ANCESTORS: SHAKING UP THE FAMILY TREE

A recently identified species of ancient ape-men may profoundly change current ideas of human lineage and the speed of its evolution

BY JOHN H. DOUGLAS

'Tis spring, and open season on Pliocene hominids. For reasons of weather and the academic calendar, hunting for the earliest ancestors of modern humans is about as circumscribed as duck season. Each summer US. and European anthropologists fan out through Asia and Africa in hopes of finding a few more bones to contemplate during long winter evenings. Then, just as regularly, each spring they exhibit their trophies. Judging from the crop already displayed, this certainly looks like a bumper year.

It all began with the announcement in the Jan. 26 SCIENCE of a new hominid species, *Australopithecus afarensis,* claimed to be the common ancestor of both the later australopithecines and of modern humans (SN: 1/20/79, p. 36). With one bold stroke, the two young authors of the paper not only proposed a new interpretation of human evolution but directly challenged the theories and prestige of the most famous family in archaeology.

Based on the skeletal remains of several dozen individuals recovered from two East African sites, Donald C. Johanson of the Cleveland Museum of Natural History and Timothy D. White of the University of California at Berkeley concluded that *A. afarensis* was a stable species that existed for at least the period from 2.9 to 3.8 million years ago in the middle of the Pliocene. Individuals stood only four to five feet high, with considerable size difference between male and female. They had primitive features and small brains, but their skeletons showed that they walked upright.

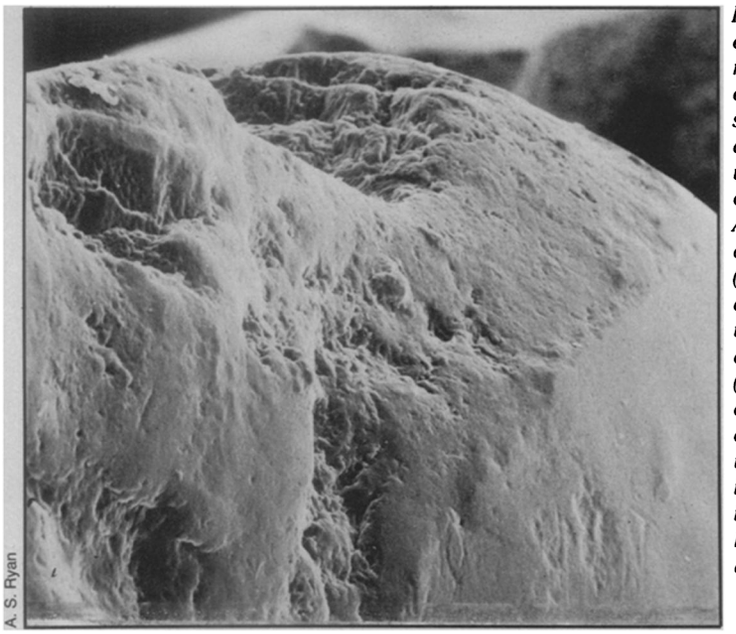
Although they did not mention it in their paper, the authors might also have added: "And they left a dandy set of footprints." But these prints were the trophy of another hunter, Mary D. Leakey, who announced her own, very different interpretation of the East African data in March (SN: 3/31/79, p. 196). In keeping with the long-standing Leakey family tradition of claiming a much earlier separation of the uniquely human from the ape line, Mary Leakey refused to name the creatures that left the tracks, but said they were "direct ancestors to man." Moreover, she emphasized, they were "not like other *Australopithecus* ... which died out." As for the theory of Johanson and White that *A. afarensis* was a common ancestor of the later australopithecines as well as humans, Leakey said their work was "not very scientific" and their conclusion "doesn't seem to be possible."

Her criticism of the very concept of identifying a single *afarensis* species rests in part on the mixing of data from two sites, separated by 1,000 miles and at least a half-million years in the time they were deposited. The footprints, as well as some of the fossils in question, were found in the Laetolil area of northern Tanzania and date to about 3.6 million years ago, while the rest of the so-called *"afarensis"* material comes from the Hadar region of Ethiopia, with dates of 2.7 to 3.1 million years ago.

