas Galitzine reported $3,190,000 in advance gifts, primarily from some of the Field Museum trustees.

needed. The Museum contemplates a unified air conditioning system capable of handling a total cooling load of approximately 3,000 tons.

—*James Simpson Theatre*, $1,185,000. The 1,125 seat theatre and supporting toilet and checking facilities are all original construction. Much broader use of this facility by science-oriented and other groups would be obtained if a modern functional facility could be provided. A completely renovated 1,000 seat threatre with new seating, lighting, and acoustical treatment together with modern lounge, toilet, and checking facilities is contemplated.

—*Lecture Hall*, $125,000. The Lecture Hall can be converted into an excellent modern facility of approximately its present capacity of 241 persons. The Museum has a great deal of use for a hall of medium capacity.

—*Architectural alterations and equipment for exhibits*, $5,000,000. To maintain and enhance the Museum's position as one of the world's largest natural history museums, substantial modernization programs should be initiated to incorporate recent marked advances to strengthen materially the quality of the public exhibits. This would involve substantial alterations of structure and integral elements of exhibits.

—*Terrace walls*, $800,000. Due to settling of the land fill, substantial portions of the terrace walls need resetting and replacement.

—*Exterior lighting*, $95,000. To enhance the aesthetic value of the classical structure of the Museum, the illumination level of the North and South porticos should be increased and the exterior lighting of the entire building upgraded.

—*Tuckpointing*, $150,000. Although the building has been tuckpointed intermittently over the years and as recently as 1970 $39,000 was expended, we urgently need to complete this work.

Here then is quite a different aspect of Field Museum's history. It's the practical aspect that bears most directly on what our future can be. If these critical financial needs are not met we won't immediately close our doors. Deterioration has much more subtle consequences than that, but they accelerate as time goes on.

It will be seen from the foregoing that Field Museum's plans are in the truest sense conservation—aimed at protecting the treasures in our care and at creating an institution that can serve its constituency through the 1970s and into the next decade. It is not a program of major expansion and it is not a frozen blueprint for several decades. We feel that one of the prime responsibilities of any service institution in this period of rapid change is to preserve flexibility. This dictates a constant assessment of institutional function based on contemporary community and national needs. The program we are embarking on is our pledge to the 1970s. Nothing less will fulfill our responsibility to those who have built a great museum in the past nor to those we seek to serve in the future.

Elizabeth Munger is associate editor of the Field Museum Bulletin.

NOTES FROM UNDERGROUND

HARRY G. NELSON

There are several things that almost everyone knows about earthworms:

1. They are slippery slimy creatures.

2. They make admirable fish-bait and can be collected at night after the ground has been wet.

3. They lack eyes but respond to light.

4. They live in the soil, burrowing in it by eating their way along.

5. They are hermaphroditic, combining both male and female parts in the same animal.

Some of the above statements are true, but some are misleading or omit even more interesting features of the animals. Let's examine them.

1. Under normal circumstances the outer surface of an earthworm is cool, moist, and covered with a thin coat of mucus. It is cool because it is moist; that is, evaporation of the moisture helps to keep the animal's temperature low. Like many "cold-blooded" animals, earthworms can be injured by even brief exposure to temperatures as high as those most mammals find comfortable. The mucus coat is responsible, in part, for the moisture, for it holds water, swelling or contracting as the amount of water increases or diminishes. As water is lost, the mucus becomes sticky and then stiff, and finally shrinks to a small fraction of its former volume.

Because the mucus tends to hold water next to the body surface, it also plays an important part in the respiratory exchange of atmospheric gases (oxygen, carbon dioxide, and even ammonia) through the worm's body surface. If the body surface becomes dry, passage of these gaseous materials is greatly slowed. The chemical composition of the mucus itself is not well understood. It apparently contains proteins and some kind of carbohydrate material, the combination being secreted by certain cells of the epidermis, the outermost single layer of living cells beneath the nonliving cuticle. The mucus may be

produced in large amounts and seems to account for as much as 50 percent of the nitrogen excreted from the body each day. (That is, the proteins of the mucus, lost to the body as it is worn away, contain nitrogen that is thereby given off.)

The mucus has several other important functions for the worm. It minimizes friction damage as the animal pushes its way through the soil. Its lubricating effect also undoubtedly aids in the emergency when a robin catches part of a worm in its beak. Also, as the mucus wears away and accumulates along the walls of burrows, it holds soil particles in place to keep the walls from collapsing. This kind of "engineering" would not work in sandy soils, and, in fact, earthworms are rarely found in soils that are very sandy. Of course, there is also the fact that sandy soils have poorer water-holding capacity than worms require.

A special thickened layer of gland cells, called the clitellum, produces a heavy dense mucus that plays a vital role in sexual reproduction in these organisms which are imperfectly adjusted to a terrestrial existence. The mucus partially covers the two worms during mating, minimizing damage to the sperms being transferred to the partner. The egg cocoon produced by each worm a few hours or days after mating is composed of a similar dense mucus.

As for mucus in general, apart from worms, virtually all groups of the animal kingdom, excepting only the Arthropoda, produce mucus on at least some parts of the outer surface and along such inner passages as the digestive tract and certain respiratory and reproductive passages.

2. Probably it's their easy availability and large size that have made earthworms the favorite bait among anglers, at least those who fish in inland waters. Worms do not normally drown in cool water, intact earthworms being known to live for more than a year while totally submerged, but they obligingly come to the soil surface during rains, especially when the weather is warm. As the rain tends to saturate the ground and fill all air pockets, the worms move up. They are responding partly to the decreased oxygen supply and increased carbon dioxide supply caused by many soil microorganisms enormously increasing their metabolic activity when water becomes abundant in the soil. The life activities of these bacteria, fungi, protozoans, algae, rotifers, etc. rapidly use up the oxygen not already displaced by the water and in the process release large amounts of carbon dioxide. Further, the liquid nature of the soil at this time greatly slows the movement of all gas particles compared with the action of diffusion when air permeates the soil.

There is another interesting aspect of this business of fishbait, and it has to do with the geography of earthworms. We do not understand why, but it appears that the earthworms of northern Europe have been amazingly able to invade other continents, establish colonies, and drive the native species out of the ground, as it were. There is no doubt that the European worms have been carried about by man in connection with one or another

of his enterprises. Many were transported in the soil accompanying cultivated plants; in fact, commercial greenhouses have unwittingly been staging areas aiding the invasion of temperate areas. And enormous numbers of soil-inhabiting organisms have been carried in the soil used as ballast in ships that carried lumber from the forests of eastern United States and Canada to Northern Europe. Since the ships could not safely come back empty, their holds were ballasted with bags of soil and rock. The dirt was emptied into New England harbors or the St. Lawrence River, and later on shore (under direction of harbormasters charged with the responsibility for maintaining navigable conditions for shipping). In this way hundreds of species of soil insects, other arthropods, annelid worms, and various micro-organisms crossed from the Old to the New World as well as to other continents.

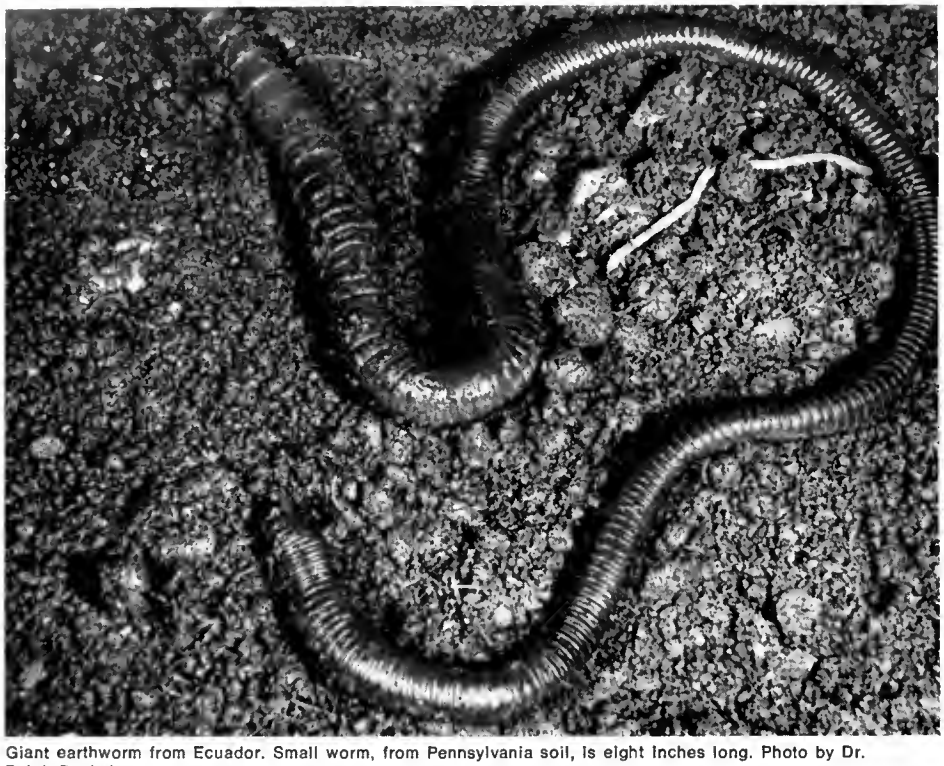
Typical mating position of *L. terrestris*. As the two worms lock tightly together by means of modified bristles with barbed hooks that each one thrusts into its partner's body, the glandular clitellum of each produces copious mucus which encloses the partners. This photo and photo on page 16 courtesy of CCM: General Biological, Inc.

In most cities of eastern North America; in such South American cities as Sao Paulo, Rio de Janeiro, Buenos Aires, Santiago; in most large cities of Australia and New Zealand, the only species of earthworms to be found are species introduced from Northern Europe! In the Chicago area even the forest preserves in the farther reaches of Cook County contain these introduced species. It may be observed that city parks and domestic gardens are areas that in one way or another are maintained in an unnatural condition—unnatural, that is, compared with original forest or prairie soil. It is probable that this maintained or managed state somehow gives an advantage to the foreign earthworms. In North America north of Mexico, of a total of sixty species of earthworms recorded in 1966, 37 (61 percent) were introduced from Europe. Interestingly, the only species of earthworms now found in those portions of Europe from which the glaciers retreated 12,000-15,000 years ago are the same species that have been able to migrate around the world.

The favorite "angle" worm is *Lumbricus terrestris,* the big night crawler, or "dew-worm." This species, perhaps the most studied member of the phylum Annelida, is a typical member of the European peregrine (i.e., traveler) group of species. It has been brought by fishermen to parts of the world not only where it was previously absent but where no earthworms previously existed. For better or worse, this species of angle worm is now available "naturally" in the highest remote areas of the Rocky Mountains, in most of the National Parks, and on every continent. Its large size and rapid rate of reproduction have undoubtedly aided in its dispersal.

Although some individual worms may be out and active on cloudy days, various factors make earthworms active primarily at night. They are less vulnerable to such predators as robins and woodcocks (few other birds feed regularly on earthworms). The simple exchange of respiratory gases through a worm's body surface will be more likely to meet its internal requirements during the lowered temperature and higher relative humidity of the dark hours. And also, loss of water from its body surface will be minimized. The adult *Lumbricus* loses an estimated 60 percent of its total weight as water each day under average circumstances. In dry periods earthworms retreat to lower levels in the soil, in some cases to ten feet below the surface. They may finally retreat to a small chamber and become twisted into a close knot surrounded by a film of drying mucus. This condition may persist for several weeks until increased moisture becomes available. In certain species a true estivation, or diapause, sets in. Once asleep, the animals cannot be roused by any change in temperature or moisture conditions. The dormant state lasts about two months and has been supposed to be controlled by a hormonal mechanism.

3. Although other classes (Polychaeta and Hirudinea) of the phylum Annelida possess eyes, often of considerable complexity, earthworms do not. However, all species studied do have



Giant earthworm from Ecuador. Small worm, from Pennsylvania soil, is eight inches long. Photo by Dr. Ralph Buchsbaum.

single cells scattered in the dorsal epidermis, particularly near the anterior end, which are like minute eyes. Groups of similar cells are found in the nerve cord as well as certain anterior nerves. An internal lens-like body in each cell appears to concentrate light rays upon a nerve fiber. Blue light produces the maximum response from worms, while red light appears hardly to be detected, except as it may have a warming effect. A worm's response to strong light is to suddenly withdraw into its burrow. On the other hand, earthworms are positively attracted to weak intensities of light. Thus, the worms are kept in their burrows by their innate responses to daylight, when, in fact, it would be dangerous for them to be active. Correspondingly, they are attracted out at night when conditions are less inimical to their survival.

But their light-sensitive mechanisms sometimes betray them. Worms do not appear to be able to detect ultraviolet light in the usual sense, but they are sensitive to it, as is all other protoplasm. When heavy rains saturate the ground and earthworms come to the surface during the daytime, even if the sun is not shining brightly they are exposed to much more ultraviolet light than at night. It is a common experience after a heavy daytime rain to find many dead and dying worms on the ground. They came up in a time of stress for a "breath of fresh air" and were fatally injured by the ultraviolet light from the sun. Sixty seconds of full sunlight is enough to fatally injure an earthworm.

4. In the loose upper layers of soil, particularly near bodies of water, earthworms are able to push their way between soil particles by means of coordinated contractions of the circular and longitudinal muscles of the body wall. The fluid contained in their coelomic body cavities hydraulically extends the several anterior body segments, which become progressively more slender toward the front tip. However, in more densely packed soil at greater depths, or in heavy clay or earth thick with plant roots, the earthworm's only means of burrowing is to eat its way along. Secretions from glands of the front end of the digestive tract soften the earth and make swallowing easier.

Killing two birds with one stone, as it were, the normal collection of digestive enzymes is secreted into this soil that more or less fills the digestive cavity. Whatever was swallowed that can be digested by these enzymes is fragmented chemically and absorbed, mostly from the intestine, which takes up three-fourths or more of the posterior part of the body. It is evident, however, that in many species (such as *L. terrestris*) the amount of food a worm takes in during burrowing activity is only a small fraction of what it consumes during nightly foraging at the surface, while keeping its posterior end in the burrow. Study of the microscopic contents of the digestive tract of earthworms discloses various soil algae, fungi, rotifers, smaller earthworms, nematodes, many insect larvae, protozoans, and so on.

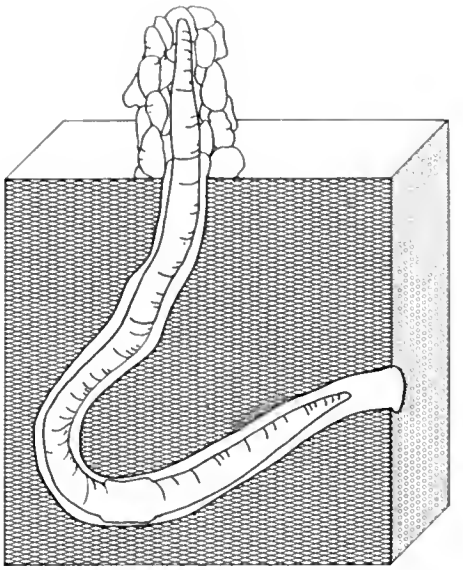
When an earthworm is ready to eliminate its load of diggings, it backs up through an existing tunnel to the surface of the ground or into an abandoned burrow and empties perhaps as much as one-third the intestine of its semifluid contents. These "castings" contain particles of soil whose average size is less than uningested soil and whose bacterial count is increased by about one-third. There is some evidence that such natural manure may be beneficial to plant growth even if the earthworms themselves are absent, although the active presence of earthworms is even more helpful. In some cases the crops grown in experimental greenhouse plots were 200 percent greater when earthworms were present than when they were excluded. Their numerous channels (as many as 280 were counted in a square meter of soil at a depth of fourteen inches) aids aeration

of the soil, penetration of rain water, growth of aerobic bacteria and other organisms, decay of organic material, and the movement of many other small animals. Some earthworm burrows found at depths of several feet in clay soils have undoubtedly existed for many years.

Earthworms can bring an amazing amount of soil to the surface from lower layers. (Charles Darwin published the first serious study of this matter in his book *The Formation of Vegetable Mould, by the Action of Worms,* in 1881. Up to 700 lumbricid worms have been reported under the surface of one square meter of meadow soil. It has been calculated that up to 17.5 lbs. of soil per year are carried to the surface of every square meter in a large field from depths as much as several feet. Objects at the surface have been estimated to sink at rates of 3-5 mm. per year. Buildings as big as Roman dwellings in Britain and Indian houses in Central America have disappeared into the earth largely due to the action of earthworms.

Different species of earthworms live at different depths in the soil, some never reaching the surface. Such "preferences" may be related to moisture or soil type, although smaller species are usually confined to the upper few inches because their particular food is found only there.

Earthworms cultivate their soil environment in another way too. Every gardener has noted tufts of twisted leaves and twigs, sometimes a dozen or more, protruding from the ground, particularly on mornings after cool nights. During the night the worms' searching mouths have pulled these bits of organic material that is their major source of food into their burrows to eat. In the process numerous seeds are effectively planted and may take root. Narrow leaves, such as willow or grass, may be pulled well into the burrow, making a lining to a depth of several inches.



Earthworm castings can build up to considerable heights at the soil surface.

5. Although all earthworms are hermaphroditic, the usual method of reproduction is by cross-insemination. Each of the partners during the mating process receives several thousand spermatozoa from the other. After mating, which commonly takes a few hours, the animals separate and return to their respective burrows. A few cocoons (7 mm. x 5 mm. in *L. terrestris)* are formed later and are deposited in the soil or among leaf debris, where in warm, moist climates they hatch in a few weeks. The young *L. terrestris* worm is about 10 mm. long. In this species usually only one worm emerges from each cocoon, but mating is more or less continuous in spring and fall, cocoons being deposited every three or four days.

A very few cases of self-impregnation have been reported in earthworms. That is, worms isolated from all others from the time of hatching or before have been found to produce fertilized eggs. There is a possibility that viable sperms from another worm persisted in the environment in any of a number of ways, so perhaps the conclusion that self-impregnation occurred is not strictly warranted from this evidence. But it is at least plausible.

Parthenogenesis is another modification of the usual cross-fertilizing method—meaning that offspring develop from the unfertilized eggs of a single parent. Parthenogenesis has been increasingly reported in earthworms during the last twenty years and may be more common than is yet realized. The details vary somewhat, but the general situation is that normal sperm are simply not produced, yet eggs are laid which develop into embryos and finally young worms. Chromosome analysis demonstrates that parthenogenesis has occurred and distinguishes this kind of reproduction from self-impregnation.

At least some of these cases suggest evolutionary changes in process—that is, some of these species are becoming parthenogenetic at the present time.

There are other peculiar aspects of earthworms. For example, to continue the list we started with:

6. They possess five pairs of hearts.

7. They lack hard skeletal structures, their cuticle being thin and nonsupporting.

8. They can regenerate missing parts.

9. Their size ranges from ¾ inch long to 8 feet, though the largest American species (in the South) is only 3½ feet.

10. They perform useful functions in compost piles and hence in organic gardening.

But there is a danger in telling more about earthworms than a lot of people want to know in one sitting. So the rest can wait for another time.

Harry G. Nelson is associate, Division of Insects, Field Museum, and professor and chairman, Department of Biology, Roosevelt University.

migrations melvin a. traylor

This is the time of year when even the most case-hardened city dweller becomes aware that something is moving besides the cars on the expressways. In late August he realized without thinking of it that there were great flocks of martins roosting nights on the Bahai Temple and Aquarium; in September the calls of high-flying nighthawks drew his attention skyward, but in October the insistant honking of the geese as their lines and "V's" move southward over the city itself makes him realize that summer is indeed ended and the birds are on their southward migration. With his awareness thus heightened, he recognizes from the gentle rain of warblers and thrushes around "Big John" and the other tall buildings that this movement involves most birds, both big and small.

Although the migrations of larger birds, particularly the enormous flights of waterfowl, were understood by the ancients, the ability of sparrow or warbler-sized birds to travel thousands of miles a year was not accepted until the last century. They were generally believed to hibernate in hollow trees or in the mud of ponds, or else to hitchhike their way south on the backs of eagles or hawks. It is only through collecting in tropical countries during the northern winter, and by tracing the movements of individual birds through the use of numbered bands, that an accurate knowledge of the migration of each species has been determined.

