even make it possible to measure irregularities and precession in the polar motion, which in turn could lead to estimating the planet's moment of inertia and from that its bulk density distribution. In fact, he says, if the spin rate could be narrowed down to within microseconds (an extremely slim possibility, he points out), it might be possible to measure the seasonal change in mass distribution as the atmosphere freezes out and thaws at the poles.

The three drifting "walks" by the orbiters have been particularly valuable to the radio team in refining the shape of the Martian gravitational field, including the subtle "harmonics" which indicate the degree to which the planet is flattened at the poles and pear-shaped on polar or equatorial axes. In January, orbiter 2 is to be shifted into an orbit whose low point comes as close as 300 kilometers to the surface, once per orbit, for up to six months. Besides providing striking photos of the surface (with resolution as fine as 10 meters), the low passes should yield precise tracking data about local gravity anomalies, reflecting mass concentrations beneath the surface such as the one discovered by Mariner 9 as it passed over the Tharsis uplift zone, or bulge.

There are even radio measurements relating to the surface composition. When the lander's radio path to the orbiter just grazes the surface on the way, changes in its amplitude reflect the dielectric constant and conductivity of the material it is grazing. Viking measurements suggest a dielectric constant of about 3.5, consistent, says Michael, with some sort of pumice or tuff. Water content also affects the signal, he says, and it is just barely possible that seasonal water changes late next year could be detected in the data.

Even the earth may be better understood from Viking's radio studies, using the essentially fixed signals of distant quasars as well as those of the Viking craft to pin down the earth's axial and orbital motions. Finally, general relativity will get a checkout, as Michael's team determines how much the spacecraft signals are slowed as they pass near the sun, and how the precession rate of Mars's orbital perihelion varies. □

Whoopers up

More whooping cranes are migrating this year than at any time since 1938, the Canadian Wildlife Service has announced. The increased number signals the success of a "foster parent plan" attempted during the last couple of years, in which eggs from whoopers in Canada's Northwest Territories were hatched by sandhill cranes in Idaho. Of the 14 transplanted eggs, three juveniles and three yearlings survived to join this year's migration, bringing the known world population of whooping cranes to 95. □

Rio Grande Rift: Crack in crustal plate

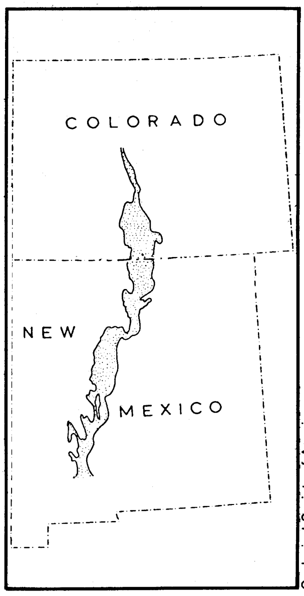
From south-central Colorado southward 850 kilometers through nearly all of New Mexico runs a series of basins created where linear blocks of the earth's crust have dropped down between a line of parallel faults. This series of basins used to be known as the Rio Grande depression, for the river that flows through most of its length. Recently geologists have been calling it by a more dramatic name: the Rio Grande Rift. For it is now evident that the feature marks the site of a crack in the North American crustal plate, the huge slab of the earth's upper surface that carries on it the western Atlantic Ocean and virtually all of the North American continent.

At the annual meeting of the Geological Society of America last week in Denver a dozen presentations by 29 scientists from 11 institutions reported results of new studies of the rift. The studies probed the rift with a vast array of geological and geophysical instrumentation. The reports show that the rifting process is still going on, that the rift's western margin has abnormally high heat flow, that much of the rift represents an anomalous zone of crustal thinning and that one segment of the rift area has lying beneath it a body of magma 1,000 square kilometers in extent. Finally, a theory of continental rifting applied to the Rio Grande Rift, presented at the meeting, explains in considerable detail the observed structure of many of the mountains extending along the sides of the rift through Colorado and New Mexico.

The rifting began about 30 million years ago, reports C. E. Chapin of the New Mexico Bureau of Mines and Mineral Resources, when regional extension began to pull the continental lithosphere apart along a major north-trending zone of weakness. "It began as a simple pull-apart structure," says Chapin. The Colorado Plateau, the eastern margin of which abuts the rift, began to be pulled apart from the rest of the continental mass. There was extensive volcanism in the area for the next 10 million years, then a lull, then renewed thermal activity about 12 to 14 million years ago.