Mary's son, Richard Leakey, also challenged Johanson's ability to identify the remains as belonging to one species, during a seminar in February in Pittsburgh. The variations in size of the bones, he pointed out, might indicate the presence

NYT Photos

Johanson and Leakey at conference in Pittsburgh square off to do theoretical battle over origin of the human species.



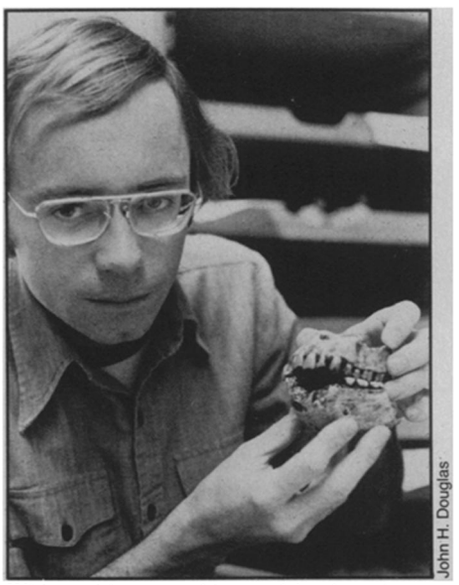
Ryan's scanning electron microscopic examination shows three distinct types of wear on incisors of A. afarensis. *All three, abrasion (pitting), attrition (linear wear striations) and microflaking (small chipping caused by clamping objects with the teeth), indicate an important hominid adaptation.*

of two separate species; and besides, even the bones found together at one of the sites might have washed there from other places. Richard Leakey's own long-held theory has been that the genus *Homo* split off as a separate line some 4 to 6 million years ago, and that by 2.9 million years ago (the time of *A. afarensis)* there is already evidence ("skull 1470") of a large-brained true human.

However, even before the analysis of material at Laetolil and Hadar indicated the presence of a very primitive species in the human line more recently than Leakey's theory would allow, Leakey's placement of skull 1470 in the same time frame as *A. afarensis* received a devastating blow. Two other Berkeley researchers, Garnis H. Curtis and Robert E. Drake, found an error in the dating technique used by Leakey's collaborators, and they assigned skull 1470 to just over 1.8 million years ago — well within the realm of already known fossils of true *Homo.*

Like other hunters, anthropologists can't consider the season finished until after the final trophy show and judgment by their peers, which took place this year at the meeting of the American Association of Physical Anthropologists (AAPA) in San Francisco in late April. In a special symposium devoted to Pliocene evolution, speaker after speaker presented additional data supporting the designation and importance of *A. afarensis.* Later, a spare room in the hotel was literally transformed into a trophy arena, where the subtleties of dental wear and jaw structure could be argued about with replicas in hand. In both forums some members of the crowded audience criticized specific aspects of the Johanson-White scheme, but there seemed to be no support whatever for the position of the Leakeys, who did not attend.

Although much of the argument so far has involved the arcane rules for designating species (*A. afarensis* was the first new hominid species claimed in some 15 years), discussions at the AAPA meeting showed that the real importance of this demi-human is its place in shaping the human family tree and the implication of its development for the theory of evolution. The popular writers who once argued so vehemently over "missing links" not only seriously underestimated the complexity of their subject (strictly speaking, there are thousands of evolutionary "links" that separate humans from extinct primitive species), they also missed a key point. The important thing is not to fill in every little gap of human lineage but to understand the overall shape of the family tree and how it grew. Thus the importance of *A. afarensis* — if the Johanson-White scheme is borne out — is that it represents the phylogenic trunk from which later species branches split and that it implies a rather erratic course for evolution.