The more one learns about migration, the more one is impressed by the amazing diversity of migratory patterns, and by the enormous distances that some birds travel. Some species, such as our familiar Song Sparrow and Blue Jay, move only as far as the severe weather forces them, and hardy individuals may even remain here during the winter. At the other extreme, the Barn Swallows and Bobolinks will leave here in late August, when the weather is still fine and food abundant, and travel 6000 miles to Argentina, where they are among the more conspicuous birds of the southern summer. We like to think of these last two as our typical native birds, but the four months they spend with us are no more than the time that they spend in South America. As one goes further north, this discrepancy between time spent on breeding and wintering grounds becomes even greater. The shorebirds that breed on the arctic tundra have barely two months in which to rear their young, and individuals that we saw migrating north in May will be back with us on their southbound voyage in late July.

The routes followed by these long-distance migrants are not a simple south in autumn and north in spring. A glance at the map will show that the whole of South America lies east of New York, and our birds that winter there must make a southeasterly flight. Some may accomplish this by following the arc of Central America, but the majority make it by flying directly across the Gulf of Mexico or the Caribbean, even though this involves a non-stop flight of several hundred miles. The flights of European song birds to Africa are even more remarkable. Not only must they cross the Mediterranean, but immediately thereafter they are faced with 1000 miles of Sahara Desert, which offers nothing but death by desiccation for birds that land there. It has been determined that many of the European song birds must make a minimum non-stop flight of 1200 miles, no small feat for a bird weighing an ounce or two. They are able to accomplish this by laying up fuel in the form of a heavy layer of fat just before they start their flight. When they take off, up to 30 percent to 40 percent of their weight may be fat, most of which will be expended by the time they reach subsaharan Africa. The most remarkable long-distance migrant of all is the Arctic Tern. After breeding in northern Canada, it crosses the north Atlantic, goes south along the west coast of Europe and Africa, winters in antarctic waters, and returns north along the coasts of the Americas, a 25,000 mile round trip every year.

Most people who have had birds nesting around their homes have wondered whether the same birds return each year or new ones arrive opportunistically. The general rule (no rule of behavior can be written that will fit all species) is that the same bird or pair of birds will return year after year to the spot where they nested previously. This was demonstrated many years ago with Purple Martins and later with many other species. But what has only

recently been appreciated is that each bird will have its own restricted wintering ground to which it returns year after year, even though the latter has none of the strong breeding associations characteristic of the northern home. Dr. Jocelyn van Tyne first demonstrated this in 1934 by banding Indigo Buntings in Guatemala one winter and finding the same individuals returning the following year. Since his pioneering efforts others have demonstrated the same for many species both in Africa and tropical America. Even more remarkable than this ability to find the same garden or field after a trip of several thousand miles is the proven ability to follow the identical route along the way. Banders trapping birds during migration are finding that the same birds pass through, autumn after autumn or spring after spring. One bander in Tunis on the north coast of Africa captured the same Redstart each spring for three years. For the Redstart this meant crossing a thousand miles of featureless desert and finding the same small garden in which it rested a few days the previous year before leaving for its nesting home in Europe. It would be like stopping at the same gas station on the way from Chicago to New York, but without any roads to guide us.

One can hardly study migration without wondering how the birds find their way. It was originally believed that they piloted by following natural features such as shorelines and major rivers, and these were frequently designated major flyways. There is no question that birds do take advantage of these landmarks, and there are often concentrations of migrants in favorable areas, but too much accurate navigation takes place in the absence of natural features for this to be the only means. The Bristle-thighed Curlew crosses a minimum of 2000 miles of open ocean from Hawaii to its only nesting place in western Alaska, and it must obviously navigate without landmarks. Experiments have shown

Migrations of the Bobolink. After making an anormous flight across the Americas, the Bobolink winters in eastern Bolivia, southern Brazil and northern Argentina.

that some species orient by the stars and others by the sun, and in both cases they have an inner clock that allows them to compensate for the rotation of the earth. Bird navigation is too large and uncertain a subject to be treated fully in an article on migration, but my own feeling is that birds will use all the means mentioned above, as well as others not demonstrated, such as the magnetic field of the earth.

The altitude at which birds fly is another aspect of migration for which many details are known, but for which no general rules may be laid down. Radar studies show that small songbirds may fly at any level up to 5000 feet above the ground, and the shore birds and waders up to 10,000 feet. Generally the migrants are higher on clear nights than on cloudy ones, and it is the low-flying birds on the cloudy nights that are confused by the lighted buildings of the city and fly into them. These dead and injured birds are usually the city dweller's only clue to small-bird migration. The absolute height records are probably held by migrants crossing the Himalayas, where even the passes are at 20,000 feet.

Whatever the means of navigation, the particular pattern of migration is genetically determined for each species. Among many of the shorebirds the adults leave as soon as the young can fend for themselves, and the latter make migrations of thousands of miles without any experienced birds to guide them. One would expect that the evolution of such intricate behavior would take countless thousands of years, but those of our more northern migrants must have evolved within the last 10,000 years, because before that their breeding grounds were covered with ice. A suggestion of how present migratory routes developed may be found in the migrations of species that are at present rapidly extending their ranges. The Asiatic Arctic Warbler and Yellow Wagtail have crossed over and now nest regularly in Alaska, and our Gray-cheeked Thrush now nests in eastern Siberia, but in each case the birds cross back over the Bering Sea to return to their old wintering grounds, instead of going south to the much nearer tropical areas of their new continents. Apparently the birds are conservative in their habits, and new routes are built up by adding small increments to the old ones.

I have confined my discussion to bird migration, for that is my own field of knowledge, but migration is not confined to any one group of animals. Butterflies, of which the best known is our Monarch, may travel a thousand miles, and the former seasonal movement of the Buffalo on the plains was one of the most awesome sights of nature. Salmon are notorious for their breeding runs, and already the Coho in Lake Michigan have developed a predictable pattern that allows the fisherman to meet them on their way up the lake in summer. Even though we cannot fully understand how migration takes place, we can be enthralled by the beauty and intricacy of the patterns nature develops.

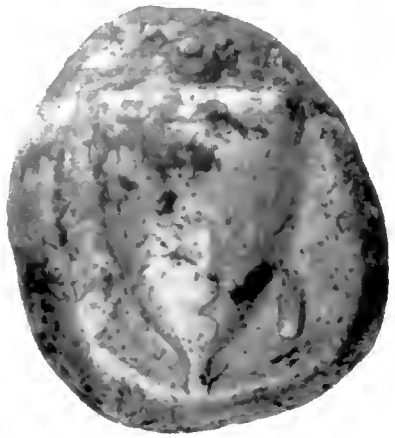
SUGGESTED READING

Jean Dorst. *The Migrations of Birds*. New York: Houghton Mifflin Co., 1962.

Robert T. Orr. *Animals in Migration*. New York: Macmillan Company, 1970.

Melvin A. Traylor is associate curator of birds, Field Museum.

before credit cards elizabeth munger



When the inhabitants of one country became more dependent on those of another, and they imported what they needed, and exported what they had too much of, money necessarily came into use. For the various necessaries of life are not easily carried about, and hence men agreed to employ in their dealings with each other something which was intrinsically useful and easily applicable to the purposes of life, for example, iron, silver, and the like. Of this the value was at first measured simply by size and weight, but in process of time they put a stamp upon it, to save the trouble of weighing and to mark the value.—Aristotle, *Politics,* Bk. I:Ch. 9, 33-41, trans. by Benjamin Jowett.

Several especially important ancient Greek silver coins and two Roman medallions, part of a collection recently donated to Field Museum by Jon Holtzman, of Madison, Wisconsin and Paul Holtzman, of Las Vegas, Nevada, are on display in the South Lounge through November 7. Three different styles of coin from the 6th century B.C. represent the earliest period in the history of coinage, the *Archaic* period of Greek art. One beautiful specimen from the 4th century B.C. exemplifies the *Finest Art* period.

Western world coinage is believed to have been invented about 640 B.C. in the Asia Minor Kingdom of Lydia. That's what Herodotus said, and most modern scholars are disposed to agree with him. The beginning of coinage in China about the same time was probably an independent invention. In the West the first metal used was a naturally occurring mixture of gold and silver called electrum, which came from the river beds in Lydia. But silver then became most commonly used, and only occasionally gold.

Among ancient Greek coins now on display in South Lounge are these illustrated. *Page 22, top to bottom:* stater of Aegina, struck 550-480 B.C., obverse and reverse, and tetradrachm of Athens, struck 540-500 B.C., obverse and reverse. *Page 23, top to bottom:* tetradrachm of Acanthus, struck 525-500 B.C., obverse and reverse, and tetradrachm of Clazomenae, struck 387-301 B.C., obverse and reverse.

Technologically it was really just a step forward to make small equivalent units, coins, of the precious metal bars or ingots that were previously used in trade exchange—no doubt sometimes stamped with their claimed weights, and perhaps even a mark identifying their origin.

The stater was an early basic weight denomination. It's an oversimplification of many variations of standards, but we could think of 3,000 shekels (staters) = 60 Minae = 1 Talent, and 1 stater as equal to 2 drachms. Hence the tetradrachm pieces shown here were equal to two staters. Electrum consisted of about 73 percent gold and 27 percent silver and was valued at 10:1 in relation to silver. The same weight standard was thus easily usable for both metals, so that one electrum stater or tetradrachm would equal ten silver staters or tetradrachms. Gold was more complicated because it had a 13.1:1 relationship to silver.

The first coins were merely equivalent weights of metal lumps hammered more or less flat between two unengraved die punches. This technique, which accounts for their irregularities, remained the standard method for at least 1,500 years. But artistic treatment emerged very early in the form of an engraved image (called *type*) on the lower die, which produced the obverse or face of the coins. The reverse side had only an incuse, a rough indentation from the punch.

In the beginning the types were animals, which probably had sacred significance as well as special local import for the town issuing the coins. Only later was the image of a divinity especially important to the town used.

Its purpose was not only to identify the origin of the coin but also to impress the users that an unimpeachable witness vouched for its full weight and purity. In fact, a vestige of the tradition is still with us, for our own coins assert "In God We Trust." These silent invocations did not identify the value of the coins, whatever Aristotle meant (the translation is a little ambiguous). They "marked" the value of coins only in the sense of an intended guarantee of full value.

But neither forgeries nor debasement were prevented by such devices. Some of the specimens on display show how wary ancient bankers made their test cuts to be sure the coins were pure through and through. In fact, there is evidence that in Roman times debasement was sometimes so institutionalized that mintmasters had to earn their pay by producing a certain proportion of coins that were merely silver-plated over a copper core.

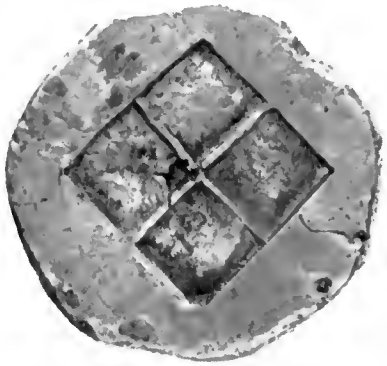
The first European Greek city-state to establish coinage was Aegina, in the late 7th century B.C. The early example shown here has the smooth-backed sea turtle emblem, an animal sacred to Aphrodite, whose temple overlooked the harbor of Aegina. One of her most important responsibilities was to function as goddess of trade. Aegina's coins became the internationally accepted currency of trade throughout the Peloponnese until Athens took possession of the island during the Peloponnesian War.

Athens' coinage, established about 575 B.C., was the first to use a type on both sides and also the first to use a human head to identify a god. The "almond" eye of Athenia in profile on the obverse side of the specimen shown here is a mark of the *Archaic* period. The owl on the reverse side was as much the emblem of the city as was their patron goddess; it represented the Athenian god of the night, the originals of which lived in the hills around the city. Next to the owl the first three letters of the city's name can be faintly distinguished. These emblems persisted in Athenian coinage down to the time of Augustus, though the style of representation changed. The Athenian "owls" challenged and replaced the Aeginetan "turtles" as the pre-eminent international currency.

A lion downing a bull was the constant—and appropriate—emblem of the city of Acanthus in Macedonia, for according to Herodotus this area had many lions and wild bulls. Even camels in Xerxes' expeditionary forces against the Greeks were attacked by lions in this district. The reverse side of the example shown here has the quartered-square incuse that this city's coins retained until late in the 5th century B.C.

The tetradrachm of Clazomenae with its high-relief three-quarter-view head of Apollo on the obverse and spread-winged swan on the reverse side is a choice example of the high artistic level Greek coins reached during the 4th century B.C. The die engraver, Theodotos, signed his work, though it is not legible on this specimen. Of the only twenty specimens of this coin known to exist, two are in the British Museum, and now one in Field Museum.

Elizabeth Munger is associate editor of the Field Museum Bulletin.



FIELD BRIEFS

Brenton Reported Missing

Francis Brenton, who soloed the Atlantic three times, twice in dugout canoes, has not been heard from since leaving on his latest venture. The writer-photographer sailed from Portsmouth, Virginia on March 22 bound for Portsmouth, England. His craft was a catamaran, the *Sarape*, made of two decked-over dugout canoes. The U.S. Coast Guard has called off the alert for him because of the time that has elapsed.

Brenton returned from South America early this year with more than 100 artifacts collected for the Museum while exploring the jungles along the Amazon and Orinoco Rivers.

In 1967, after a 107-day voyage that had begun at Trepassey, Newfoundland, he was unwillingly rescued by a Russian ship, just 30 miles from his destination, the African coast.

Resourceful Brenton has made it successfully through many difficult situations in the past. When necessary, he existed on a diet of barnacles and seaweed during long voyages. He is an excellent sailor.

We hope that we have news that he is safe and well soon.

Backyard Safari

Field Museum, the Chicago Board of Education, and WBBM-TV are cooperatively producing a 39-week series of natural history television programs for young Chicago viewers. "Backyard Safari" can be seen each Sunday, 8:00 - 8:30 a.m. on Channel 2. The programs focus on the natural history of the Chicago area and encourage viewers to enjoy studying natural history "in their own backyard."

Program host is Dr. Leonard Reiffel, CBS science consultant. Appearing on the show each week with Dr. Reiffel are a special guest—often a Field Museum scientist—and two science students from Chicago schools.

AAA Short Courses

The first in a series of short courses for college teachers on a broad range of subjects will be presented at Field Museum on October 28 and 29, sponsored by the American Association for the Advancement of Science. The opening courses are Thermodynamics and Biology and Human Affairs. Other courses will be offered in two-day sessions in November and December.

Supported by the National Science Foundation, the program is open to college teachers in the natural and social sciences, mathematics, and engineering from two or four year degree-granting institutions. It is offered at twelve field centers throughout the country. The courses consist of an initial session of two days of intensive lectures and discussions, followed by approximately three months for individual study, and a final two-day session in February and March, 1972.

For further information contact the Museum's Department of Education.

de la Torre Appointed Head of Mammals

Dr. Luis de la Torre has been appointed curator and head of the Division of Mammals in the Museum's Department of Zoology. Prior to this appointment he was professor in the Department of Oral Anatomy at the University of Illinois Medical Center, but he has also been associated with our Division of Mammals for twenty years. Dr. de la Torre's research has covered such diverse areas as chromosome and DNA analysis and descriptive taxonomy.

Young Visitor

Nine-year-old Kevin Dye, who managed to survive during the 11 days he was lost in the Wyoming wilderness, came to Field Museum recently to see the animals and birds in the collections. He is shown with his parents, Mr. and Mrs. Phillip Dye of Casper, Wyoming, as they visited Malvina Hoffman's sculpture of the Vadda Man from Ceylon. Kevin was in Chicago for a week of testing by medical specialists.

$25,000,000 Capital Campaign

Field Museum has launched a three-year capital campaign to fund a $25-million major improvement program. These funds are needed to maintain and modernize the Museum's fifty-year-old building, revise and renovate exhibit areas, install new and relevant exhibits, and improve visitor service and educational facilities. The full story of the capital campaign is told in "More About Field Museum, or Why We Need $25,000,000" beginning on page 9 of this issue of the *Bulletin*.

Field Museum's Woman's Board members are busy planning a gala Jade Ball on November 5 to inaugurate the soon-to-open "John L. and Helen Kellogg Hall," housing the Museum's famous collection of Chinese jades. Mrs. Edward F. Swift, vice-chairman of the decorations committee, and Mrs. Thomas E. Donnelley II, chairman of the Jade Ball committee, unpack some of the beautiful Chinese lanterns just received from Singapore and Hong Kong that will be part of the exciting setting for the event. Tickets are $50 per person and reservations may be made by phoning or writing the Women's Board.

Jade Ball

November 5

CALENDAR

Exhibits

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Continues indefinitely. Hall 25.

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of textiles blending classical African motifs and contemporary design. The original Field Museum Benin artifacts which inspired many of the designs are also shown. Financial assistance for the exhibit was received from the CNA Foundation, Chicago, and the Illinois Arts Council, a state agency. Through December 31. Hall 9.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

Rare Ancient Numismatic Collection, a highly important group of four Greek silver coins from the sixth and fourth centuries B.C. and two Roman medallions from the third and fourth centuries A.D., on display in the South Lounge through November 7. They are part of a collection donated to Field Museum by Jon Holtzman of Madison, Wisconsin, and Paul Holtzman of Las Vegas, Nevada.

Hours

9 a.m. to 5 p.m. Saturday through Thursday, and 9 a.m. to 9 p.m. Friday.

The Museum Library is open 9 a.m. to 4:30 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Children's Programs

Continuing

"Between the Tides," Fall Journey for Children, takes them hunting for exotic and beautiful sea creatures in the Museum exhibit areas. All youngsters who can read and write are welcome to join in the activity. Journey sheets are available at Museum entrances. Through November 30.

Film Program

Free Natural History Film "Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturdays and 11 a.m., 1 p.m., and 3 p.m. on Sundays in the second floor Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit. Continues indefinitely.

Fall Film-Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre.

October 16: "Norse Adventure," narrated by Hjördis Kittel Parker. A film history of Norway from the Ice Age through the Viking Period and up to the present time. Highlights include the flora and fauna of Spitzbergen, near the North Pole; the home life of a modern Oslo family; and scenes of the magnificent fjords.

October 23: "Our Glorious National Parks," narrated by Edward M. Brigham, Jr. A film commemorating the creation of the first national park in 1872. It emphasizes the need for the protection of wildlife and natural wonders. Some of the parks shown are Yellowstone, Glacier, Mesa Verde, Petrified Forest, Grand Canyon, Rainbow Bridge, Zion, Yosemite, and Brice.

October 30: "Ecuador and Darwin's Galapagos," narrated by Hugh Pope. This unusual film visits Quito, where quaint Spanish traditions abound, the jungles of the Oriente Province, and the Colorados Indians; it then travels six hundred miles off the mainland of Ecuador to the fabulous Galapagos Islands, where penguins, giant tortoises, marine iguanas, and other unique creatures roam unafraid.

November 6: "As an Artist Sees Spain," narrated by Franklyn Carney. A film journey to the Prado Museum, El Greco's Toledo, and colorful cities and gardens.

November 13: "Camera Safari to Africa," narrated by Col. John D. Craig. A film tour of important game parks to see the wildlife and scenic wonders.

November 20: "The Two Worlds of Berlin," narrated by Arthur F. Wilson. A timely biographical sketch on film of a city and its people from World War II to the present.

November 27: "Micronesia," narrated by C. P. Lyons. A film story about a group of tiny islands in the Western Pacific and the colorful people who still retain their picturesque customs and traditions.

Meetings

October 12: 7:45 p.m., Nature Camera Club of Chicago.

October 12: 8 p.m., Chicagoland Glider Council.

October 13: 7:30 p.m., Windy City Grotto, National Speleological Society.

October 14: 8 p.m., Chicago Mountaineering Club.

October 17: 2 p.m., Chicago Shell Club.

