Briefing:

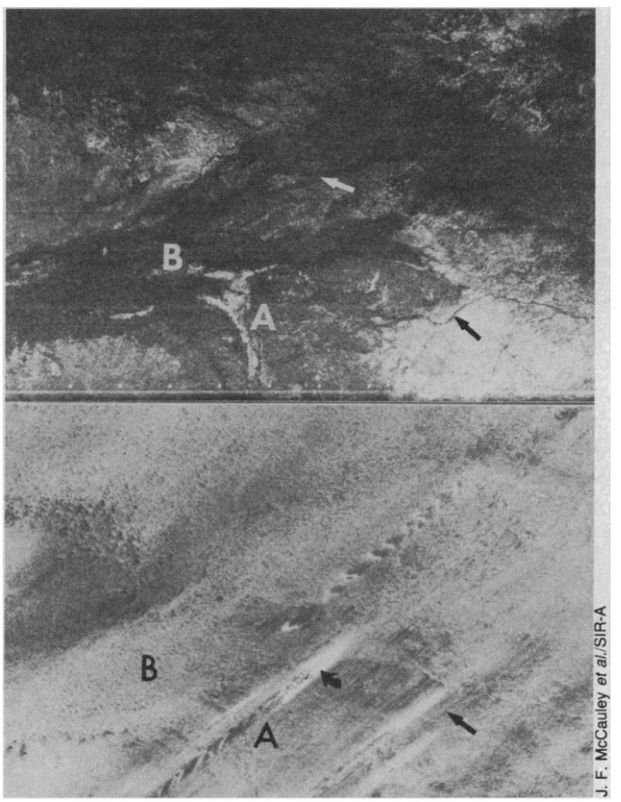
Ancient River System Across Africa Proposed

According to a new hypothesis, a river system of Amazonian proportions once spanned the African continent. It flowed from near the present-day Red Sea, across the path of today's Nile, through the eastern Saharan Desert that now receives only 1 millimeter of rainfall per year, across central Africa with its towering mountains, and into the Atlantic 4500 kilometers from the system's headwaters. Today that ancient route lies broken into isolated pieces—its water stolen by other rivers, blocked by new mountains, or scorched from the ground—illustrating the many ways that rivers, even the mightiest, can die.

This long dead trans-African river system is being proposed by John McCauley and his colleagues at the U.S. Geological Survey in Flagstaff and at other institutions on the basis of the latest in satellite remote sensing, the current understanding of how plate tectonics has shaped Africa, and the revelations of a backhoe operated near the Egypt-Sudan border.

Remote sensing by the Shuttle Imaging Radar (SIR) provided a missing link in the system and impetus for further study when in 1981 it revealed a previously unseen network of river valleys beneath the driest part of the Sahara where Libya, Egypt, and Sudan meet. Filled by windblown sediments and overlain by a few meters of sand, the existence of such valleys had been surmised only here and there on the basis of scattered patches of stream-worn gravel or from serendipitous discoveries during oil exploration. But the SIR signals penetrated the meter or two of obscuring sand and reflected to varying degrees from valley fill, underlying rock, and cemented sediment, revealing that the area once thought to be a wind-eroded flatland devoid of major streams had instead been cut by river valleys 10 to 30 kilometers wide and hundreds of kilometers long. Radar images of the present-day Nile Valley 300 kilometers to the east bear a strong resemblance to these buried valleys.

Just where the source of these rivers and the associated drainage system was or where they flowed to was not clear from the radar images. Fortunately, comparison with Landsat images did make it possible for researchers to trace the river courses by following subtle nuances of topography, color, and texture. Guided by the Landsat images and a satellite navigation system, McCauley and his colleagues in the SIR-B Egypt task group found and dug into channels as narrow as 0.5 kilometer wide, unearthing from beneath a desolate sandy surface the remains of freshwater clams and aquatic snails, casts of the roots of reeds, quarter-million-year-old hand axes, and equally ancient riverside campsites. Clearly, the rivers made the area a good deal more livable than it is today.



Seeing through sand

Shuttle Imaging Radar (top) pierces the sand sheet and some dunes (curved arrow) of the eastern Sahara that obscure Landsat view (bottom) of buried river channels. These river valleys appear to have been part of a 4500-kilometer-long drainage system that had cut across North Africa. In the radar image, narrow river channels cut in the bedrock (straight arrows), a scarp (A), and a valley (B) about 20 kilometers wide stand out. Radar can image buried features because its signal has a wavelength of 24 centimeters, allowing it to pass through a meter or two of dry sand, but the signal reflects to varying degrees from rock and sediments.

The group initially proposed that the ancient radar rivers drained into the Bodélé and Chad basins, the low points of the south-central Sahara that now contain one shallow lake—Lake Chad—that on occasion drains to the normally dry adjacent basin. That suggestion has held up, the group believes, but they now favor the Red Sea Hills in far northeast Africa between the Red Sea and the present-day Nile as the most likely source. The Red Sea Hills rose 2 kilometers about 40 million years ago as rifting split Africa from Arabia to form the Red Sea. With the radar rivers providing the missing link, water could have flowed off the Red Sea Hills in far northeastern Africa, through the Chad Basin, and then out to the Atlantic 4500 kilometers away through the Benue Trough, a linear depression formed at the bottom of the bulge of West Africa when the opening of the South Atlantic began a rift but could not keep it open.

To look at a modern-day map, this route seems an unlikely one. The explanation is that the obvious obstacles are younger than the proposed trans-African drainage system. Their development dismembered the trans-African drainage system but only after it had been flowing 10 million and perhaps more than 20 million years, according to the proposal. Fifteen million years ago, doming of the crust and outpourings of lava, alterations of the sort that precede rifting, began to divide the one great drainage basin into several basins. Six million years ago the Mediterranean dried up, letting the primeval Nile cut a Grand Canyon–size valley southward. In the colorful language of geologists, this pirate stream beheaded the older, Atlantic-ward flowing system, stealing its headwaters for the Mediterranean.

The final blow would have come only about 2 million years ago when progressively intensifying aridity struck the system's mid and upper reaches; earlier, lush vegetation had generally covered the area. Occasional rejuvenation of channels embedded in the fill of the radar rivers drew early humans to their banks, but, of late, humans have been only passing through, often unknowingly following the hard, trafficable fill of the old valleys hidden below. What the far future holds for the path once followed by the river system no one can say, but, if the past is any guide, it will be interesting—before there were channels filled with freshwater, a broad seaway bisected the continent there. ■ RICHARD A. KERR

ADDITIONAL READING

J. McCauley *et al.*, "Paleodrainages of the eastern Sahara—The radar rivers revisited," *IEEE Trans. Geosci. Remote Sensing* **GE-24**, 624 (1986).