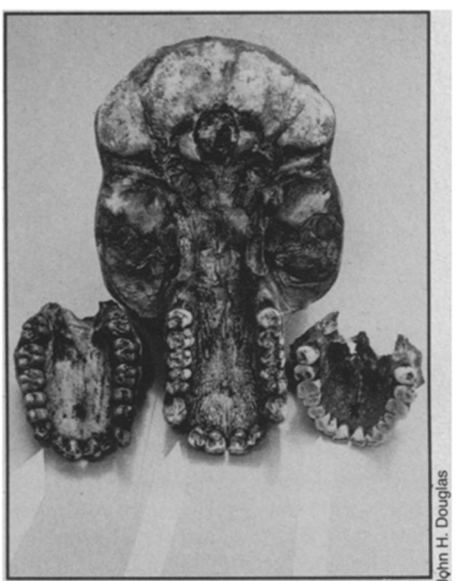


White, with casts of jaws of A. afarenis — *new pieces in puzzle of human evolution.*

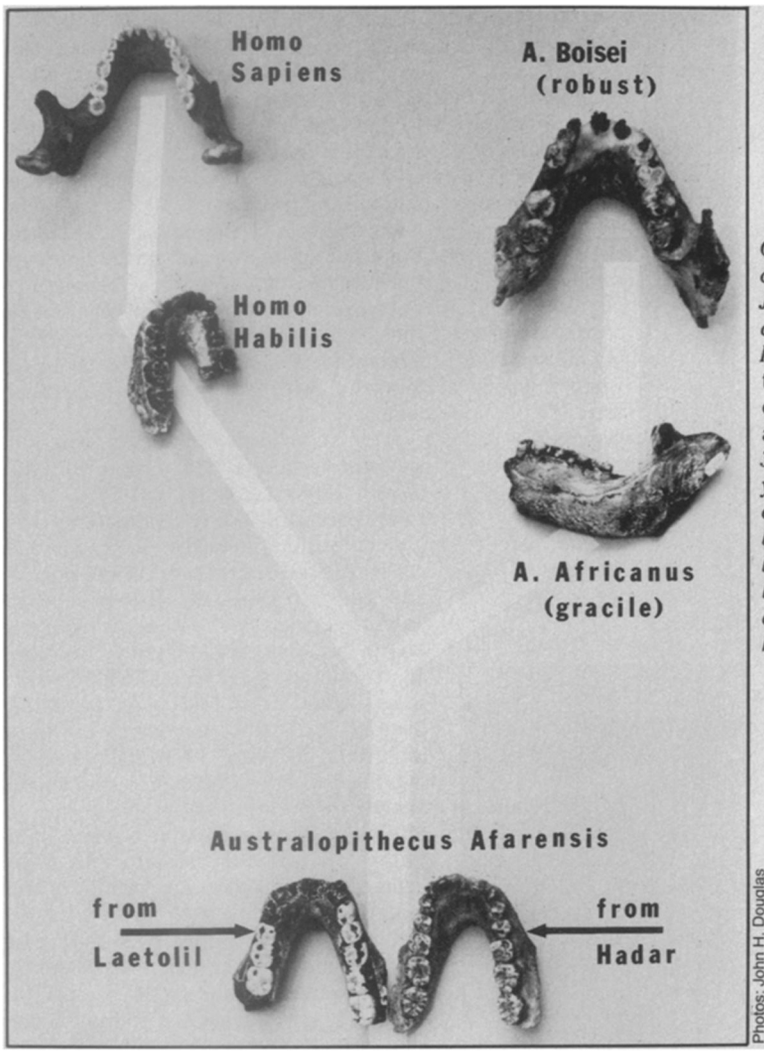
According to current theories of "mosaic" evolution, natural selection tends to favor one species over another according to only one trait at a time. Thus, while it was once thought that the human brain and upright posture evolved together, biologists now favor the idea that bipedalism came first. *A. afarensis,* with its small brain but apparently full-upright posture, fits into this scheme at a crucial point. It is not surprising that one of the key topics in the AAPA symposium was to compare the evidence for bipedalism taken from the footprints with that based on skeletal remains.