A Reminder

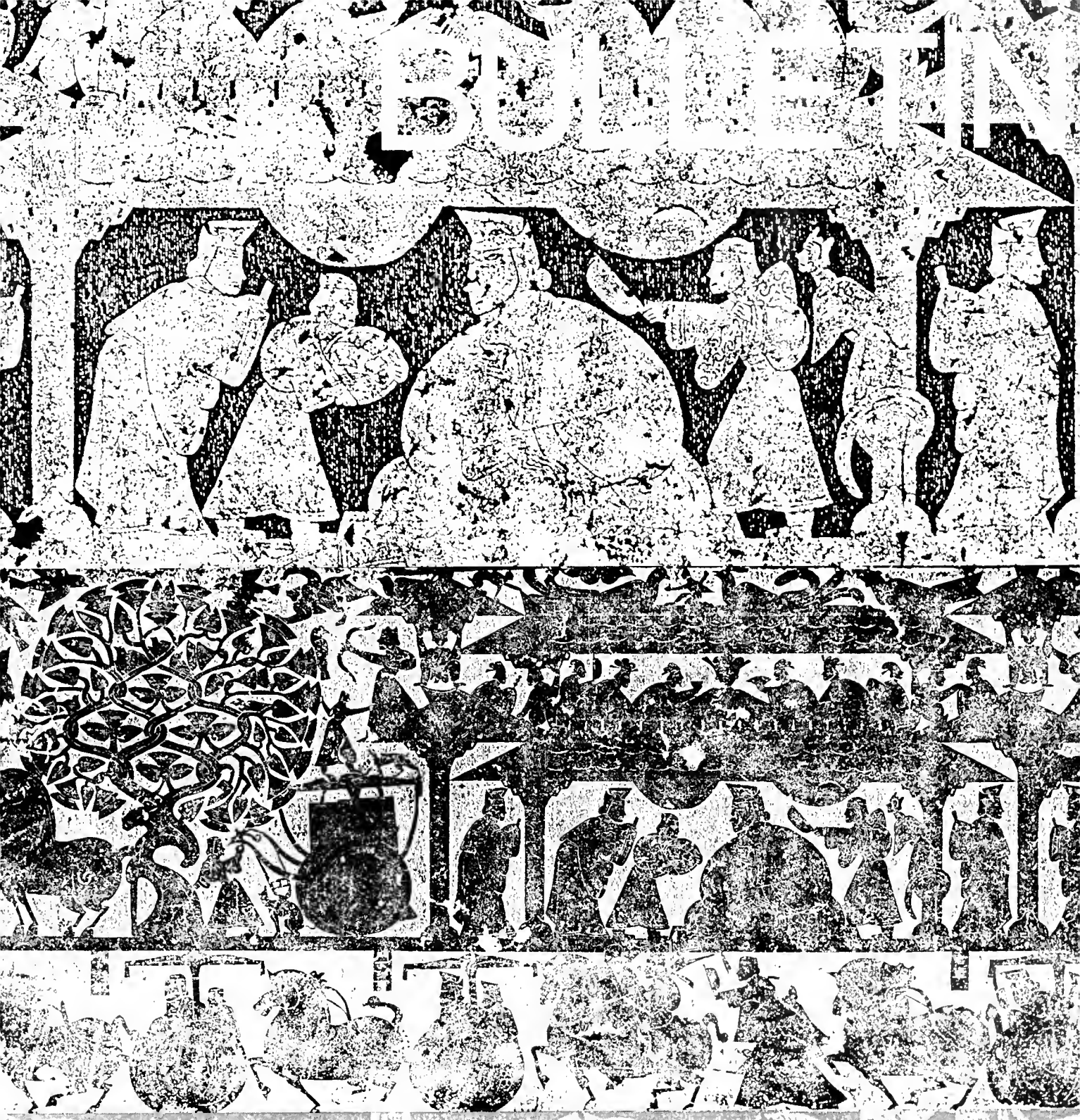
Visits to Field Museum earlier in the day are recommended for Sundays when Chicago Bears home games are scheduled in Soldier Field.

Because of the afternoon games, the Southeast parking facilities will be filled, and the North lot reserved for Museum guests undoubtedly strained to capacity.

Dates are: October 10 and 31, November 7, 14 and 21, and December 19.

Sue Maxwell
641-4578

BULLETIN



BULLETIN

Volume 42, Number 10
November 1971

Cover: Taken from rubbing from Wu family shrine, Shantung Province, Letter Hen Dynasty (A.D. 25-220), depicting reception of King Mu by Hsi-weng Mu, the legendary mother queen of the west. She dwells in the K'un-lun Mountains and has within her power the gift of immortality. Enlarged facsimile of rubbing is in the new Hall of Jades.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; **Associate Editor** Elizabeth Munger; **Staff Writer** Madge Jacobs; **Production** Russ Becker; **Photography** John Bayalis, Fred Huysmans.

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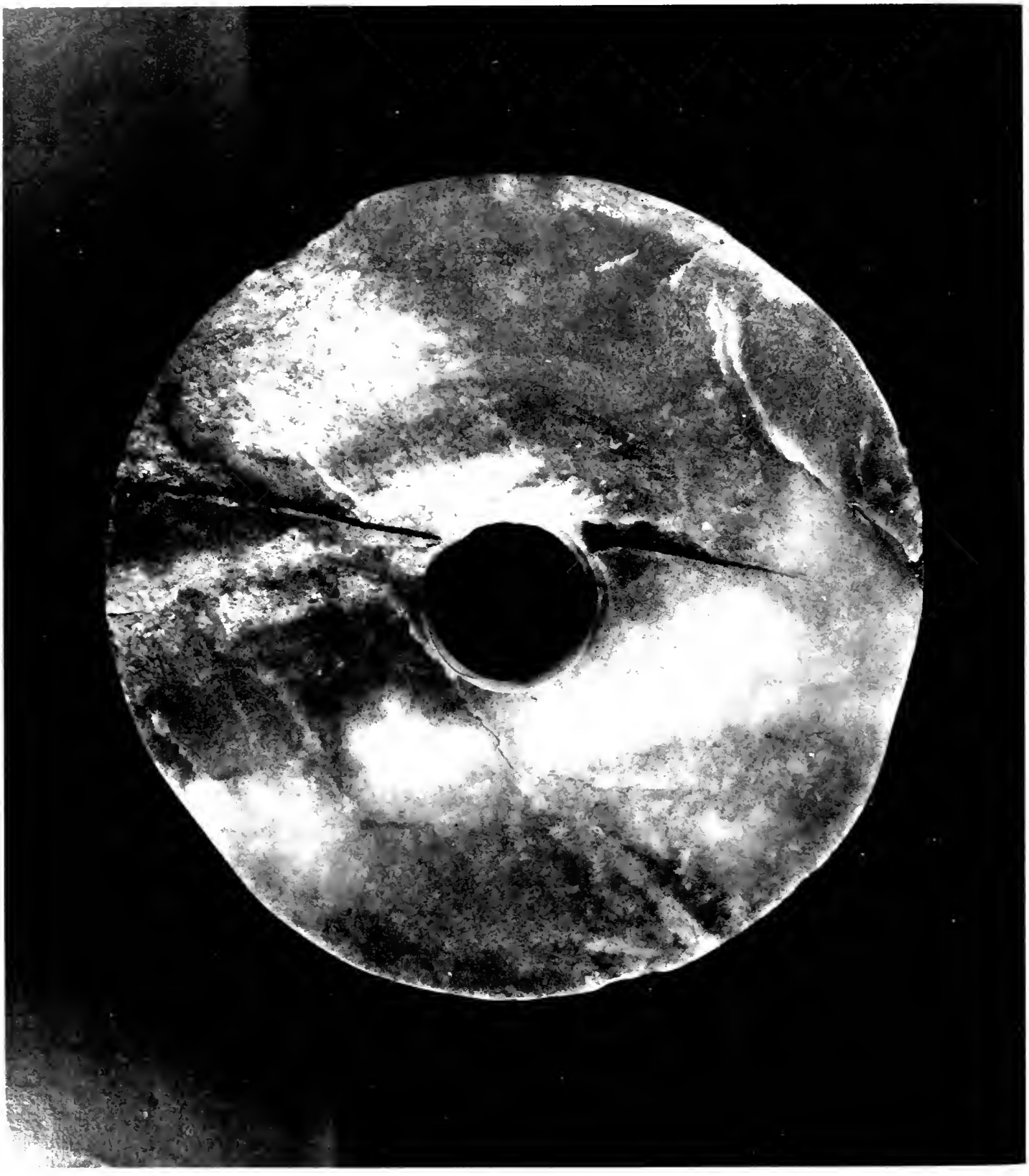


Jade in Chinese Culture

Louise Yuhas

Hundreds of the choicest pieces in Field Museum's exceptional collection of Chinese jade carvings are again on view as of November 10. That is the opening date of the new jade room, called the John L. and Helen Kellogg Hall of Jades. This new permanent exhibition was made possible by a generous gift from Mrs. Kellogg in memory of her husband.

The old jade hall was closed in 1969 to permit redocumentation of many pieces based on new archaeological data which made more accurate dating possible.

The foundation of the Museum's collection was laid by Dr. Berthold Laufer, a major figure in the early study of jade and jade carving and chief curator of the Department of Anthropology from 1915 to 1934, on two separate expeditions to China—the Mrs. T. B. Blackstone Expedition of 1908-1910 and the Captain Marshall Field Expedition in 1923. The largest single addition was the Bahr Collection, acquired in 1926. Its purchase was made possible by a large contribution mainly from Mrs. Frances Gaylord Smith, who also bequeathed to the Museum her important collection of jades of the Ch'ing Dynasty and modern period. Many other people have also added fine pieces to the collection.

To mark this new exhibition of our jade treasures, a brief review is presented of the role of jade in Chinese culture from the Neolithic period down to modern times.

All of the objects pictured are among those on exhibit in the new hall, along with Chinese porcelains, bronzes, scrolls, rubbings, and ceramics.

Though several cultures have carved jade at one time or another, the Chinese raised the craft to its greatest height in a tradition spanning all that nation's history from the Neolithic period to the present. The position of jade in Chinese culture can only be compared with that of gold in the West. Just as

Jade carving is one of China's oldest continuous traditions, spanning over 4,000 years. The earliest carvings were made during the Neolithic period, which flourished in China—especially northern China around the Yellow River—for several thousand years, ending about 1500 B.C. Jade was then one of the hardest materials known, and Neolithic Chinese carved their weapons and tools in it.

The jade disk shown opposite is called a *pi*. Its function in Neolithic times is uncertain, but gradually the *pi* became accepted as a symbol of heaven and was used both in religious ceremony and for burial with the dead.

When the use of bronze became widespread in China's first historical period, the Shang Dynasty (c. 1500-1050 B.C.), jade was no longer essential for tools and weapons and became ceremonial in function.

Shang motifs are almost all animal-like forms. Many carvings combine human and bird characteristics, for the Shang people, whose religion may have been animistic, traced their origins to a mythical bird. Although the small carvings shown here were buried with the dead, it is likely that they were worn during the life of their owners. Some are perforated pendants or appliques. The fish, traditionally the symbol of wealth and fertility, is one of the most common types of burial carvings. The small dragon bears bovine horns; its typical Shang eye hooks sharply downward at the inner corner. Although most Shang carvings are very stylized, some, such as the alligator here, combine formalized heads with naturalistic bodies. *Top,* fish; *left,* crested bird; *right,* dragon, alligator.

gold and jewels—the most precious of materials to Western eyes—were thought to be most suitable for religious and courtly objects like chalices, sceptres, reliquaries, and crowns, so also jade was treasured by the Chinese, who fashioned it into the paraphernalia of their ceremony and religion. Jade has also taken a role in the Chinese language analogous to the role of gold in European imagery: heart of jade, tree of jade (handsome young man), and wheel of jade (the moon) are common metaphorical expressions. The chief deity of the Taoist religion is Yü-huang-ta-ti, the Great Jade Emperor.

One reason for this, of course, is the beauty of the stone itself. The qualities peculiar to jade were sometimes compared to the characteristics of the man of virtue. A lexicon compiled in the 2nd century A.D. defines jade as follows:

Jade is the fairest of stones. It is endowed with five virtues. Charity is typified by its lustre, bright yet warm; rectitude by its translucency, revealing the color and markings within; wisdom by the purity and penetrating quality of its note when the stone is struck; courage in that it may be broken but cannot be bent; equity, in that it has sharp angles which yet injure none.

The *Li Chi*, a book attributed to Confucius but probably written during the Han Dynasty (206 B.C.—A.D. 220), quotes the master explaining to a disciple why the superior men of former times valued jade over all other stones. He begins by saying that it is not because of the rarity of jade, but because of the analogies between the luster, strength, soft angles, musicality, and translucency of jade and the Confucian virtues of benevolence, intelligence, righteousness, propriety, and loyalty. He goes on:

. . . with an intense radiance issuing from it on every side—like good faith; bright as a brilliant rainbow—like heaven; exquisite both in the hills and in the streams—like the earth; standing out conspicuous as a symbol of rank—like the path of truth and duty . . . That is why the superior man esteems it so highly.

The Chou Dynasty was the longest in Chinese history, lasting over 800 years, from 1122-770 B.C. (Western) and 770-249 B.C. (Eastern). The Western or Early Chou period was in many respects a continuation of the Shang, particularly in bronze casting and jade carving. Most surviving jades of the Early Chou are small amulets associated with burial which continue the Shang style, such as the bovine head and rabbit shown here. The rabbit was associated with immortality as well as fertility and was thought to live in the moon, pounding out the elixir of immortality from jade.

One notable difference in the carving of the Early Chou and the Shang is greater naturalism in the Early Chou jades. Clearly identifiable animal heads replace composite masks.

The fashioning of ceremonial blades remained an important occupation of the jade carver in Chou times. In general, the forms are continuations of the Shang blades, ultimately derived from Neolithic prototypes, such as the adze and chisel types and rectangular knife blades. They probably served as emblems of court rank. *Above:* Early Chou ritual blade.

During the Middle Chou, a period of warfare and chaos, all of the arts suffered a loss of skill and fineness. Surviving jades from this period reveal a change from the intense perfection of Shang detail to large, cumbersome forms with less surface decoration. However, lapidaries were producing some attractive decorative beads and buttons which anticipate the Late Chou renaissance. The jade used is of finer quality than that used to carve larger ceremonial objects, and the surface carving is skillful. *Left to right:* button; bead.

This process of forming analogies carries with it a slight flavor of rationalization, justifying the love of a beautiful material within the strict code of Confucian standards. But it is these qualities of jade, whatever their external associations, which give jade its immediate sensual appeal.

The Chinese reverence for jade is also due to the length of the history of jade carving in China, giving it the appeal of a venerable tradition. By the 5th century B.C., when Confucius is said to have given the description of jade quoted above, jade had already occupied a position of importance for more than a thousand years. The Neolithic Chinese, the founders of the jade-carving tradition, made tools and weapons from it, valuing it for its toughness and hardness—for its functional qualities—rather than for its esthetic appeal. When metals were introduced, jade was gradually displaced by bronze as the best material for tools and weapons, and by the 11th century B.C. it had become a sacred material, used exclusively for ritual purposes and valued for its beauty, rarity, and expense. As these rituals in turn died out, jade underwent another transformation and by the 3rd century B.C. had become primarily a luxury item, carved into jewelry and decorative objects. The following 3rd century B.C. poem from the *Ch'u Tz'u,* translated by David Hawkes, and reproduced in the new jade hall, shows how the Chinese had come to use jade.

On a lucky day with an auspicious name,
Reverently we come to delight the Lord on High.
We grasp the long sword's haft of jade,
And our girdle pendants clash and chime.
Jade weights fasten the god's jeweled mat.

The god has halted, swaying, above us,
Shining with a persistent radiance.
He is going to rest in the House of Life.
His brightness is like the sun and moon.
He yokes to his dragon car the steeds of God.
Now he flies to wander round the sky.
The god had just descended in bright majesty,
When off in a whirl he soared again, far into the clouds.

During the latter part of the Chou Dynasty feudal warfare ravaged the country. Paradoxically, the political breakdown triggered tremendous creativity in political, social, and artistic theories. During this period China's two major philosophical systems—Confucianism and Taoism—evolved.

Iron tools replaced bronze and stone, making possible much more ambitious jade carvings. Jades of this period show sophistication and proficiency of technical skill never before realized. Ceremonial blades and undecorated *pi* disks completely disappeared, and jade became popular for decorative and utilitarian objects, such as the hilt guard shown here.

The *ts'ung* is one of the most problematical ritual jades. It has traditionally been identified as the symbol of the earth. Among the modern theories of its origin are suggestions that the *ts'ung* was the sighting tube on which astronomical instruments were rotated; that it was a tube for storing ancestral records; that it was a phallic symbol; and that its form was derived from the wheel nave of a chariot: *Below:* two *ts'ung* forms from Chou period.

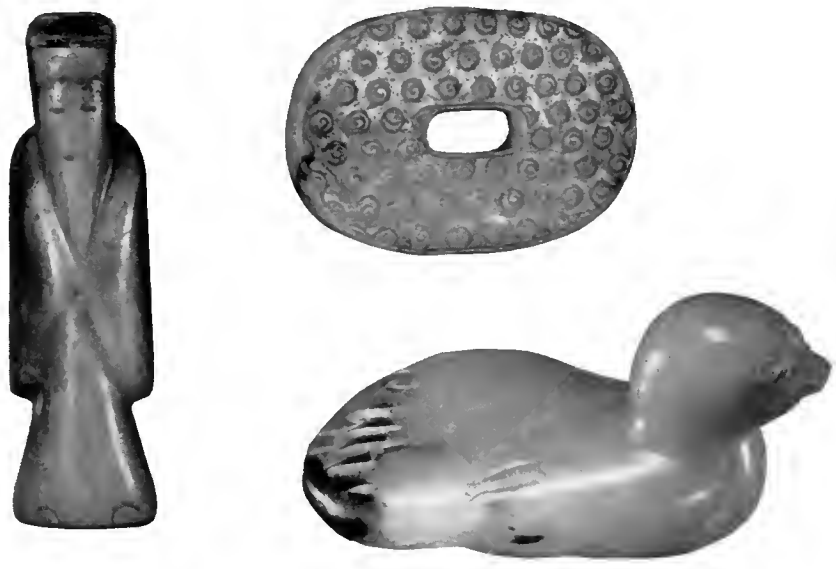
However, its beauty and its associations with ancient ritual made it an unusual and nonfrivolous kind of luxury item. By the time the Han Dynasty was established, jade had developed its own mythology. The bodies of the dead were dressed with jade to prevent decomposition, and immortality was thought to be assured by placing jade amulets in the tomb. This association of jade and death may have stemmed from the Neolithic practice of placing a man's possessions, some of them made of jade, in his grave with him. A body of legends grew up: for example, that the elixir of immortality could be distilled from jade, or that eating jade would produce both immortality and the power to make oneself invisible and able to fly. In addition, the Isles of the Immortals were said to produce trees and flowers of jade, the most famous of which were the peaches of immortality. These and other legends provide much of the subject matter of Han Dynasty and later jade carvings.

Another factor contributing to the high value of jade in Chinese eyes is its intrinsic rarity and expense. No source for the stone has ever been found in China proper; it therefore must have been imported, even in Neolithic times. This fact, combined with the difficulty of carving it, has made all but the smallest jade object into a luxury item, reserved for the court and the well-to-do.

These qualities of beauty, antiquity, ritual usage, legend, expense, and difficulty of carving all combine to make jade the "fairest of stones," more precious to the Chinese than gold, more cherished than diamonds.

The English word "jade" comprises two distinct minerals, nephrite and jadeite. The Chinese word *yü* refers primarily to nephrite but can indicate any fine stone which has some of the same qualities. Nephrite is the form of jade traditionally carved by the Chinese. Jadeite, familiar to the Western world through its use in

Elaborate myths, many of which have survived among the people of China down to the present day, provided subject matter for many Late Chou carvings. Dragons, the most important of the spirits, inhabited water and clouds and controlled the rains. The half-disk shown here depicts dragons in the clouds.



With the founding of the Han Dynasty (206 B.C.-A.D. 220), following the short-lived Ch'in Dynasty (221-206 B.C.), China entered her first imperial age. Her borders were extended into Central Asia and Korea, and Buddhism was introduced through contacts with India.