From an analysis of the most complete skeleton found at the Hadar location (which Johanson calls "Lucy") C. Owen Lovejoy of Kent State University in Ohio concludes that the human lineage had already reached a plateau of upright posture and full "striding gait." Three separate anatomical steps are required to bring this about, he says, and in Lucy "all three changes have been accomplished." White, who worked with Mary Leakey at the Laetolil site, thus concludes: "What these footprints do is to confirm the Lovejoy hypothesis." Specifically, he says, careful analysis of both the tracks and the skeletons show that the creature did not "shuffle" — an obvious reference to Mary Leakey's original interpretation of the footprints.

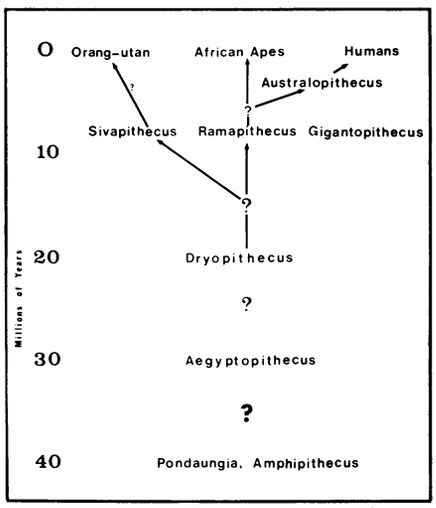
If evolution proceeded by selecting for one trait and then another, it also seems to have moved in fits and starts. *A. afarensis* appears to have remained stable for perhaps a million years, yet within the next million years the human and australopithecine lines not only diverged but developed independently at a relatively rapid rate. What caused this change remains a



The "diastema" gap in upper jaw that accommodates the canine teeth of lower jaw. An example of ways in which A. afarensis *(left) stands between apes (center) and humans on the evolutionary scale.*



Genesis according to Johanson and White: From Australopithecus afarensis *of 3 million years ago evolved both the later australopithecines and the human line.*



The tentative family tree of human beings from the earliest higher primate onward.

mystery, although it obviously involved some sort of change in habitat for the creatures involved. The australopithecine line became more "robust" — developing massive jaws and teeth apparently suited for masticating tough vegetation. The human line began to develop its distinctive brain, greater stature and more generalized skills. The advantage soon became clear: Before 1 million years ago, *Homo erectus* had spread throughout the Old World and the last *Australopithecus boisei* (a robust "thug of a hominid," as Phillip Tobias calls it) had died out.

To establish the position of *A. afarensis* in this scheme, a new technique — scanning electron microscope examination of tooth wear — was used. Symposium speaker Alan S. Ryan of the University of Michigan described the results. In general, he says, three kinds of wear can be identified by SEM examination: attrition (lines scored by stripping leaves), abrasion (pitting due to crushing food) and microflaking (small fractures caused by clamping objects with the teeth). Particularly important in the evolution of humans is the progressive frequency of microflaking, which is often found among modern aborigines but not among apes. Significantly, Ryan says, *A. afarensis* shows all three types of tooth wear. He concludes that this "seems to indicate an important hominid adaptation," and further studies may indicate just what diet changes were involved in evolution of this period.

In the discussion that followed the AAPA symposium, most of the criticism was directed not so much at the identification of *A. afarensis* as a single species ancestral to both the later humans and australopithecines (which the Leakeys had objected to) but rather its position at the fork of the family tree. C. Loring Brace of the University of Michigan, in particular, maintains that the great division may have come even later. "We don't yet want to cast *Australopithecus africanus* [which followed *A. afarensis*] into the limbo of an extinct line," he told his colleagues. Later, in an interview with SCIENCE NEWS, he elaborated on his objections, saying that the differences between *A. afarensis* and *A. africanus* are less than those that distinguish various human races today.

In separate interviews with SCIENCE NEWS, Johanson and White defended their assignment of *A. afarensis*, countering arguments raised by both the Leakeys and other critics. *"Australopithecus africanus* is already off the main line to man," Johanson maintains. Although commonly called a "gracile" (slender) australopithecine, *A. africanus*, he says, already shows the enlarged teeth and thick jaw of the extinct, robust line of hominids. White adds, however, that one cannot really consider *A. afarensis* as a true "human" yet since it lacks the two main distinctions of the *Homo* line — a large brain and ability to use tools.

Important as the implications of *A. afarensis* may be, the new species represents only one of several recent discoveries that are changing the way anthropologists view human evolution. The view that evolution took place in alternating periods of stasis and crisis is receiving support from experiments in molecular biology and from studies of present human differences. Robert Eckhardt of Pennsylvania State University told SCIENCE NEWS that physical adaptations to high altitude — such as barrel-chestedness in the Indians of the high Andes — may take place within as short a time as 10,000 years. Another piece of evidence for rather quick selection of a single trait, he says, is the fact that in breeding animals one can produce changes twice as fast by selecting for one trait than for two.

Evidence that evolution may have progressed faster than previously thought was also presented for the time preceding *A. afarensis*. Moving backwards in time, the next great splitting of the human line, before the australopithecines branched off, occurred about 8 to 9 million years ago (the early Pliocene period), according to David Pilbeam of Yale University. This announcement, given at another symposium at the AAPA meeting, marks a radical change for Pilbeam, who has previously maintained that the ape line and human line split some 15 to 20 million years ago (the Miocene period).

Pilbeam has been working at sites in Pakistan and says he has discovered a period of less than 200,000 years in the early Pliocene in which there was a "hominid bloom." At least three distinct species

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. . . TV and science

presented are "basically...science reports that include medicine," Gendel says, because medical stories "strike home to viewers." Gendel says that people are now calling up with ideas for future segments and doctors who previously resisted the idea of having their work televised are now calling up *asking* to be shown.

The problem of holding enough viewer interest to sustain a science series on commercial TV has proved, by and large, unsuccessful, and there are those who don't hold out much hope for its success in the future. Graham Chedd, former science editor and producer of "NOVA," flatly stated in an interview before he left "NOVA" that such a prospect was "impossible." CBS's Ron Bonn disagrees. Bonn hopes to transfer some of his fascination with the wonders of science by presenting a weekly half-hour newsmagazine of science called "Universe" on the heels of the nightly news. Walter Cronkite, well remembered for the way he communicated his joy at the wonders of science during the moon landing, will play host for the pilot (scheduled for June 27). The show, which Bonn hopes will "look like *Star Wars* and sound like 'Sixty Minutes,'" will contain segments on breaking science news, investigative pieces and theoretical pieces.

Asked whether he thought he was attempting the impossible in trying to find a TV audience for science, Bonn replied with some heat, "I fully intend to do it! The audience is there. I don't know how many indicators you need." He points to the widespread alarm exhibited in response to the events at the Three Mile Island nuclear plant as an indicaton of a widespread and growing concern about the effects of modern technology. At the other end of the scale, he mentions the overwhelming popularity of science fiction, hastening to point out that science fact "is just as interesting and mind boggling."

The reluctance to provide science programing on commercial networks is matched in the realm of public television by drawbacks in public TV's makeup. Its labyrinthine structure — including the Corporation for Public Broadcasting, which acts as a conduit for funds, and the Public Broadcasting Service, which represents the collective interests of its member stations — presents a formidable challenge.

Obtaining funding — either by the stations themselves through the Station Program Cooperative or by corporations or private foundations — is but one difficult step on the road to acceptance for broadcast. Another is a lack of guidance. There is no central science programing division, so the fate of potential progams is up to individual station production groups — many of which do not have scientists.

"NOVA" has shown that a science-oriented program can make it on noncommercial TV, but its approach to science is limited. According to executive producer John Angier, "We like to tell a good story, one that will interest and entertain and inform. I wouldn't like to put our aims in any more high-minded manner than that. We like to entertain first, and then the information and public understanding can come along later."