In this strongly imperialistic and militaristic age, jade continued to be a popular material for decorating swords and scabbards. The archer, meanwhile, used a jade thumb ring to protect his thumb from the bowstring. Belthooks, belt rings, and studs of jade became popular. The use of seals came into vogue and many were made of jade.

The ancient *ts'ung* and *pi* forms reappeared. The *pi,* often decorated with floral or dragon motifs, lost the ritual austerity of its prototype.

Jade continued to be used in funeral rites in Han times. The bodies of the dead were covered with shrouds sewn with jade plaques and jade was placed in the apertures of the body to prevent decomposition. The tomb was generally furnished with models of animals, servants, and whole households, to accompany the soul of the deceased in his journey to the afterworld. These burial carvings show an increased realism and feeling for sculpture in the round over traditional flat plaques.

Religious Taoism which produced much of China's rich mythology also flourished in the Han Dynasty. *Above, left to right:* old man, traditionally identified as Taoist Immortal; sword guard; duck (burial carving).

jewelry, was not used in China until the late 18th century.

The mineral properties of nephrite and jadeite differ significantly. While nephrite is a calcium-magnesium silicate belonging to the amphibole group, jadeite is a sodium-aluminum silicate belonging to the pyroxene group. Although both minerals are crypto-crystalline in structure, nephrite is formed of short interlocking fibers, while jadeite is an aggregate of small grains. Jadeite is harder, but nephrite, because of its fibrous structure, is more difficult to work.

Although it sometimes requires the eye of an expert or the tools of a geologist's laboratory to tell whether a specimen is nephrite or jadeite, the two minerals can often be distinguished more simply, by color, hardness, and texture. Jadeite takes on a smooth, glassy sheen when polished, while nephrite, because of its fibrous structure, has a slightly uneven surface called "tangerine-skin" texture, and takes on a waxy rather than a glassy sheen. Jadeite is also hard and glassy to the touch; nephrite feels slightly oily and seems softer and warmer. Hard, bright colors, particularly green, are characteristic of jadeite, while the colors of nephrite tend to be softer shades of green, brown, and white.

Pure jade, whether nephrite or jadeite, is white. The wide range of possible colors, which span the spectrum from white to black, is due to compounds of iron, manganese, and chromium in the stone. The most common colors are whites, greens, and browns; reds, yellows, blues, lavenders, and blacks also occur. The bright "apple green" common in modern jade jewelry occurs only in jadeite.

External conditions may also affect jade colors. Stones which have lain in the open or in river beds for long periods often acquire a "skin" of brown due to weathering. Jades buried close to colored objects may absorb

During the second century A.D. the power of the Han rapidly declined; eunuchs and warlords gained sway at court while peasants revolted in the countryside. The fall of the last Han emperor in A.D. 220 was followed by over three centuries of chaos and barbarian invasion, known as the "periods of the Three Kingdoms and Six Dynasties." It was a time of artistic and literary florescence, similar in many ways to the Late Chou Dynasty. Great advances were made in prose writing and landscape painting. At the same time, however, the art of jade carving fell into decay, partly because tribal unrest along China's western frontiers had cut off the flow of jade from distant Khotan.

Jades in the style of the Six Dynasties tend to be small in size and secular in function. Figurines in the round are among the most common forms. The two small boys shown here originally formed part of sets of entertainer figurines used as tomb furnishings

The 1,500 years between the end of Han and the 18th century are known as the "dark ages" of jade. They are called "dark ages" because very little excavation has been done on sites of this period, with the result that few jade carvings can be accurately dated. In general, attributions to Six Dynasties, T'ang, Sung, or Ming are provisional.

The T'ang Dynasty (618-906) was one of the great periods of Chinese history. The empire was greatly expanded and trade was carried on with India and the Near East, while Chinese missionaries spread Buddhism to Korea and Japan. Tomb sculpture reached its height in the T'ang, and tombs were filled with ceramic models of entire armies, exotic animals, and foreigners.

The dragon and phoenix, which appear on the slit ring here, were popular symbols in the T'ang. They represent the powers of *yin* and *yang*. The dragon is *yang*, the male principle, the bright, positive force, and therefore the emperor. The phoenix is *yin*, the female principle, the dark, negative force, the earth, and therefore the empress. The two together produce and sustain all life.

some of the color. The color of nephrite can also be altered by burning. When heated to 1025° C, it turns into a yellowish-white opaque substance. As this color is similar to that of jade which has become leached through long burial (called "chicken-bone white"), burning is often used to simulate an antique appearance. Burning usually produces fine cracks on the surface which can be used to distinguish it from leached nephrite, but the best test is the X-ray diffraction method, which reveals the changes in mineral structure created by burning.

One of the most interesting facts about jade has already been mentioned—that it has apparently never been found in China proper. The nearest known source of nephrite is around Khotan in Sinkiang Province in the far west of China and about 1,500 miles from the center of Chinese culture in the Yellow River Valley. Thus the Neolithic Chinese—probably the first Chinese to work jade—must have obtained it through contact and trade with Central Asian peoples. There is no evidence, however, that the Chinese learned the craft of jade carving from the Central Asians. No carved jade has been found in the Khotan region.

Until the end of the 18th century, the Chinese seem to have obtained all of their jade raw material from Khotan; thus the political relations between the Chinese and the Central Asian tribes exercised a strong influence on the amount of jade available for carving in any period. At the end of the 18th century a new source of nephrite was discovered in Siberia. Siberian nephrite is a dark green color with darker flecks and is often called "spinach jade." It was at this time also that jadeite was introduced from Burma.

Jade is also found in other areas of the world and has been worked by other peoples. Although none evolved carving techniques and skills that could

The T'ang Dynasty collapsed in 906 after a century of decline. China was reunited in 960 under the Sung (960-1279) but did not regain its former power. Prevented from imperial expansion by the Central Asian tribes, the Chinese turned inward and explored their own past. They reconstructed Shang and Chou ritual blades and carved jade cups, pitchers, and vases.

But, for the most part, the small size of Sung jades reflects the shortages of jade caused by continuing poor relations with the Central Asians, who controlled the trade routes to Khotan. The Sung took a great interest in the natural world as evidenced by the sensitive animal jade carvings that have come down to us. Many of these carvings, such as the camel shown here, have been worn smooth from years of handling.

The Mongols conquered all of China in 1279, ending the Sung rule and establishing their own dynasty, the Yüan, with the capital at Peking. The dynasty lasted only until 1368 and was too brief to produce a distinctive jade carving style.

The Mongols were expelled in 1368 and the Ming Dynasty (1368-1644) was established. Ming artists and craftsmen, while reviving Sung traditions, produced an art particularly their own. They frequently combined purely contemporary styles and motifs with the antique.

Ming jades often incorporated the brown "skin" or weathered outer surface of jade pebbles into the carvings, as in the cup decorated with pairs of mother and baby dragons representing maternal love shown here.

Ming powers went into decline in the late 16th century. In 1644 the Ming emperor accepted aid from the Manchu, a Northeast Asian tribe, in order to drive Chinese rebels out of Peking. The Manchu liberated the city but refused to return it to the Ming, installing their own ruler instead and establishing the Ch'ing Dynasty, which remained in power until 1912.

equal those of the Chinese, the Maoris of New Zealand, the Alaskan Eskimos, and the Indians of Middle America all carved jade and valued it highly. Only the Mughals in India in the 18th century lavished such time and craftsmanship on jade, creating elaborate carvings inlaid with precious stones. Even the Indian carvings, however, lack the sense of history and tradition communicated by those of China; they are pure luxury items with none of the wealth of associations that a Chinese jade conveys to the connoisseur. Nephrite has also been found in Wyoming and northern California, but it is not of gem quality.

As we have noted, the traditional source of jade for the Chinese was the area of Khotan. Jade pebbles washed down from the mountains were taken from the riverbeds and shipped to China for working. This rather primitive method of acquiring jade was used exclusively until the late 18th century, and partially accounts for the small size of most early carvings. Around the end of the 18th century the demand grew for large carvings, and attempts were made to quarry large blocks directly from the mountains. One method was to build a fire under a rock face; as the rock heated up, cracks would form. Water was poured into the cracks and allowed to freeze, expanding the cracks and dislodging the block. Although wasteful, this method yielded larger pieces of jade than could be found in streambeds. A large jar was carved from such a boulder for the Ch'ien Lung Emperor (r. 1736-1795) and was placed in the Imperial Palace in Peking. This jar is now in the Field Museum collection.

Once the jade had been fished from the streams or quarried from the mountains of Khotan and shipped by camel train to China, it was fashioned into a wide variety of religious and decorative forms. All the processes involved in working jade, from the initial cutting to the final polishing, are variations on a single technique: the

The new Ch'ing emperors adopted Chinese culture and became avid patrons of the arts. The 18th century was the greatest period of jade carving since the Late Chou. Unlimited supplies of nephrite were available from Khotan and Siberia, and jadeite from Burma was introduced.

Items frequently carved in jade during the Ch'ing include: large seals whose inscriptions commemorate an event; jade books dedicated by the emperor to a deceased relative; dinnerware for the very wealthy; musical instruments, such as chimes, flutes, and bells; objects used in the study of the scholar-official, such as bars to fasten and hold handscrolls open, inkstones used for grinding ink, desk holders for water, boxes to hold vermillion used in applying seals, brush holders, and decorative desk screens; small carvings of humans and animals having symbolic connotations; bowls in matched pairs; snuff bottles; hairpins and dome-shaped carvings worn in the elaborate coiffures of Chinese noblewomen; belt hooks; pendants, toggles and knot-openers; thin plaques mounted as belt buckles; incense burners; and traditional ritual forms of blades and *pi* disks.

***Below, left,* duck on lotus leaf connoting marital fidelity and happiness; snuff bottle depicting Lui Hai, the patron of commerce, luring a greedy toad out of a well with a string of gold coins; *right,* hair ornament; cup carved to represent peach of immortality.**

abrading of the surface of the stone with drills and saws edged with an abrasive paste. The traditional abrasive consisted of sand or crushed garnets and quartz moistened with water. A finer powder, called *pao yao*, is used for the final polishing. In the 20th century the industrial abrasive carborundum has become popular.

The drills, cutting wheels, polishing disks, and gouges are all operated in a rotary fashion, either mounted on a bow or driven by treadles. In recent years electricity has come into use in some workshops.

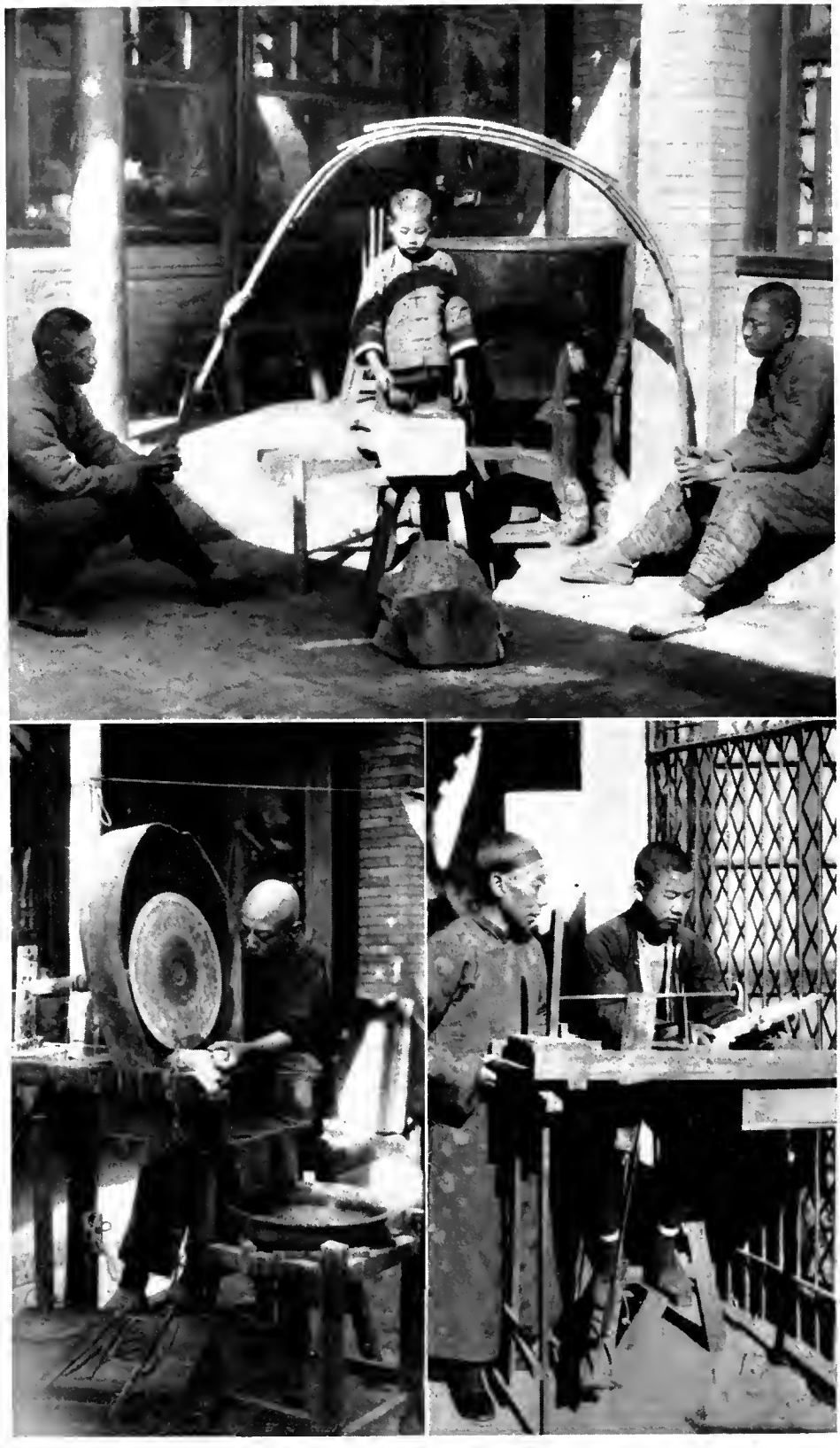
It is difficult to imagine the arduous process traditionally used by the Chinese in working jade. Most early carvings are flat and thin, since pebbles and boulders were sliced up to get the most use from the expensive material. The cutting was done with a wire saw; two men worked the saw while a third fed the abrasive paste into the cut. In the earliest days of jade carving, this process was accomplished with stone blades not much harder than the jade itself. The cut was usually made from both sides toward the center, and the jade was broken off along the remaining narrow line, leaving a ridge. Cutting could also be done with rotary wheel blades, which often left identifying marks.

Holes were formed by using hollow tubular drills, again in conjunction with an abrasive. The holes were most often drilled from two sides toward the center.

After the jade had been sliced and shaped, decoration was incised with a variety of small drills and gouges. Modern drills are generally mounted on a frame and powered by a foot-treadle; the jade is held up to the drill and moved around. The finished carving is then polished with fine grinding wheels and the *pao yao* abrasive.

The rarity, high price, and hardness of jade—the very qualities which make it so prized by the Chinese—also make it

Photos: *top*, cutting large block of jade with wire saw; *left*, initial forming of jade into a shape using a cutting wheel; *right*, polishing e jade carving.



difficult to work with and expensive to buy. For this reason a large number of other materials which share some of the qualities of jade are carved as substitutes. These minerals are all softer than jade, and cheaper, since they are found in China proper. The most common substitute materials are serpentine, steatite (soapstone), prophyllite, and glass. Far from despised by the Chinese, they are often called varieties of *yü*, of which nephrite is merely the finest type.

These materials can generally be distinguished from true jade visually. They tend to lack the characteristic sheen of jade. Glass can approximate the appearance of jadeite but is usually more translucent; small bubbles can often be seen in the glass. Another simple test is to scratch the carving with a steel knife-blade. Steel will not scratch nephrite or jadeite (providing that the jade is not leached or badly weathered) but will scratch most substitute materials. Positive identification, however, can only be made by the X-ray diffraction method.

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Landscape scenes were popular subjects in Ch'ing jade carvings. Scholars often appear in these jade landscape scenes and thus are associated with both long life and the traditional ideal of retreat into nature. The scene from a brush holder here of Siberian nephrite ("spinach jade") depicts scholars gathering to drink wine and compose poetry in the mountains.

Spurred by internal dissatisfaction and foreign support, revolts against the decadent Ch'ing emperors broke out, and the dynasty fell in 1912, when a republic was established. Mao Tse-tung gained control during the 1940s, driving out the Japanese invaders and forcing Chiang Kai-shek to flee to Taiwan in 1949.

Jade carvers were organized into cooperatives in 1953; in 1959 there were 1,400 craftsmen in the Peking Jade Studios. The introduction of the diamond point, the industrial abrasive carborundum, and electricity (in 1958) have facilitated the carving process and encouraged elaborate workmanship and hard glassy polishes.

The making of traditional forms such as belthooks, buckles, dishes, and desk ornaments has continued into the modern period, but the effects of modern methods are apparent in the elaborate undercutting, high relief, and high polish. The large disk shown here is one of a pair of desk screens carved of Siberian nephrite. An inscription on the top dates the screen to the reign of the Ch'ien Lung Emperor (1736-1795), but the style and treatment are modern.

Thus, the carving of the "fairest of stones" by the Chinese spans over 4,000 years and continues today, combining the use of modern materials and age-old techniques.

Is it really jade or not?

Edward J. Olsen

When questions regarding jade are presented to a mineralogist a number of small but perplexing problems arise. Probably the question that comes up most often is the one of authenticity. The truth is, whether a given piece of jade is truly jade is not a mineralogical question but a question of archaeological definition. Because the term *jade* is not a mineralogical word and does not have a precise mineralogical definition, the mineralogist is willing to accept anything the archaeologist defines as jade on the basis of whatever archaeological standards he chooses to use. Thus, as a whimsical example, if archaeological study were to turn up the heretofore unrecorded fact that the craftsmen of China have, for ten centuries, regarded carved green soap with the same high esteem as carved green rocks, and the Chinese refer to both with the same word, *yü* (jade), then by archaeological definition the green soap is jade also. To the mineralogist it doesn't matter in the least what archaeologists accept as jade, but the fact that they accept a good deal of different mineralogical material as jade makes it hard for the mineralogist attempting to ferret out fakes.

First off one thing must be made clear. The materials accepted as jade are not minerals in the strict sense, but rocks. A rock is an aggregation of grains of one or more minerals. For tens of centuries the finest Chinese jade consisted of a type of rock that is made up *almost entirely* of grains of the mineral *actinolite.* Actinolite characteristically occurs in the form of needle-shaped grains. When these are microscopically small and tightly interlocked, then the actinolite rock is called *jade.* The mineral actinolite varies somewhat in its chemical composition: when it contains a moderate amount of iron, its color is medium to dark green; when it is completely free of iron, it is white. The special mineralogical name for such iron-free actinolite is *tremolite;* the whole range of such minerals is called the tremolite-actinolite series. Thus, this rock can range in color from dark green to white. Archaeologists accept this range of colors in these rocks as jade.

It is rare for an actinolite rock to consist entirely of grains of only the one mineral. It commonly has grains of black magnetite, white quartz, white feldspar, white calcite, and even small amounts of green mica-like minerals. Some of the finest jade carvings show black streaks of magnetite in them. The question then arises, how much of what impurities will be tolerated and still permit a designation as jade? The answer to this is clearly an arbitrary matter of taste, esthetics, and tradition.

Since this form of jade is comprised of microscopic interlocking needles of actinolite (or tremolite), what does one do when the needles are so large they are no longer microscopic? What does one call a pure actinolite rock in which the green needles are an eighth of an inch long and clearly visible? If a fine-grained actinolite rock is jade, why not a coarser-grained one? Again it is a matter of esthetics. In both these cases, impurities and grain-size, the mineralogist can offer no answer.

About two centuries ago a new source of attractive green rock (also sometimes gray, or even blue) was discovered close to China in Burma. It was hard like jade, usually green like jade, and could be worked into pleasing carvings. Archaeological usage caused it to enter the ranks as jade. Mineralogically, however, this material is an entirely different rock, one composed of interlocking microscopic grains of a different mineral called *jadeite.* In fact, the mineral acquired its name because of the use of the rock in which it is found. This rock too possesses problems relative to acceptable impurities and size of mineral grains. Thus two materials are accepted, by archaeological definition, as jade. In the jade business these are usually distinguished by modifying words. The original actinolite rock is referred to as *nephrite jade,* and the jadeite rock as *jadeite jade.* The buyer of an object advertised as jade does not usually know which type he is getting. Both are jade; the value depends mostly on the age of the piece, craftsmanship, size, and archaeological factors. In general, the majority of pieces one sees sold are made from nephrite jade simply because it is a vastly more abundant rock type than jadeite rock in the earth's crust.

If only these two kinds of rocks were ever worked as jade, mineralogical problems would be relatively limited to those mentioned earlier. But native craftsmen over the centuries have, unfortunately, not always been discriminating in their choices of materials. A large variety of other rocks and minerals have also been utilized: such green rocks as serpentinite, metamorphosed basaltic lavas (called greenstone), soapstone, hard clays, and such minerals as green chalcedony and uvarovite garnet have shown up in some old collections. In some cases the craftsman may have had it in mind to defraud; however, in most instances lack of knowledge or lack of discrimination led to the use of any workable attractive green rock or mineral that would take a good polish. In more recent times dyed glass has been used extensively to simulate jade in an obvious attempt to

defraud. Frequently even the seller is unaware he is selling glass. A fairly common practice in costume jewelry is to mix the pieces with part of the object made of jade (usually nephrite) and part of it made from glass, soapstone, or serpentinite chosen (or dyed) to provide closely matched color. Thus such a piece can be sold as "jade," which lies just inside the border of truth.

For a mineralogist to pass on the authenticity of a particular piece, in most cases it comes down to determining if it consists mainly of either actinolite or jadeite. The first simple test is to scratch it with a common steel needle. Neither of these materials can be scratched; however, "look-alikes" such as serpentine, soapstone, and greenstone are readily scratched. Unfortunately, chalcedony and hard lead glass are not scratched. These can sometimes be distinguished from jades by optical tests. A severe limitation in applying such a test is that it is usually not possible to obtain a chip of a specimen on which to work. A valuable carving cannot be sampled in a cavalier manner with hammer and chisel. It is usually necessary to sample from down inside a carved hole or depression, or on some inconspicuous spot on the bottom of the object, if it has a bottom surface at all. Frequently, especially with small objects, the piece is fully polished on all sides and a sample removed from anywhere will ruin its appearance.

As a general practice the quickest and safest method is X-ray diffraction. This method is based on the fact that each kind of mineral has a characteristic chemical composition and the atoms of the chemical elements are arranged in regular three-dimensional symmetrical patterns. X-rays passing through such a three dimensional network are diverted (bent) into patterns of rays that reflect the characteristic arrangement of the atoms in the mineral. Each mineral has, in a sense, an X-ray "fingerprint" which permits its definite identification. For large objects, a minute amount can be scratched from an inconspicuous spot and mounted for X-raying. Small objects often can be fitted directly into the X-ray sample holder and X-rayed as a whole, unscathed. Thus the real jades and the "look alikes" can be readily distinguished. In preparing objects for installation in the new John L. and Helen Kellogg Hall of Jades, over one hundred pieces were checked by X-ray. These were chosen for examination because of questions regarding their authenticity. A relatively small percentage turned out to be non-jades, and these were omitted from the exhibit collection.

It would appear that the X-ray method solves many problems. Unfortunately, archaeological acceptance makes for other difficulties. Long ago Chinese noblemen frequently had nephrite jade objects buried with them at their funerals. Soil acids and moisture acted slowly on these objects to gradually alter their composition and form different minerals of them. This alteration may form only over the outside as a coating, or it may completely work its way through an object, especially if it is small. When such pieces were dug up, centuries later, they were found to be quite pleasing in appearance. They had become an off-white color and resembled polished bone material. These objects became prized and it is logical that someone should experiment in an attempt to learn how to speed up this slow alteration process. It was soon discovered that nephrite jade could be converted to this appearance if it were subjected to intense heating. Today both of these forms of bone jade are accepted as jade; however, neither one is nephrite jade any longer. Depending on the process, long-term burial or short-term heating, two different rocks result made of several entirely different minerals. They are, nevertheless, considered to be jades also.

These altered materials complicate matters. Both consist of mixtures of several minerals in varying proportions depending on such factors as temperature and time. It is not possible to distinguish these rocks formed by the alteration of original jade from the same kind of rocks formed by other processes from original material that was not jade at all. Thus for these materials archaeological definition generally confounds mineralogical determination.

The authentication of jade is clearly not as straightforward as one might imagine. For the majority of cases X-raying provides a simple and relatively nondestructive method. In a small number of cases the final decision will depend on what the archaeologist is willing to accept. Probably the only other material that raises even more difficult mineralogical questions regarding authenticity is amber. It is regrettable that once man attaches monetary value to a mineral or rock, problems are created that go outside the realm of the mineral kingdom.

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mid-sky charming girls

virginia straub

It was Barbara Tuchman's book *Stilwell and the American Experience in China 1911-45* that brought to mind the Field Museum's collection of pigeon flutes and whistles. She was describing Stilwell's visit to Sian, ancient capital of the Han and T'ang dynasties, where he "found it hard to glimpse an idea of the former greatness of the city, but even in decline the people of Sian devised pleasures. They tied bamboo whistles of varying pitch to the tail feathers of pigeons so that when circling in hundreds overhead the birds made the sound of a flying pipe organ."

Flying pipe organ indeed! This fanciful description of the small objects on display in our Chinese exhibit in Hall 32 made it seem worthwhile to see what Dr. Berthold Laufer might have said on the subject when he brought them to the Museum. (He was then associate curator of East Asian Ethnology; later curator of the Department of Anthropology.)

In the *Scientific American* in 1908, Dr. Laufer remarked on the great esthetic enjoyment the Chinese derived from the sound of this aerial music:

> . . . we are wont to speak of the Chinese as sober, practical, and prosaic people . . . but nevertheless they are by no means lacking in purely emotional matters of great attractiveness . . . [and] even in affairs of minor importance their soul reveals to us traits of poetical quality of no small degree . . . One of the most curious expressions of emotional life is the application of whistles to a flock of pigeons.

These whistles, very light, weighing hardly a few grammes, are attached to the tails of young pigeons soon after their birth, by means of fine copper wire, so that when the birds fly the wind flowing through the whistles sets them vibrating and thus produces an open-air concert, for the instruments in one and the same flock are all tuned differently. On a serene day in Peking, where these instruments are

manufactured with great cleverness and ingenuity, it is possible to enjoy this aerial music while sitting in one's room.

But East is East, and the West wasn't always with them. A. B. Freeman-Mitford had earlier complained in his book *The Attaché at Peking:* "The Chinese certainly find pleasure in what are to us very disagreeable noises. Fancy a flight of pigeons with Aeolian harps tied to their tails! The first time I heard it above my head I thought something dreadful must be going to happen." He also wrote: "However, that fancy has a practical side to it, for it keeps off the hawks which abound at Peking."

Writing at about the same time, toward the end of the nineteenth century, Archdeacon John Henry Gray said in his book *China* that pigeons with whistles served as convoys for carrier pigeons: "Merchants at Hong Kong use them [carrier pigeons] in conveying news of the arrival of the English, French, or American mails to their partners in trade at Canton. To defend the pigeon during its flight from attacks on the part of falcons or hawks, a whistle is attached to its tail, and the shrill noise of this contrivance, as its bearer flies through the air, terrifies the birds of prey."

A picture of a pigeon with a whistle on its tail appears with Elisha Hanson's article "Man's Feathered Friends of Longest Standing" in a 1926 *National Geographic*. Part of the caption reads: "When the bird flies, the wind blows through the whistles and sets them vibrating. The Chinese explain their love of this aerial music by saying that the sounds keep the flock together and frighten off birds of prey."

Dr. Laufer didn't agree with the protective theory. According to him, "There seems . . . little reason to believe that a hungry hawk could be induced by this innocent music to keep aloof from satisfying his appetite; and this doubtless savors of an afterthought which came up long after the introduction of this usage, through the attempt to give a rational and practical interpretation of something that has no rational origin whatever . . ." He thought it was not the pigeon which profited from this practice, but merely the human ear, which liked to feast on the wind-blown tunes and derive esthetic pleasure from the music—"it seems to be a purely artistic and emotional tendency that has given rise to a unique industry and custom applied to nature-life."

The esthetic theory seems to have got the nod also from a T. Watters, Esq., who wrote on "Chinese Notions about Pigeons and Doves" in the *Journal of the North-China Branch of the Royal Asiatic Society* in 1868. He said, "The pigeons which fly about with whistles attached to them are called *pan-t'ien-chiao-jen,* mid-sky charming girls." Dr. Laufer translated the term as "mid-sky beauties."

Then we find a theory about their origin, which Dr. Laufer had expressed much earlier, in a lecture by Harned Pettus Hoose entitled "Peking Pigeons and Pigeon-Flutes," delivered in 1938 to the College of Chinese Studies at

the California College in China at Peking. He said that the use of these flutes was suggested by the whistling arrow invented by Chinese warriors "countless ages ago" for signaling by singing as it sped through the air. The belief was that when the warriors were not fighting they amused themselves by fastening delicate silver bells on the tails of their pigeons, and when this metal proved to be too heavy, they used bamboo for flutes. Then squat miniature gourds were tried, and found to produce much fuller, deeper tones. When reed and gourd were combined and flown together the music was even more pleasing. Said Dr. Hoose: "It must have been about this time that a pigeon-flute maker made a pair of flutes, one smaller than the other, so that the female pigeon could carry the smaller one. To his delight, he found that the smaller one's note was higher than the larger one's. From that time up to the present, flutes have been made in pairs and are known as mates: male and female."

Dr. Hoose's singing arrow theory of origin does not include any mention of the musical kite, which Dr. Laufer also wrote about. He described it as a paper kite with a bamboo flute fastened to the head so that

when the wind struck the holes of the flute . . . [it] produced sounds like those of a harpsichord . . . Such flutes are still . . . used . . . They consist of a short bamboo tube closed at the ends and provided with three apertures . . . When the kite is flying, the air . . . produces a somewhat intense and plaintive sound, which can be heard at a great distance. Sometimes three or four of these bamboo tubes are placed one above another over the kite, and in this case a very pronounced deep sound is produced. Imagine that hundreds of such kites may be released at a time and are hovering in the air, and there is a veritable aerial orchestra at play.

According to Freeman-Mitford, the music of kite and pigeon was the same: "As the New Year approaches the principal amusement in the streets is flying kites . . . In the tail of the kite is placed a sort of aeolian harp, such as I once told you the Chinese attach to their pigeons."

Dr. Hoose said in 1938 that there were still in existence some flutes made by six of the most famous flute makers, who lived in the Ch'ing dynasty and "whose skill has never been equalled." He added, "Of course, none of these old masters made pigeon-flutes for anyone but themselves and certainly they never sold them. The business of selling flutes is quite modern."

Two general types are described by Dr. Hoose, gourd flutes and bamboo flutes. "These two types are often combined . . . and with both types is used a very slender reed with which small supplementary flutes are made. The former can be made of three types of gourd."

When making the flute, the top of the gourd is cut off, leaving a rounded sounding box, which is then capped by a part of the top that has been shaped to produce flute-lips. This main flute is supplemented with several much smaller ones that are fashioned of reed, glued to the sides and top of the main body. A bone or bamboo handle is attached to the bottom, for the purpose of fastening the flute to the pigeon's tail. Throughout this process exact measurements are necessary in order to assure a correct angle against the wind, and a good tone. At this point, the artist carves his surname on the bottom of the flute and then paints the whole surface with "Chinese ink." . . . When this has dried, shelac is applied on both the inner and outer surfaces of the gourd. Sometimes both the male and female voices are combined in one flute, by cutting the gourd in half, inserting a cardboard partition, and gluing it together again. No gourd flute can be made larger than two inches across the top, as pigeons are incapable of carrying a flute any heavier. . . .

The material for the bamboo flutes comes from South China, while the delicate reeds are grown outside this city [Peking]. The bamboo and reeds are combined in many arrangements, resembling the Pan-pipes or a pipe-organ. These flutes are attached to the pigeons' tails by a holder at the bottom, and a thread sewn through, and perpendicular to, the bird's two middle tail-feathers at a point exactly a fore-finger's distance from the bird's body. The holder is thrust through the space between the thread and the bird's body, and is held in place by a small wire ring hung on the end of the holder after it has been thrust between the thread and the body of the bird.

Whether this charming practice is still followed under the austerity of the People's Republic we don't know, but at least during World War II the flutes were still available. In his 1942 book *I Flew for China,* Captain Royal Leonard, personal pilot for Chiang Kai-shek, described the town of Urumchi, now known as Wulumuchi, in Sinkiang province: "The distinctive quality of Urumchi lay in its sound. . . . The thousands of pigeons constantly flying overhead have bamboo wind whistles attached to their tails. Each is made to sound a different note; some are tremolo and high-pitched, others equal the deep bass of an organ. Most of them carry a large harmonized cluster of three or four . . ." And he also remarked: "According to my hobby, I picked up a knickknack representing a product for which the city was famous. . . . At Lanchow I bought pigeon whistles . . ."

Now the next time Henry Kissinger goes to China, if he could do some shopping . . .

Virginia Straub is secretary of the Women's Board, Field Museum.

FIELD BRIEFS

Archaeological Discoveries in Southwest

Dr. Paul Martin holds sculpture of a bear discovered in a kiva in Arizona.

The story of the early inhabitants of the Southwest is gradually being unfolded through a series of archaeological excavations conducted in Hay Hollow Valley, Arizona by Dr. Paul S. Martin, chairman emeritus of anthropology at Field Museum of Natural History. This summer, twelve high ability college sophomores and juniors from various parts of the country participated in the Museum's ten-week program "New Perspectives in Archaeology," supported by the National Science Foundation.

The sites that have been continuously excavated and studied during the past nine years are located on a 72,000 acre ranch near Vernon, Arizona owned by Mr. and Mrs. James Carter. Dr. Martin believes that these sites were occupied from approximately 1000 B.C. to 1500 A.D.

This year, twenty-five additional rooms of a one-level pueblo were found, in addition to the twelve uncovered last year. Perhaps as many as thirty to fifty men, women and children, culturally related to the Hopi, occupied these dwellings. The pueblo is estimated to date from around 1000 or 1100 A.D.

While making a test trench, the archaeological team stumbled onto a kiva about 14 feet square at a level about 10 feet below the surface. The floor of the kiva was inlaid with sandstone slabs to form a thunderbird design.

One of the unusual discoveries this year is a sculpture of a bear, carved from reddish-brown sandstone, found on the floor of the kiva. Dr. Martin surmises it may have originally been set into a wall and could indicate a bear clan. Another carving found at the site has a concave, bowl-shaped surface on one side and a representation of a bear on the other.

A preliminary report on this year's field work is being prepared by Dr. Martin and five staff members, which will be available in printed form by the end of the year. His contribution will be based on the philosophy of education, emphasizing practical and theoretical archaeology, which is employed on the "New Perspectives in Archaeology" program.

Mario Villa

Mario Villa, tanner in the Department of Zoology, passed away September 30. He was 48 and had been with the Museum since 1956. Mario was trained by his father, Dominick, who retired from the Museum's staff in 1961. He worked with the skins of animals from many parts of the world and became an expert in his field. He will be greatly missed.

Backyard Safari

Children in the 4th, 5th, and 6th grades especially are invited on a "Backyard Safari" each Sunday at 8:00 a.m. on WBBM-TV (Channel 2). This unique series of half-hour programs focuses on the natural history of the Chicago area. Future programs will explore: November 14, Trees in Fall; November 21, Lake Michigan in Wintertime; November 28, The Chicago River; and December 5, Microscopic World of House Dust.

"Backyard Safari" is produced cooperatively by WBBM-TV, the Chicago Board of Education, and Field Museum.

Recent Grants

A grant of $8,200 has been awarded Field Museum by the National Aeronautics and Space Administration for support of research entitled "Geochemistry of Silicate and Phosphate Phases in Iron Meteorites." The grant, to run approximately one year, will enable Dr. Edward J. Olsen, curator of mineralogy, to make a study of the chemistry of silicate minerals that occur in very minor amounts inside iron meteorites. These have largely been ignored over the past fifty years and it is believed they may yield valuable new information.

The National Endowment for the Arts has awarded $8,000 to Field Museum for costs of an exhibition of aboriginal art, under the direction of Dr. Phillip H. Lewis, curator of primitive art and Melanesian ethnology. The exhibit, "The Art of Arnhem Land," is scheduled from January 20 through September 10, 1972.

Gift from Museu de Angola

E. Leland Webber, director of Field Museum *(left)* accepts a handsome Angolan mask from Dr. Mesquitela Lima, director of Museu de Angola, Luanda, Angola, Africa. The mask is a gift to Field Museum from the Museu de Angola.

CALENDAR

Exhibits

Opens November 10

Chinese jades—a permanent exhibit of Field Museum's collection, in the John L. and Helen Kellogg Hall of Jades, arranged chronologically from the Neolithic period (about 2500-1500 B.C.) through the Ch'ing Dynasty (1644-1912 A.D.) The installation is made possible through a generous gift from Mrs. Kellogg. Porcelains, bronzes, ceramics, and poetry supplement the jades, putting them into proper historical perspective to show how the symbolism of a dynastic period carried through in various art forms. Hall 30.

Begins November 10

Studies in Jade, a selection of books from Field Museum's library, featured in the South Lounge to coincide with the opening of the new Hall of Jades. Included are *The Bishop Collection, Investigations and Studies in Jade,* in two volumes, and *Chinese Jade Carvings of the XVIth to the XIXth Centuries in the Collection of Mrs. Georg Vetlesen,* in three volumes. On display through January 9, 1972.

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Continues indefinitely. Hall 25.

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of textiles blending classical African motifs and contemporary design. The original Field Museum Benin artifacts which inspired many of the designs are also shown. Financial assistance for the exhibit was received from the CNA Foundation, Chicago, and the Illinois Arts Council, a state agency. Through December 31. Hall 9.

Hours

9 a.m. to 4 p.m. Saturday through Thursday; 9 a.m. to 9 p.m. Friday; 9 a.m. to 5 p.m. Saturday and Sunday.

The Museum Library is open 9 a.m. to 4:00 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

Children's Programs

Through November 30

"Between the Tides," Fall Journey for Children, takes them hunting for exotic and beautiful sea creatures in the Museum exhibit areas. All youngsters who can read and write are welcome to join in the activity. Journey sheets are available at Museum entrances.

Film Program

"Queen of Cascades," free wildlife film offered by the Illinois Audubon Society at 2:30 p.m., November 28, in the James Simpson Theatre.

Continues indefinitely

Free Natural History Film "Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturdays and 11 a.m., 1 p.m., and 3 p.m. on Sundays in the second floor Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

Fall Film-Lecture Series, 2:30 p.m. Saturdays in the James Simpson Theatre:

November 13—"Camera Safari to Africa," narrated by Col. John D. Craig. A film tour of important game parks to see the wildlife and scenic wonders.

November 20—"The Two Worlds of Berlin," narrated by Arthur F. Wilson. A timely biographical sketch on film of a city and its people from World War II to the present.

November 27—"Micronesia," narrated by C. P. Lyons. A film story about a group of tiny islands in the Western Pacific and the colorful inhabitants who still retain their picturesque customs and traditions.

Coming in December

"Faces of Africa," Winter Journey for Children, begins December 1. Youngsters test their powers of observation by answering written questions and making sketches of African masks in Museum exhibit areas while on a self-guided tour. All boys and girls who can read and write may participate. Journey sheets are available at Museum entrances. Through February 29, 1972.

A Reminder

Visits to Field Museum earlier in the day are recommended for Sundays when Chicago Bears home games are scheduled in Soldier Field.

Because of the afternoon games, the Southeast parking facilities will be filled, and the North lot reserved for Museum guests undoubtedly strained to capacity. Dates are: November 7, 14, and 21, and December 19.