The "NOVA" philosophy is reflected in the composition of its staff. The majority of the filmmakers are nonscientists, an asset, they feel, since they can anticipate the level of audience comprehension. Topics for shows are chosen from suggestions made by the general public, as well as from the scientific community. Although the show has not deliberately skirted controversial topics — it has covered reactor safety, water resources policy and genetic engineering and plans to tackle such subjects as the policy issues surrounding oil spills and the control of toxic chemicals — its staff tries to focus on the human drama of scientific endeavor.

A series that is currently airing on public TV on the West Coast takes a radically different approach — and does it within the framework of a ground-breaking concept. "Synthesis" is produced under the auspices of the KPBS Science Center in San Diego, Calif. Now in its fifth year of operation, the Science Center was founded "to increase the public's understanding of science. ... To report on the people, events and policy issues that make science and technology essential to our society."

The director of the Science Center since its inception is Jeffrey Kirsch, who holds a Ph.D. in aerospace engineering. The Science Center has produced both regional and national programs, with three local science series to its credit.

"Synthesis" represents the newest of the Science Center series and is the first of its kind in the United States: a cooperative effort by a consortium of regional public television stations. "The unique goal of 'Synthesis,'" say those concerned with the Science Center, "is to provide accurate, understandable information on the scientific or technical aspects of high visibility policy issues and integrate it with a report on the political context of the public debate." A panel of science policy analysts suggests topics for potential shows and reviews scripts for authenticity, objectivity and educational value. Subjects of past "Synthesis" programs have included the Alaskan pipeline, Frank Press on the President's science policy, and the efficacy of the Ames test in detecting carcinogenic agents; future programs will include examinations of Western coal resources and nuclear waste disposal.

Still another approach will be offered by Carl Sagan in his series "Cosmos," premiering in 1980. According to Sagan, the aim of the show is "to explore the deepest connections of human beings with a vast and awesome universe in which we float like a grain of sand in the cosmic ocean." The proposed scope of the show takes in virtually all scientific disciplines and will employ the use of lavish special effects to heighten the wonder of science as it influences life.

These shows all take different tacks, but there is an audience they don't address. In early 1980 the Children's Television Workshop, creators of public television's "Sesame Street," will attempt to fill the gap. They will debut an educational series on science and technology aimed at children, more specifically the 14 million eight- to 12-year-olds in the United States.

Joan Ganz Cooney, president of CTW, says that this audience was chosen because research indicates that the age range represents a critical time in developing positive attitudes toward the understanding of science. Part of the problem, she says, is that many schools do not provide formal science instruction as part of the curriculum until the student enters junior high school — years after he or she has begun to develop the capacity for systematic thinking. In addition, many children — particularly minority children and girls — have already developed a negative view of science.

If the show is successful, its creators say, it will show the joy and diversity of scientific exploration as part of a cooperative human endeavor in which everyone may participate. The net effect of such a television program on children, they say, will be an acquaintance with various styles of scientific thinking so that, as children grow older, they will be better able to critically examine issues relating to science and technology.

With another television season ending, the monthly content of the Science on TV column may be meager; but if the enthusiasm of those attempting to bring science into the home on television is reflected by the viewing public, that won't be a problem for long. □

. . . Evolution

are represented, called *Ramapithecus, Sivapithecus* and *Gigantopithecus*. He and Johanson announced that they would be meeting this summer to see if they could establish connections between the two periods in question. And now, with the even more recent announcement of the discovery of the earliest known higher primates, *Pondaungia* and *Amphipithecus* — possibly ancestral to the humans, apes and monkeys (SN: 5/12/79, p. 310) — the human family tree may have been taken back to its earliest distinct roots, some 40 million years ago.

In summarizing the significance of the recent work, Berkeley anthropologist F. Clark Howell, who chaired the Pliocene evolution symposium, told SCIENCE NEWS: "I think this is a normal-science kind of 'breakthrough' — sort of inevitable if you examine all the data dispassionately. It's very exciting, but it raises more questions than it solves." □