Volume 42, Number 11 December 1971
Field Museum of Natural History

BULLETIN

BULLETIN

Volume 42, Number 11
December 1971

Eighteenth century engraving of Christmas rose *(Helleborus niger)* from which cover design was made.

Field Museum of Natural History
Director, E. Leland Webber

Editor Joyce Zibro; Associate Editor Elizabeth Munger; Staff Writer Madge Jacobs; Production Russ Becker; Photography John Bayalis, Fred Huysmans; Cover design by Samuel Grove.

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The Christmas Rose

W. Peyton Faucett

Preserved in one of the medieval Nativity plays is the legend of the origin of a flower long associated with Christmas and now much less known than the familiar poinsettia. In the play a little country girl named Madelon, who has accompanied the shepherds to the manger in Bethlehem, weeps because she has nothing to offer the Christ Child. She cannot even bring flowers for it is winter. An Angel leads her into the dark night and, touching the cold ground, causes a flower to spring up and blossom—the Christmas rose, called also the Christmas flower, and Christe herbe. She fills her hands with the miraculous blooms and hurries back with her gift. From that day to this, according to the legend, the flower blooms every year at Christmas; and, in fact, it often does.

The Christmas rose is a perennial, low-growing plant with dark, shining, smooth leaves. The flower-stalks, with their white blossoms, rise directly from the root. Despite the name, it is not a true rose but a member of the Ranunculaceae, or buttercup, family, the species of which often have flowers resembling the wild rose in appearance. It is native to the mountainous regions of central and southern Europe, Greece, and Asia Minor and is cultivated in this country as a garden plant. In mild winters the plant flowers about Christmastime, even in the northern parts of the United States. The time of blooming, however, depends largely on the weather. If the temperature is favorable, the first flowers may open as early as October or November; if not, they may delay opening until the first mild days of spring. In our Midwest area there are reports of gardeners gathering the flowers on Christmas day, with the thermometer hovering around the zero mark and the blossoms hidden under several inches of snow. It is more usual, however, to find them in spring.

Engraving of *Hellaborus niger* (Christmas rose) from *Herbier Artificiel*, Paris, 1783. Drawn by Melle de St. Suire; engreved by Dupin Fils. This book is in the Sterling Morton Library, Morton Arboretum.

The Morton Arboretum, Lisle, Illinois, has a bed of Christmas roses in its ground cover collection on the east side of its administration building and reports that in most years the flowers appear in early March.

Ironically, the Christmas rose, with its pure white flowers and festal associations, is poisonous, as indicated by its scientific name, *Helleborus niger* (black hellebore). *Helleborus* is derived from two Greek words meaning "to kill" and "food"; *niger* refers to the plant's dark-colored root. The plant contains two glucosides, helleborin and helleborein, both powerful poisons. The former is a narcotic and the latter a highly active cardiac poison, similar in its effect to digitalis. Used as a drug, the plant possesses drastic purgative and anthelmintic properties but is violently narcotic. Consequently, it must be used with great care and is usually considered more dangerous than beneficial. It is occasionally used in the cure of dropsy and has proved useful in some nervous disorders and hysteria. It is also used in veterinary medicine.

The ancient Greeks and Romans were well aware of the poisonous nature of the Christmas rose, or hellebore, and used it widely as a medicine. This use is of great antiquity and, for this reason, few plants are more surrounded with legend and superstition. Greek tradition holds that it was the shepherd and seer Melampus who first discovered its virtues. He supposedly lived about 1500 B.C. and counted among his accomplishments the ability to understand the language of birds. Melampus traveled into Egypt to study the healing art and there became acquainted with the cathartic qualities of hellebore by observing its effect on some goats that had fed upon it. He used the herb to cure the three daughters of Proteus, King of Argos, of a peculiar form of madness which caused them to run naked in the field under the delusion that they were cows. In some versions of the story the plant itself was used, followed by baths in a cold fountain; in others, the milk of goats that had eaten the plant was used. In any event, the cure was successful, and for centuries thereafter hellebore was famous as a cure for insanity.

It is not surprising that a number of superstitions grew up around a plant with such mysterious and magical powers. Pliny the Elder recorded in his *Natural History* in the first century that the Greek *rhizotomoi*, or root-gatherers, thought it necessary to take great precautions in gathering hellebore:

> A circle is first traced around it with a sword, after which, the person about to cut it turns towards the East, and offers up a prayer entreating permission of the gods to do so. At the same time he observes whether an eagle is in sight—for mostly while the plant is being gathered that bird is near at hand —and if one should chance to fly close . . . it is looked upon as a presage that he will die within the year.

It was also considered wise to eat garlic beforehand to ward off the poisonous fumes and to drink wine every now and then, with "care being taken to dig up the plant as speedily as possible." Houses were protected from evil spirits by being ceremoniously strewn or perfumed with hellebore, and cattle were similarly blessed to ward off the spells of the wicked. The Gauls rubbed the points of their arrows with it in the belief that it rendered the game more tender.

The Romans at first regarded hellebore with horror but gradually came to accept it enthusiastically. Pliny wrote that in his time it had become "familiar" and was looked upon as possessing "mind-expanding" capabilities:

> . . . Studious men are in the habit of taking it for the purpose of sharpening the intellectual powers required by their literary investigations. Carneades, for instance, made use of hellebore when about to answer the treatises of Zeno.

The hellebore of Anticyra, in the Gulf of Corinth, was then esteemed the best, and Pliny noted that Drusus, "the most famous of all the tribunes of the

people," was cured of epilepsy there. Its fame was such that hypochondriacal persons were told to "take a trip to Anticyra"—Horace called a hopeless mental case "one that not three Anticyras could cure."

It should be pointed out that it was not necessarily *Helleborus niger* to which all these wonderful virtues were ascribed, for there are a number of species of hellebore. It is believed that the hellebore of the ancients may have been *H. orientalis;* but the species which came to be used the most for magical and medicinal purposes was *H. niger,* which the famous herbalist Parkinson called the only "true and right kinde."

Black hellebore continued to be used down through the sixteenth and seventeenth centuries very much as in ancient times. The herbalist Gerarde regarded it as a cure for mania and wrote that "a purgation of Hellebore . . . is good for mad and furious men, for melancholy, dull, and heavie persons, and briefly, for all those that are troubled with black choler and molested with melancholy." Burton, in his famous *Anatomy of Melancholy,* introduces hellebore among the emblematical figures in his frontispiece with the following lines:

Borage and Hellebore fill two scenes,
Sovereign plants to purge the veins
Of melancholy, and cheer the heart
Of those black fumes which make it smart;
To clear the brain of misty fogs,
Which dull our senses, and soul clogs;
The best medicine that e'er God made
For this malady, if well assaid.

The plant was much valued in medieval times and after for keeping away witches and evil spirits and breaking spells and enchantments. Cattle that had been bewitched or poisoned were cured, according to Parkinson, in the following way:

A piece of root being drawne through a hole made in the eare . . . cureth it, if it be taken out the next day at the same houre.

It was thought that hellebore could cure deafness caused by witchcraft and that it could even cure such as seemed possessed by the Devil and was therefore called *Fuga Daemonum.*

Engraving of *Helleborus niger* (Christmas rose) by Nicolas Robert from Denis Dodard's *Estampes pour Servir a l'Histoire des Plantes,* Paris, 1701. This book is in the Sterling Morton Library, Morton Arboretum.

It is curious to note that the celebrated physician Paracelsus made great use of hellebore. He believed that it could restore youth and vigor to old people and advised that it should be gathered when the moon was in one of her signs of conservation, dried in an east wind, powdered, and mixed with its own weight of sugar for best effect.

We seem to have come a long way from the hellebore of our predecessors on this earth, with its magical and medicinal properties, to the Christmas rose of today, with its happy associations, and, even if we can no longer value it for the virtues it does not really possess, we can still admire it for its beauty.

W. Peyton Fawcett is head librarian, Field Museum Library.

Hanukkah

Maurice I. Kliers

Legend has it that Alexander the Great, as he swept through and conquered the whole of the then known world, approached Jerusalem at the head of his vast army. Instead of confronting him with armed forces as did all other peoples, the Priests of Judah, in their priestly white robes, went forth to greet him in peace.

Behind this legend is the fact of the historic confrontation of two civilizations: Hellenism and Judaism. Alexander was not only a great general. He was also a student of Aristotle, and spread Greek thought until it blanketed the world. During his lifetime and for almost 200 years, Judaism and Hellenism lived harmoniously and enriched each other in Judah.

Antiochus, King of the Greco-Syrians and successor to a portion of Alexander's empire, was not as wise. He, probably with the encouragement of Jewish Hellenists in Judah, attempted in 165 B.C. to foist upon all of the Judeans the Greek way of life—its language, sports, garb, but also its idolatry.

Mathathias, a priest in the hamlet of Modin, near Jerusalem, and his sons the Maccabees rebelled and began a guerilla war which lasted over two years and was successful.

The rebels, also known as the Hasideans, may have recognized the splendor of Greek thought—its philosophy, architecture, sculpture, literature, and science. However, they were committed to that which was lacking in the Greek way of life: a

living God, a vital faith, and the sacredness of the human personality. It has also been said that whereas the Greeks believed in the holiness of beauty, the Jews believed in the beauty of holiness.

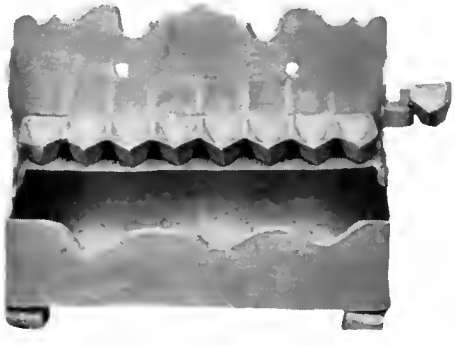
It was this cultural clash that lay behind the war of the Maccabees. With their victory came a freedom to worship their God without paying homage to strange idols. This war of the Maccabees can therefore be considered the first fight man waged for religious freedom and therefore has universal significance. All who fight for religious freedom owe a debt to the Maccabees.

The Maccabean victory was undoubtedly inspired by religious faith, but it was also helped by the rising power from the West—Rome. Antiochus retreated from Judah to mend his fences back home and prepare for the struggle with Rome which loomed on their horizon.

Under the leadership of Judah Maccabee, son and successor of Mathathias, the Temple in Jerusalem was cleansed and dedicated. Hanukkah means "dedication" in Hebrew. The Temple had been polluted by the Greco-Syrians by virtue of having idols brought into it. When the Temple was cleansed, only one small cruse of oil was found undefiled. Normally it would have lasted only one day. It was used as a perpetual flame in the Temple. (Today this light is represented by the Ner Tamid—"Eternal Light" in the Synagogue.) However, according to a Jewish tradition, the oil lasted eight days. Thereafter, a holiday of eight days was established and called Hanukkah.

Today in Jewish homes, and in Israel also in public institutions, an eight-branched Menorah or candelabra is lit on the 25th day of the Hebrew month of Kislev, or toward the middle of December.

In the first century before the common era there was a controversy between the Schools of Hillel and Shammai as to how the Menorah should be lit. Shammai wanted all eight lights kindled on the first night and one less on each succeeding evening. Hillel—and this practice prevailed—wanted one lit on the first night and one more on each succeeding night. The Sages of the Talmud regarded this controversy as implying a difference between the pessimistic outlook and the optimistic.



Hanukkah, then, is a holiday of light and joy and optimism, as well as religious freedom.

Photos: Bench type Hanukkah lamps, with eight oil receptacles in a row, plus the *shammash* (servant) above to light them. Hanukkah lamps developed from a simple Roman oil lamp made of clay. The bench type shows that Hanukkah was originally celebrated in the home only. When Hanukkah lights were later kindled in the synagogue for wayfarers, the bench type could not be enlarged, and designers went to the candelabra shape of the old Menorah, adding two lights to it. Thus the Menorah type of Hanukkah lamp was created. *Left,* Italian cast brass, c. 1600, in collection of Mr. and Mrs. Milton Horn, Chicago; *above and right,* 19th and 18th century pewter. In Morton B. Weiss Museum of Judaica at K.A.M. Isaiah Israel Congregation, Chicago.

Dr. Maurice I. Kliers is Rabbi of the South Side Hebrew Congregation.

輞川真蹟 Wang Ch'uan chen chi

Alice Schneider

Chinese dynasties referred to here:
Chou (1122-256 B.C.)
Han (206 B.C.-A.D. 220)
T'ang (618-907)
Five Dynasties (907-960)
Sung (960-1279)
Yuan (1280-1367)
Ming (1268-1643)
Ch'ing (1644-1911)

During the process of cataloging one of Field Museum's thousands of Chinese rubbings, Dr. Hoshien Tchen came upon a note which indicated that another rubbing in the collection which had previously been cataloged might be far more important than we had suspected earlier.

The rubbing of special interest, mounted on a long hand scroll, shows various scenes of what has often been described as the country estate of Wang Wei (687-759), a famous T'ang dynasty poet and artist. It had been taken from a stone engraved in 1617 to reproduce his painting known as the *Wang Ch'uan* (the name he gave to his home) and was entitled *Wang Ch'uan chen chi* ("true picture of Wang Ch'uan").

We had long known that among the several editions of *Wang Ch'uan* rubbings in the Field Museum collection, all from different stones, and all engraved in the Ming and Ch'ing periods, this one was particularly fine. A preface in the scroll by Shen Kuo-hua, the Ming magistrate who ordered the stone cut, stated that it had been engraved from a "true picture" of Wang Wei's *Wang Ch'uan* done by Kuo Chung-shu. Kuo was a talented Sung artist who followed in the footsteps of Wang Wei a few hundred years later. But Shen did not make clear whether this Sung "true picture" had been a painting or a rubbing. The note Dr. Tchen came across later, written by a Ch'ing scholar named Wang Ting, stated that the 1617 edition was copied from a Sung stone carving.

Even if the 1617 stone had been cut from a painted copy by Kuo, it would be of great value. As a disciple who was said to have continued the earlier master's style of painting into the Sung period, Kuo would have rendered a true likeness. But if Kuo's "true picture" were a rubbing, our 1617 copy of it would be of still greater value —because the Sung model would probably have been traced from the original for the express purpose of rendering as true a likeness as the engraving technique permits. Thus did the Chinese ensure preservation of a masterpiece, and also make reproductions for collectors.

I should point out that a specimen of Chinese pictorial art may be a copy several times removed from what we would call an "original" and still be greatly valued. The late R. H. van

Segments of *Wang Ch'uan chen chi*, rubbing mounted on hand scroll in Field Museum collection, taken from a 1617 stone engraving. Because Chinese hand scrolls are read from right to left, this sequence should properly be viewed from page 10 "backward" to this page.

Gulick, a wise, discriminating student and collector of Chinese art, succinctly expressed how "the traditional Chinese view . . . is fundamentally different from ours. While we insist that a picture actually is painted by the man whose signature it bears or whom it is ascribed to, the Chinese have throughout the centuries considered this as a point of secondary importance; for them works of art serve in the first place to preserve and faithfully transmit the spirit of the [original] artists, they did not particularly care whether this aim was achieved by originals or by good, bona-fide copies."

Why, then, should we attach so much importance to whether the model for this 1617 rubbing was a painting or a rubbing?

We are, of course, primarily interested in authenticating as well as cataloging and preserving our materials. But we are also, to paraphrase Dr. Tchen, "interested in opening questions that other researchers may pursue on a deeper basis," for these rubbings are source materials—the bare facts of Chinese history and culture. In this instance, it can readily be seen why a model for the 1617 rubbing which was itself a rubbing would be of greater value for our understanding of the original than would a model which was a free-hand copy, permitting distortions or expressions of the copyist not found in the original. The art historian, as well as the art lover, could then look upon this 1617 rubbing as a fairly accurate statement of a painting considered by the Chinese themselves to be one of their most important, and one that has not been seen for hundreds of years.

In a 1914 article John C. Ferguson claimed that "the earliest copy [of the *Wang Ch'uan*] which has come down to our present time is that of Kuo Chung-shu of the Sung Dynasty," and that he had had the privilege of studying its details and found that they tallied with a description of our 1617 rubbing of the *Wang Ch'uan* published by Berthold Laufer. (Most of Field Museum's rubbings were collected in the early 1900s by Dr. Laufer, who became one of the Museum's most renowned curators for his wide knowledge of East Asia.) Ferguson also commented that Kuo, out of respect for the earlier master, would never have permitted himself the freedom of imitating only the style of Wang Wei; such a copy would be called a *fan* painting. Kuo made a *lin pen*, which term (used in an inscription on the painting) means a faithful reproduction copied directly from the original, perhaps traced. This painting is now housed in the Metropolitan Museum. The fact that Kuo Chung-shu made a painted copy of the *Wang Ch'uan* does not rule out the evidence that he also did an engraving.

Many artists made free-hand copies of the original *Wang Ch'uan*. One such painting, and famous in its own right, is an eighteen-foot-long hand scroll in the British Museum by Chao Meng-fu (1254-1322). In an inscription following his signature on the painting, he acknowledges it to be a "free" copy; and it is important to look upon these "free" copies as just that. While a masterpiece, and supposedly based upon the T'ang model, the painting reflects many of the characteristics attributed to the Yuan period of painting. And it is, as Chao implies, an example of his virtuosity.

In an exhibit of late Ming and early Ch'ing painters recently shown at the Art Institute of Chicago, there was a hand scroll entitled *Wang Ch'uan Villa*. It was painted by Wang Yuan-ch'i (1642-1715). The accompanying catalog to the exhibition mentioned that it was based on a "1617 engraved version of the famous *Wang Ch'uan* composition attributed to Wang Wei," which Wang Yuan-ch'i referred to as a "popular stone engraving." Though his picture too is a "free" copy, it is interesting that of the several rubbings from various stones available in the seventeenth and eighteenth centuries, as well as painted copies, he chose

this 1617 version as his model.

China has produced many major painters, both before and after Wang Wei, but he has a unique place in the long history of China's pictorial art in that he has been credited with creating the Ch'an (Zen in Japanese) Buddhist school of landscape painting. It came to be known as the "Southern" in contrast to the "Northern" school. These are not geographical terms; rather, they express styles and approaches—the "Southern" using light ink-washes and relying upon intuition and suggestion, as against the stricter attitude of color over outline preferred by the "Northern." These distinctions, as so often happens, were really interpretations by artists and art critics of following periods, but they set Chinese landscape painting into two models—not truly always clear from each other—and for one thousand years followers of the two schools vied with each other on merits.

Thus, the possibility that the 1617 stone could have been copied from an early Sung stone could be as exciting to the Chinese art historian as would be the discovery of a new fossil species to a paleontologist.

Why did Wang Wei and his period, the T'ang, assume such importance? It was one of China's most expansive periods—politically, militarily, economically, and artistically. The country was unified and strong, its borders and influence extended far, and the arts reflected this vitality. Although the T'ang dynasty is perhaps better known by collectors and art museums in the West for its tomb pieces of majestic human and animal figures, it was for the Chinese their great period of poetry and calligraphy. It was also a period of innovation in painting, greatly influenced by Taoism and Buddhism, when new patterns of tradition became established.

Wang Wei was one of these innovators. He was a successful physician and poet in his early twenties. He served briefly as an assistant minister to the Emperor Hsuan Ts'ung until imprisoned for a time by rebel forces. After his young wife died when he was only thirty-one, he retired to a country villa. There he spent the remaining thirty years of his life in the meditations of Buddhism, writing poetry, and painting. Wang Wei's poems are said to be paintings, and his paintings poems. The scenes he painted and often accompanied with poetry were largely of the beautiful landscape of the Lan-tien District of Shensi Province in northern China.

There has been an adulation given to Wang Wei few Chinese artists have enjoyed. In the long annals of Chinese art criticism, he is almost without criticism. In fact, it was said that when Wang Wei painted a banana tree growing in snow, it was plausible. None of his paintings exist today. It is questionable whether any paintings of T'ang artists still exist; those which claim to be T'ang are suspect. It is therefore with great respect and reverence that we turn to the copies of early masterpieces—either paintings or the rubbings from engraved copies.

What exactly are rubbings?

For one thing, most Chinese rubbings are not rubbed. The term "rubbings" usually means to us an image produced by placing paper over a hard surface and actually rubbing the back with chalk or crayon to get an impression of the engraved or relief design underneath. This is how we might, for instance, take a rubbing of a coin or an old gravestone. But the Chinese have for centuries used a much more refined technique, which is technically called ink squeeze. The paper is applied wet, gently tamped into the engraved parts, and before it is completely dry India ink is evenly and carefully patted over the surface. When the paper is peeled off, only that part which covered the raised elements of the hard surface appears black. Thus we usually see white lines on a black background

because the design on the stone is usually incised. When the impression is taken from a surface with the design in raised relief, the print will appear as black on white. If the hard surface from which the rubbing is taken is fairly smooth, like bronze or wood, the print may be difficult to distinguish from a wood-block print, which is made by inking the block and pressing it on the paper.

The Chinese wet process for taking rubbings does not imply that they wish to go out of their way to make a seemingly simple process complicated; the wet process gives a more successful print. It does not smudge (unless poorly done), and if the rubbing is carefully stored—better yet, mounted and stored—it can survive for centuries.

We have mounted rubbings in our collection going back to the Sung period. In fact, many of these rubbings have survived the stones from which they were taken, primarily because they were easier to care for.

It should be pointed out here that engravings on hard surfaces did not begin with the objective of taking rubbings. In fact, the Chinese had been engraving in bronze as well as stone long before paper was invented in the second century, permitting rubbings. Engravings were objectives in themselves, a form of preservation of what the Chinese considered their finest expression—writings—which were esteemed above all else.

It is said that to ensure to posterity the truth of the Confucian classics, which had been distorted by many generations of copyists, the Han Emperor Ling had these classics collated and standardized once and for all by ordering that they be engraved in stone, and thus began the great stone carvings of China which lasted over two thousand years.

Not so. The tradition is probably much older. Still extant in Peking are stone carvings that are memorials in poetic form to a great military success. It is now thought that they date from the seventh or eighth century B.C. But it is conceivable that carving in stone began even earlier.

Quite possibly the Chinese invented paper because they were looking for a material which lent itself to print making in order to extend the engravings. Silk had been tried very early without much success. In any event, there is strong evidence that by the third century A.D. paper had been perfected well enough to make rubbings, and that by the fifth century, when European countries were still struggling with sheepskins, the Chinese were producing rubbing prints as a "mass medium." By the Sung period, rubbings of famous calligraphies were already sought after as collectors' items.

By the Ming dynasty, pictorial art had reached such a state of perfection that there was little new to be said or reached for. Many critics have considered it a period of artistic decline, including some who lived in the Ming. By the same token, reverence for the older masters increased, and engravings of old paintings, as well as engravings of calligraphy, became more common and also sought after as collectors' items. Some of these prints, if rendered by a good engraver, were valued above contemporary paintings or free-hand copies of older paintings, possibly because they were truer likenesses of the originals.

The skills of the copyist and engraver in transmitting a style of painting or calligraphy are of utmost importance. In early days there were special court engravers who worked exclusively for the emperor. Later it became a proud trade, and very often we will find the name of the engraver as well as that of the calligrapher or painter cut into stone. Engravings, depending on the detail, demand much time and infinite patience. To reproduce the original as exactly as possible, a tracing of it must first be made and

transferred onto the stone, then carved into it. The technique can pick up the calligraphic lines of a painting but must sacrifice the freedom of the brush stroke, and cannot possibly reproduce the nuances of ink wash (although attempts to do so have been made). The harsh nature of stone does not easily yield the fluid lines created by a brush, but some results are amazing.

The quality of the rubbing from the 1617 stone indicates that the copyist and engraver knew their trades well. This judgment is confirmed in the scroll itself. The prefatory remarks written on the scroll by Shen Kuo-hua (who had the stone cut) first explain that when he was magistrate of Lan-tien District, he discovered that the copy there of Wang Wei's *Wang Ch'uan* painting was coarse looking and not even representative of the Wang Ch'uan landscape. He goes on to state that he ordered Wang Wei's "true picture" in the collection owned by Yang Pai-fu be cut on stone, this "true picture" being a copy made by Kuo Chung-shu (Sung dynasty); that Kuo Sou-lu was appointed to copy it for the new stone carving; and that his fine work is praised for being an exact copy of the Sung dynasty edition. Several colophons of appreciation also follow the picture, including one by the collector Yang Pai-fu and one by the engraver of the new stone. We are encouraged regarding the accuracy of this 1617 edition by all these testimonials; plus the fact that the Sung copyist was a fine artist and disciple of the Wang Wei "Southern" school; plus the knowledge that the print of this Sung edition used as a model was borrowed from a recognized collector.

Good rubbings are no longer easy to obtain, and are certainly not inexpensive. Many of the stones from which they were made are gone or unavailable and the craft of the engraver is dying out. Quite likely it is already gone. We are therefore fortunate at Field Museum to have received from Dr. Berthold Laufer one of the best and most encompassing collections of rubbings ever assembled —including, among other things, a prize in the 1617 edition of the *Wang Ch'uan chen chi.*

As a postscript about Chinese rubbings in general, perhaps it should be noted that the mulberry paper used is very delicate and highly responsive to changes of temperature and light. Rubbings should therefore be exhibited as sparingly as possible, and with caution. While a few of the rubbings in Field Museum's collection go back to the Sung period, most are of comparatively recent vintage—not more than 300 years old—and fairly well preserved only because these regrettably strict measures are taken. A few are on permanent display, however, in the China exhibits on the second floor.

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Alice Schneider is volunteer assistant to Dr. Hoshien Tchen, consultant to Field Museum's East Asian Study, Department of Anthropology.

A Latin American Christmas
Terua Williams

Tegucigalpa, Honduras
December 25

Dear Mother and Dad,

It was four o'clock this morning before we turned the covers down and crawled into bed. We have been celebrating Christmas as guests of our Guatemalan friends the Méridas, now residing here in Honduras. Christmas Eve, *Noche Buena,* rather than Christmas Day is the high point of this joyous occasion. At midnight the bells in all the church towers began to peal and the sky caught fire with flares and reverberated with rockets to remind us of the "Joy to the World" message that the Christ Child was born.

From the moment we arrived at the outskirts of town early yesterday evening we felt the festive mood. Children were already setting off fire crackers. Christmas and Easter are the two holidays of the year when families down here make a great effort to be together, and we were so happy to be invited to join our friends' family group for this *Noche Buena* when we ourselves were far from home. Coronel Mérida, doña Lola, Aida, Carmen Rosa, and Marco were all at the threshold to greet us with a *Feliz Navidad!*

We rather expected to have a traditional Guatemalan Christmas plus —because the Méridas had lived some years in New Orleans and so had adopted some of our northern Christmas customs. And so it was. A huge pine tree filling one corner of the living room was decorated with ornaments. The tree has become a part of Christmas here only in recent years. *El nacimiento,* the traditional nativity scene, which is always present in Latin American homes on this holiday, was arranged on a table near the tree. The figures of this one were of finely carved wood. Sometimes they are made of porcelain, and sometimes they are crudely shaped of clay and painted bright colors. Always the scene includes the Holy Family, the Three Kings, the shepherds, and the animals. Over the years various family members usually add houses, trees, and other figures and objects until the *nacimiento* becomes a village. They use Spanish moss, tiny succulent plants, lichens, and pine needles for the landscaping. The bromeliads that come into bloom in December here, with shiny green leaves and bright red bracts, as well as the poinsettias that grow so luxuriantly, sometimes as hedges, are used to decorate homes and churches. And often the floors are sprinkled with long green pine needles.

The church we went to for midnight mass was perfumed with candles and pine needles and incense. The candle-lit mass is called *misa del gallo,* for the cock is supposed to crow at midnight. At the end of the service we were all given lighted candles to carry down the aisle and out into the night as the bells peeled and the fireworks rained starlets down above our heads. When we arrived home in this spirit of joy we knelt before the *nacimiento* to give thanks for our well being and to bless the feast of which we were about to partake.

What a feast it was! You have had tamales made of cornmeal with meat inside. We had *nacatamales*—super tamales. The cooked cornmeal, called *masa,* has mixed into it lard, onion, garlic, green pepper, pimiento, salt, and the bright yellow *achiote* powder which gives color. This mixture is spread on pieces of banana leaf. Then chopped turkey meat, boiled rice, cooked chick peas, diced raw potato, green olives, capers, and even raisins are placed on top. The tamale is rolled up and wrapped in the banana leaf, tied, and placed in a big kettle to steam over boiling water. When the leaves are well cooked, so are the *nacatamales.* One alone is a meal, but that was just one course.

Then came the time to open the gifts piled under the tree. This custom is ours, not theirs, and Santa Claus was introduced to them by us. Before Santa Claus was imported children believed that the Three Kings were the bearers of gifts—and not on Christmas Day, but on the Twelfth Night. In many places children still put grass out to feed the animals the Three Kings ride. They awake next morning to find the grass gone and gifts left in its place.

Throughout the twelve days of Christmas the *paranda* custom leads to many an all-night party. During this period anyone or any group knocking at a door at any hour must be invited in and served refreshments, and the housewife must be prepared with cookies, drink, and music. The seasonal beverage is *rompope,* which requires a bottle of *aguardiente* (raw rum), ten egg yolks, a quart of milk, ten tablespoons of sugar, some cinnamon, and vanilla.

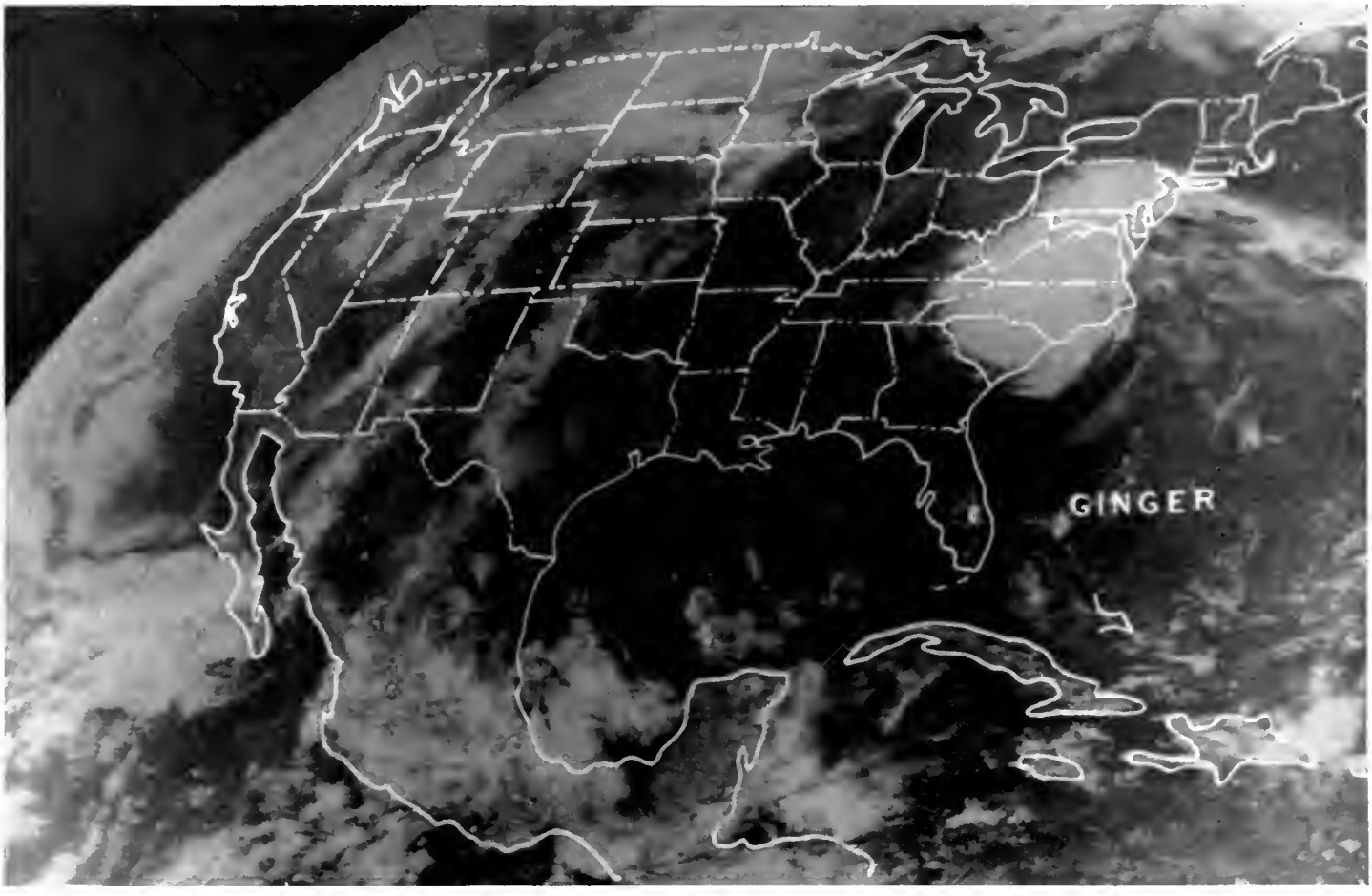
Since we couldn't share your Christmas this year, we want to share ours with you.

With love, *Rua*

Terua Williams is a volunteer in the Department of Botany and the wife of Dr. Louis O. Williams, chairman of the Department of Botany, Field Museum. This letter recalls a Christmas she and her husband spent in Latin America. The illustration is from her own linoleum block cut.

Shall we inherit the whirlwind?

John Clark



Hurricane Ginger in its dying phases shows as a broad, white cloud mass. A zone of clear weather (dark area) lies between the rotating mass of the hurricane and the normal cloud systems. The enormous heat energy which drives the rotating storm system has been moved by the storm from near Jamaica northwestward to Virginia.

Hurricane Ginger, which hit the coast of North Carolina this fall, was a large but only moderately nasty girl. Hurricane Ginger was also one of very few hurricanes that have been seeded with silver iodide or other particles, with the aim of moderating their power.

Now there is serious question whether or not the treatment was effective. Ginger was already very old, as hurricanes go, and showed several abnormal characteristics. The experts who supervise Project Stormfury, the federal agency which observes and tries to temper hurricanes, must study the results carefully before they can say just what the results of seeding were.

If we consider the tragic loss of life and property when a major hurricane strikes our coast, Project Stormfury appears to be one of the wisest investments our government makes. Its studies of the nature of hurricanes have enormously expanded our knowledge of them. With understanding has come increased ability to predict their courses. This alone has saved more money than the project costs.

But is it wise to learn to dissipate hurricanes? I wonder.

What is a hurricane anyway? We all know that it is a violent, rotating storm which follows an erratic path. What else is it? Therein lies the real problem. In order to understand, we must see hurricanes not as separate entities, but as part of Earth's atmospheric circulation system.

The circulating part of the atmosphere is a fluid film only a few miles thick surrounding our globe. The power that drives it is convection, the same power that makes a pot of water simmer over a burner.

Power for the major convection system is generated by the difference in temperature between the tropics and the poles. Warm air boils upward over the equator, passes through a series of "simmers," and eventually cools off near the poles. If you put one end of a long, flat pan over a low burner and fill the pan with a couple of inches of water, you can see the same thing happen. If the heat is great, a single "boil" (technically, a convection cell)

develops over the whole pan. Turn the heat down, and several "simmers" (smaller convection cells) appear. This more nearly resembles the situation in our atmosphere. Notice that the system is three-dimensional. Until air travel became common, we always thought of winds and storms as at the bottom of our air film—on Earth's surface. Nowadays anyone who has ridden a jet airliner knows that the atmosphere moves up, down, and sideways at all elevations.

A second and smaller convection arises due to the difference in temperature between continents and oceans. The continents are warmer than their neighboring oceans in summer, and colder in winter. This sets up a lesser system of air movement, which modifies but doesn't supersede the main one.

Hurricanes do not constitute a meteorological island, sufficient unto themselves. They are an integral part of Earth's orderly system of convective heat circulation. Most of them occur during autumn and spring, just as the Arctic temperatures are changing, and as the secondary continental-oceanic system is changing. Hurricanes receive billions of horsepower of energy from warm subtropical seas and transfer it generally northward and landward, to areas of colder air and, naturally, less energy.

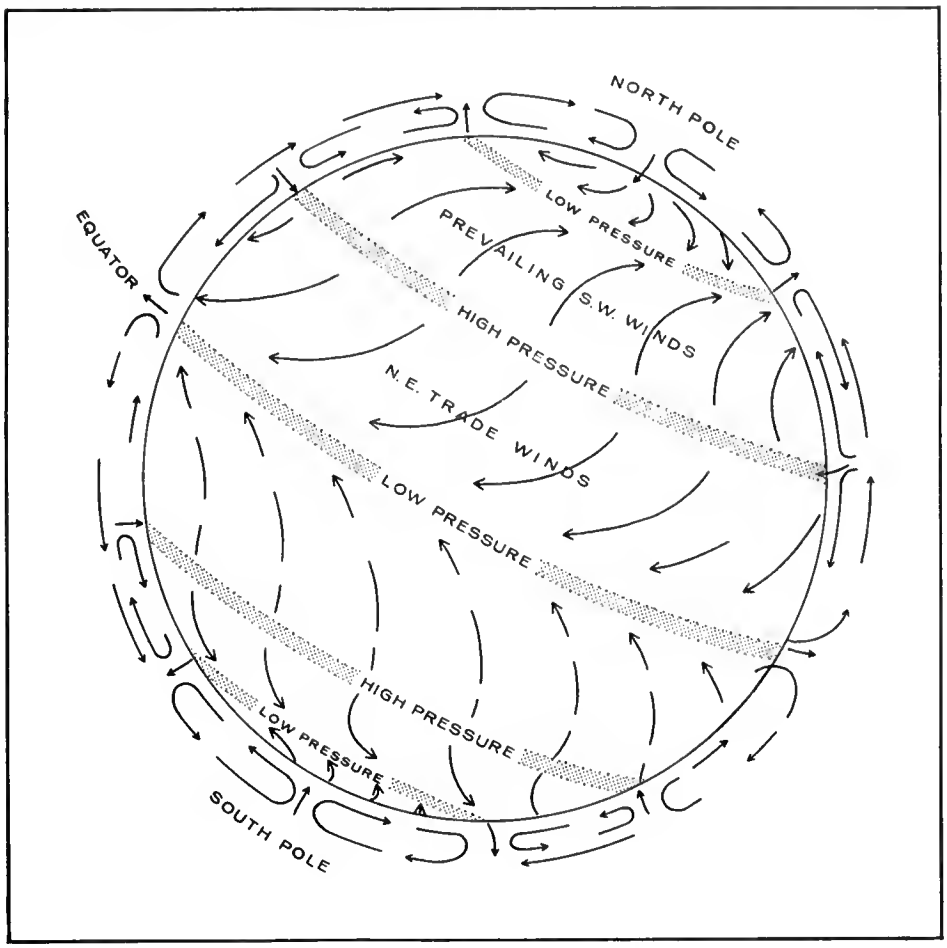
What would happen if Project Stormfury should find a way of stopping hurricanes in their tracks? Politically, we can be sure that from that day onward all hurricanes would be stopped. We cannot imagine a government deciding to stop one hurricane but not another—that would have political consequences of hurricane proportions.

And what would happen to Earth's weather patterns if all hurricanes were stopped? No one knows, and no one can possibly predict. Perhaps there would be no appreciable change.

Perhaps the climate of southeastern United States would develop disastrous November cold waves. Perhaps cutting off the hurricanes would trigger a change in the whole wind pattern. Since winds drive the major ocean currents, even a minor change in prevailing winds would change the direction of the ocean currents. We might change the climate of Europe. We simply do not know, and can't predict!

If this interests you enough to try the experiment I mentioned before, with a flat pan over a burner, you might try turning the burner to a low simmer, then placing the blade of a pancake-turner or a pie-lifter in different positions near the simmering area. Watch how the flow of water changes. Very roughly that is what suppressing hurricanes might do.

This greatly simplified diagram shows the global pattern of air convection at the earth's surface. This is modified by the secondary, continental-oceanic system and by many lesser influences. The cooling, down-moving air masses at the poles and warming, upward-moving air masses at the equator are separated by a second "simmer" or convection cell in each hemisphere.



The worst possibility, and one that seems quite unlikely, is that equatorial heat might build up until it produced a super-hurricane which we could not stop. Much more probably, some notable changes would occur in our winter weather. Since the warm-air movement would be forced into the upper atmosphere, we might well experience bitterly cold winters here at Earth's surface.

I cannot help wondering if it is wise of us to tamper with one of the mightiest forces in Nature before we know what we are doing. We may indeed, in the words of Hosea, sow the wind and inherit the whirlwind.

Dr. John Clark is associate curator of sedimentary petrology, Department of Geology, Field Museum.

FIELD BRIEFS

New Trustee

Gordon Bent, well known Chicago business man, has been elected a Trustee of the Field Museum of Natural History. Remick McDowell, Museum president, made the announcement following a recent meeting of the Board of Trustees.

Bent is general partner and syndicate manager of Bacon, Whipple & Company. He has been associated with the firm since 1946. In the past, he has held the important posts of: governor of the Midwest Stock Exchange from 1967 to 1968; governor from 1956 to 1960 and chairman in 1959 and

Gordon Bent

1960 of the Chicago Association of Stock Exchange Firms; and national governor from 1964 to 1966 and chairman in 1962 of the National Association of Securities Dealers.

Among his civic activities, Bent serves as vice president and member of the board of directors of the Chicago Maternity Center.

Three Retire

Three members of the maintenance staff retired recently after a total of 77 years' service to the Museum. Mrs. Allener Nathaniel was with the Museum for 16 years; Stephen Kovar served on the staff for 41 years; and Tomasz Turley has retired after 20 years. The Museum is grateful to these people for their long service and for the fine caliber of their work.

Dr. Karel Liem Back at Museum

Dr. Karel Liem, associate curator of vertebrate anatomy, has returned to Field Museum after a year of study abroad on a Guggenheim Memorial Foundation fellowship.

Dr. Liem spent seven months in London at the British Museum and five months in the Netherlands at the University of Leyden studying the morphology and evolution of cichlid fishes in Africa's Lake Tanganyika. The British Museum possesses the largest collection in the world of cichlid fish; the University of Leyden has the best laboratory equipment in the world for analyzing muscle function.

Cichlid fishes in Lake Tanganyika have undergone explosive evolution over approximately the last two million years. About five originally riverine species evolved into 135 lacustrine species. Evolution has occurred so quickly that all stages of that evolution are found in the lake—the original riverine species as well as intermediate stages and highly specialized species.

Dr. Liem is interested in determining why cichlids but no other fishes in the lake have had such a burst of evolution. "A study of comparative anatomy of the fishes, particularly the feeding mechanisms," said Dr. Liem, "may shed some light on the problem." Dr. Liem noted that the ancestral form was omnivorous—a general feeder—while the descendents have developed specialized feeding habits and adaptive mechanisms. Some cichlid species, said Dr. Liem, now swallow other fish whole, some scrape algae from rocks, some crush snails, some eat only scales of other fish, and some eat only fish eggs.

In mouth-breeding cichlids, the female incubates the eggs in her month until they hatch, and for some time after hatching the young return to her mouth for protection. One of the many interesting species that feed upon mouth-breeders has evolved a large-lipped mouth and very small teeth, enabling the predator fish to grasp the head of the mouth-breeder in its jaws and suck out the eggs and young fish.

A special problem presented by mouth-breeders that Dr. Liem solved at the University of Leyden was, How does the female fish respire while eggs or young are in her mouth? Fish respire by pumping water through the gills, usually by using the pumping action of the cheeks. By attaching tiny electrodes to individual muscles of live cichlids and charting muscle activity, Dr. Liem discovered that mouth-breeders can also use the pumping action of the chin (gular region) to force water through the gills. They can use both methods of breathing interchangeably, while other cichlids and non-cichlids must rely on just one mechanism—i.e., pumping action of the cheeks.

Dr. Liem was educated in Indonesia, the Netherlands, and the United States, and holds a Ph.D. in zoology from the University of Illinois, Urbana. He joined the Museum staff in 1965. He also teaches anatomy at the University of Illinois College of Medicine and has collaborated on or authored some 20 publications on vertebrate anatomy. He is a member of the National Academy of Science's Committee on Latimeria (to study the coelacanth, a primitive fish previously thought to be extinct).

Staff Appointments

Dr. Robert Inger Norman Nelson

Two staff members have been appointed to the position of assistant director. The changes are aimed at consolidating the Museum organization to prepare for the institution of two long term projects of vital importance to Field Museum in the coming decades: the $25 million capital fund campaign and a major building rehabilitation program.

Dr. Robert F. Inger, formerly chairman of Scientific Programs, becomes assistant director, Science and Education. The scientific, exhibition and education departments, and the library, come under his jurisdiction.

Norman W. Nelson, formerly business manager, is assistant director, Administration. His area of authority embraces the financial, service and administration functions of the Museum, including the operation of the building.

"The present departmental organization and internal operations will remain unaffected," said Director E. Leland Webber. "These changes have been made to strengthen our administration functions and to continue decentralization of responsibility for Museum operations and decision making."

Capital Campaign

Field Museum has received a capital gift of one million dollars from an anonymous Chicagoland donor. Announcement of the gift was made by Nicholas Galitzine and Marshall Field, chairman and vice chairman, respectively, of the Museum's Capital Campaign to raise twenty-five million dollars.

This is the largest gift received since the Museum launched the first capital campaign in its twenty-eight-year history on September 20. "We are elated by the generosity of this donor," said Galitzine, "and only wish that we could reveal the identity so that we might express our thanks publicly."

This gift brings the total contributions received in the campaign to more than $4,200,000.

Funds obtained through the campaign will be used to repair and improve the Museum's fifty-year-old building, renovate and modernize exhibit areas, and improve visitor services and educational facilities.

"We deeply appreciate this splendid gift," said Museum Director E. Leland Webber. "It lends encouraging support to our confidence that Chicagoans in the 1970s will contribute as they did in 1893, when so many persons contributed to the founding of a great museum for the city."

Fieldiana

The following issues of *Fieldiana* have been recently published and are available for purchase from the Museum's Publications Division.

Fieldiana is a continuing series of scientific papers and monographs dealing with anthropology, botany, geology, and zoology published by Field Museum. Prices cited do not reflect the 10 percent discount available to Members of the Museum. Publication Number should be used when ordering.

Botany

"Flora of Peru" (Volume XIII, Part V-B, No. 3) by Gabriel Edwin, associate professor of biology, Roosevelt University, and former associate curator of vascular plants, Field Museum. Publication 1125. $10.

"Revision of the Genus *Morganella* (Lycoperdaceae)" (Volume 34, No. 3) by Patricio Ponce de Leon, assistant curator, cryptogamic herbarium, Field Museum. Publication 1127. $1.

"A New Species of *Juniperus* from Mexico" (Volume 34, No. 4) by Marion T. Hall, director, The Morton Arboretum, Lisle. Publication 1131. $1.

"Note On *Gibsoniothamnus*" (Volume 34, No. 5) by Alwyn H. Gentry, Missouri Botanical Garden, St. Louis. Publication 1138. $.75.

"Flora Costaricensis" (Volume 35) by William C. Burger, associate curator of vascular plants, Field Museum. Publication 1140. $10.

Geology

"Notes on the Siluro-Devonian *Ischadites stellatus* (Fagerstrom 1961), a Dasycladaceous Alga" (Volume 23, No. 3) by Matthew H. Nitecki, associate curator, fossil invertebrates, Field Museum. Publication 1134. $.75.

"Revision of the *Holocystites* Fauna (Diploporita) of North America" (Volume 24) by Christopher R. C. Paul, assistant professor of geology, Indiana University Northwest. Publication 1135. $8.

"Catalogue of Type and Referred Specimens of Crinozoa (Blastoidea) in Field Museum of Natural History" (Volume 23, No. 4) by Julia Golden, custodian of types, fossil invertebrates, Field Museum, and Matthew H. Nitecki, associate curator, fossil invertebrates, Field Museum. Publication 1139. $1.

Zoology

"The Viperid Snake Azmiops: its Comparative Cephalic Anatomy and Phylogenetic Position in Relation to Viperinae and Crotalinae" (Volume 59, No. 2) by Karel F. Liem, associate curator of anatomy, Field Museum and associate professor of anatomy, University of Illinois Medical Center, Chicago; Hymen Marx, associate curator of amphibians and reptiles, Field Museum; and George B. Rabb, research associate, Field Museum and associate director of research and education, Chicago Zoological Society, Brookfield. Publication Number 1126. $3.

"Revision of the Termitophilous Tribe Philotermitini (Coleoptera: Staphylinidae)" (Volume 58, No. 4) by David H. Kistner, Shinner Institute for the Study of Interrelated Insects, Department of Biology, Chicago State College. Publication 1128. $.75.

"New Distributional Records of Bats from Iran" (Volume 58, No. 3) by Anthony F. DeBlase, Field Museum. Publication 1129. $.75.

"The Auditory Region (Ossicles, Sinuses) in Gliding Mammals and Selected Representatives of Non-Gliding Genera" (Volume 58, No. 5) by Walter Segall, research associate, vertebrate anatomy, Field Museum. Publication 1130. $1.25.

"Mating Calls of Some Frogs From Thailand" (Volume 58, No. 6) by W. Ronald Heyer, Biology Department, Pacific Lutheran University. Publication 1132. $1.

"Descriptions of Some Tadpoles From Thailand" (Volume 58, No. 7) by W. Ronald Heyer, Biology Department, Pacific Lutheran University. Publication 1133. $.75.

"A Redescription of *Amphiprion nigripes* Regan, a Valid Species of Anemonefish (Family Pomocentridae) from the Indian Ocean" (Volume 58, No. 8) by Gerald R. Allen, Department of Zoology, University of Hawaii, and Bernice P. Bishop Museum; and Richard N. Mariscal, Department of Biological Science, Florida State University. Publication 1136. $.75.

"Auditory Region in Bats Including *Icaronycteris index*" (Volume 58, No. 9) by Walter Segall, research associate, Field Museum. Publication 1137. $.75.

Fifty Years on Museum Staff

Anthony Patteri, who joined the maintenance staff of Field Museum in October of 1921, recently celebrated 50 years—a working lifetime—with the Museum.

Backyard Safari

A "Backyard Safari" gets underway each Sunday at 8:00 a.m. on WBBM-TV (Channel 2). This unique series of half-hour programs for children focuses on the natural history of the Chicago area. Future programs will explore: December 12, Cats; December 19, Dogs; December 26, Heat; January 2, The Sun; January 9, Recycling.

"Backyard Safari" is produced cooperatively by WBBM-TV, the Chicago Board of Education, and Field Museum.

Jade for Sale

The Museum Book Shop has a wide selection of jade jewelry—rings, pins, pendants, bracelets—and carvings for sale. Price range is from $5 to $50. Members of the Museum receive a ten percent discount on all purchases.

This Island Earth

Oran W. Nicks, ed. National Aeronautics and Space Administration Special Publication 250. Washington, D.C.: U.S. Government Printing Office, 1970. 182 pp. Indexed. $6.

Men have always been fascinated by high places: the view from a skyscraper, out of an airplane window, from the summit of a mountain. There is a quality about seeing the world spread out beneath us that causes most of us to stare, entranced. *This Island Earth* is a book that captures a great deal of this entrancing quality; for here is a large collection of color photographs taken from the ultimate of all high places—the orbiting satellite.

Most of us have seen a few photographs taken from the several orbiting vehicles of the Gemini and Apollo programs. This book, however, contains hundreds of them, almost all in color. The book is divided into seven chapters, each emphasizing a particular photographic subject matter: the earth's atmosphere, the seas, the lands, North America, visible works of man. The opening chapter deals with our solar system in general with some excellent color shots of some of the planets, and the final chapter discusses and illustrates the several projected NASA space programs planned, or hoped for, over the next few years.

Like all NASA projects, this is a team-written book. Team writing usually turns out badly; however, NASA has become so expert at team efforts that this book reads particularly well. One is never conscious of severe changes in style. This is, of course, a tribute to the editor, Oran Nicks.

The book can be enjoyed at three levels. One can simply leaf through the photographs and enjoy the spectacular views from hundreds of miles up above the atmosphere. To see how a major river, a mountain range, or a sea of atoll reefs appear from such a height is a delightful experience. One can, on the other hand, carefully read the photograph captions and discover details that are pointed out in the adjacent pictures. Finally, one can read the text that goes along with each chapter. The writing is easy to follow, conversational in style, and not highly technical. One can, nevertheless, learn a good deal about aspects of the earth's weather systems, oceanography, and geology.

At any of these three levels it is a fascinating book to go through. In one photo you can actually see a straight line marking the political boundary between Israel and Egypt. The Israeli side is a blue-gray color; the Egyptian side is pale tan. The colors reflect the differences in land use. In Israel the land is cultivated and irrigated; in adjacent Egypt it is the desert of the nomads. In another photo you can see a straight line marking the political boundary between New Mexico and Texas. No one is really certain why it should show up this way in a photograph, but it may have something to do with differences in water-use laws between these two states. Such photos, among the many others discussed in the book, illustrate some of the economic uses of satellite-based color photography.

The book suffers only slightly from technical defects. Only one photo is badly out of color register and is quite blurred. In general the book is well done. It is hard-bound, printed on durable glossy paper, and its format size, 9 by 11¼ inches, is large so that one does not get a cramped feeling for the panoramic views contained in it. In fact, some photographs are spread out over double pages, offering a truly expansive look. At its modest price, this book is well worth adding to any home library.

The title comes from the Apollo 10 astronauts as they looked "over their shoulders" at Earth dropping away behind them, a lovely white-frosted sapphire floating alone in a sea of cold, black space. That Earth is truly an "island" there can no longer be any doubt. In these days of impending ecological tragedy it is perhaps desirable that we be reminded of this fact—again and again.

by Dr. Edward J. Olsen, curator of mineralogy in the Department of Geology, Field Museum.

Collecting Seashells

By Kathleen Yerger Johnstone. New York: Grosset & Dunlap, 1970. 198 pp. $5.95.

Shell collecting, which has always enjoyed a considerable popularity among amateur naturalists, seems to be on the increase, to judge from the ever-growing number of books appearing on the market devoted to this hobby. What merits the addition of yet another volume on the subject?

Mrs. Johnstone wisely chose not to make this another identification manual—these exist in ample number for all levels of interest. Rather, she attempts to lead the amateur from the stage of collecting, willy-nilly, the pretty exoskeletons of that vast animal phylum termed the Mollusca to a serious study of the inhabitants which constructed the shells and the environments in which they live.

Many of the 26 chapters in her book cover the basics, from what a seashell is, what mollusks are, the details of where and how to collect, cleaning and curing, through the important though often neglected tasks of record-keeping and cataloging, to hints on display and exhibition. What sets this book off from most of its predecessors is the repeated urging for the amateur to turn his attention from the spectacular to the commonplace, to *observe* and *record* the biological facts of the living animal. The scientific contribution of amateurs in other phases of natural history is well known, and this reviewer has felt that the elevation of the amateur in malacology is long overdue. The title of Mrs. Johnstone's 19th chapter—"Stop, Look, and Learn"—might well be taken as a watchword for all amateur naturalists, both in the field and in a museum.

Six full-color photographs and numerous black-and-white photographs and line drawings illustrate the book. Rounding out the volume are sections on suggested reading, museum and aquarium exhibits, and an annotated bibliography. I wish the author had given a bit more information on the attractive endpapers, reproduced from a copy of *Historia Naturale di Ferrante* in the collection of the Museum of Comparative Zoology, Harvard University. The bibliography will lead the interested reader into the much broader field of marine biology and oceanography, the ecological aspects of which require serious attention from all intelligent persons today. The three-fourths of this planet covered by marine waters is at least as important for life as the one-fourth covered by land that we live on.

by Ernest J. Roscoe, lecturer in the Department of Education's Raymond Foundation, Field Museum.

Please address all letters to the editor to

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The editors reserve the right to edit letters for length.

CALENDAR

Exhibits

Through December 31

The Afro-American Style, From the Design Works of Bedford-Stuyvesant, an exhibit of textiles blending classical African motifs and contemporary design. The original Field Museum Benin artifacts which inspired many of the designs are also shown. Financial assistance for the exhibit was received from the CNA Foundation, Chicago, and the Illinois Arts Council, a state agency. Hall 9.

Through January 9

Studies in Jade, a selection of books from Field Museum's library, featured in the South Lounge to coincide with the recent opening of the new Hall of Jades. Included are *The Bishop Collection, Investigations and Studies in Jade,* in two volumes, and *Chinese Jade Carvings of the XVIth to the XIXth Centuries in the Collection of Mrs. Georg Vetlesen,* in three volumes.

Continuing

Color in Nature, an exhibit examining the nature and variety of color in the physical and living world, and how it functions in plants and animals. It focuses on the many roles of color, as in mimicry, camouflage, warning, sexual recognition and selection, energy channeling, and vitamin production, using Museum specimens as examples. Continues indefinitely. Hall 25.

Field Museum's 75th Anniversary Exhibit continues indefinitely. "A Sense of Wonder" offers thought-provoking prose and poetry associated with physical, biological, and cultural aspects of nature; "A Sense of History" presents a graphic portrayal of the Museum's past; and "A Sense of Discovery" shows examples of research conducted by Museum scientists. Hall 3.

John James Audubon's elephant folio, *The Birds of America,* on display in the North Lounge. A different plate from the rare, first-edition volumes is featured each day.

Hours

9 a.m. to 4 p.m. Monday through Thursday; 9 a.m. to 9 p.m. Friday; 9 a.m. to 5 p.m. Saturday and Sunday. December 27 through 30, 9 a.m. to 5 p.m.

Closed Christmas Day and New Year's Day.

The Museum Library is open 9 a.m. to 4 p.m. Monday through Friday. Please obtain pass at reception desk, main floor north.

Film and Tour Program

December 1 through December 24

"Winter Greens," a self-guided tour, designed to acquaint visitors with plants that are popular during the Christmas season. Free tour sheets are available at Museum entrances.

December 27 through December 31

"Through These Doors," a color film focusing on behind-the-scenes activities at the Museum, is shown at 1:15 p.m. in the second floor North Meeting Room. A guided "highlights" tour leaves at 2 p.m. from the North information desk.

Continues indefinitely

Free Natural History Film "Patterns for Survival" (A Study of Mimicry) presented at 11 a.m. and 1 p.m. on Saturdays, and 11 a.m., 1 p.m., and 3 p.m. on Sundays in the second floor North Meeting Room. The half-hour film offers an overall view of protective coloration in insects and provides visitors with an insight into the "Color in Nature" exhibit.

Children's Program

"Faces of Africa," Winter Journey for Children, begins December 1. Youngsters test their powers of observation by answering written questions and making sketches of African masks in Museum exhibit areas while on a self-guided tour. All boys and girls who can read and write may participate. Journey sheets are available at Museum entrances. Through February 29.

Musical Program

December 5

Metropolitan Youth Symphony presents a free concert at 2:30 p.m. in the James Simpson Theatre.

December 18

Christmas Musicale, presented by the Stein Family Ensemble of Strings and Voices, from 1:30 to 3 p.m. in the North Lounge.

Coming in January

Opens January 11

Coco-de-mer, an exhibit of the world's largest seed and its use by man, on display in the South Lounge through March 5.

Opens January 20

Australian Aboriginal Art from Arnhem Land, a selection of more than 400 bark paintings and some wooden ceremonial sculptures. The exhibit is unique because of the documentation accompanying most of the pieces, including information about the artists, when they were painted, their use, and the region in which they were produced. The material is from the extensive collection of Louis A. Allen of Palo Alto, California. Through September 10. Hall 27.

A Reminder

Make your visit to Field Museum early in the day Sunday, December 19, a date the Chicago Bears will play in Soldier Field. Because of this afternoon game, the Southeast parking facilities will be filled and the North lot reserved for Museum guests undoubtedly strained to capacity.