The modern topography, says Chapin, was born after 9 million years ago and before 3 million to 4 million years ago. This period was marked by "a tremendous surge of uplift and block faulting." Volcanism was sharply accelerated about 5 million years ago, and since then basalt flows have dotted the rift from Alamosa, Colo., to the Mexican border. Arrangement of drainage to form the ancestral Rio Grande River began before 3 million years ago, probably as a result of runoff from the newly elevated mountains.

Some of the most intense scientific interest associated with the rift concerns evidence for a magma chamber beneath the surface near Socorro, N.M. Magma chambers have many implications: They are obvious potential sources of geothermal heat, they raise questions whether they might eventually become a full-fledged volcano and their heat may be important in concentrating minerals.



Rio Grande Rift: Pulled-apart crust, magma chambers and a model for mountain-building.

Alan R. Sanford of the New Mexico Institute of Mining and Technology first reported evidence for the Socorro magma body in 1973. Last week in Denver, he and five colleagues reported new evidence based on microearthquake investigations carried out from April 1975 to September 1976. Together, the data define the upper surface of a magma body 18 kilometers beneath the rift and at least 1,000 square kilometers in area. Only the body's southeastern margin, which is highly irregular, has been clearly detected. From its crest beneath the Socorro Mountains the magma body's upper surface dips sharply to the east and west to depths of at least 20 kilometers.

Sanford also has new evidence of a small shallow magma body about 12 kilometers southwest of Socorro and of the possible existence of several other small magma bodies at depths of less than 10 kilometers.

Repeated analysis of leveling measurements in the Socorro vicinity by Robert Reilinger and Jack Oliver of Cornell University reveals a zone of major uplift that overlies and correlates spatially with the area above the proposed magma chamber. The surface has been rising at an average relative velocity of 5 millimeters per year. "This feature is one of the most clearcut and striking anomalies of this scale ever detected by leveling in the United States," they report. They suggest that the uplift in the Socorro area could result from expansion of the magma chamber.

Other striking evidence comes from a new scientific program for study of the deep basement rocks of the continent, called COCORP for Consortium for Continental Reflection Profiling. "Study of the continental basement rocks is one of the frontiers of geology," says Oliver. He is chairman of the COCORP program, which is using seismic reflection technology from the petroleum industry for basic geophysical studies of the deep crust. One of COCORP's profiles of the crust across the Rio Grande Rift shows a strong reflection at a depth of 20 kilometers which, says Oliver, corresponds to the top of the magma body proposed by Sanford.

A study of the crustal structure of the Rio Grande Rift analyzing Rayleigh waves from nuclear blasts and natural earthquakes shows that the crust is about 30 kilometers thick beneath much of the rift, G. R. Keller of the University of Texas at El Paso reports. This is about 10 kilometers thinner than the crust beneath the northern Colorado Plateau and the Great Plains.

Marshall Reiter of the New Mexico Bureau of Mines and Mineral Resources reports that terrestrial heat flow measurements along the rift indicate a narrow ribbon-like high (about 2.5 heat flow units) along the western part of the rift structure. He proposes that the crust along the western part of the rift is extensively fractured, allowing magma to rise in the fractures and also allowing groundwater to percolate downward and be heated by the magma.

Another confirmation of high heat flow comes from a technique known as silica geothermometry applied to groundwater at several thousand points. Results reported by Chandler A. Swanberg of New Mexico State University show that the rift is characterized by a ribbon of high silica geotemperatures. This ribbon has well-defined boundaries between the rift and the Colorado Plateau to the west and the midcontinent to the east. Studies by R. J. Bridwell of the Los Alamos Scientific Laboratory show that 5 to 10 million years of constant heat loss is required to create the present thermal anomaly. He notes that regional extrusive volcanism along the central rift began 5 to 10 million years ago, continuing intermittently to the present. He postulates that throughout that time heat has flowed to the surface due to transport of magma upward into the upwarp beneath the thinned lithosphere.

What effect has all this crustal extension had on the observed mountains along the rift? John K. Sales of the State University of New York at Oneonta has put together a comprehensive theory of continental rifting and applied it to the Rio Grande Rift. Extension of the crust allows the freeing of fault blocks to assume levels and tilts appropriate to their geometry. As he puts it:

"During continental extension normal faults form at $\pm 30°$ to the vertical axis of maximum compression (gravity), segmenting the crust into apex-downward triangular prisms (grabens) which sink low like a keel boat and apex-upward triangular prisms (horsts) which float high like a flat-bottomed barge."

Depending on the geometry of the faults, some of the blocks along the rift margin become uptilted, like the Sandia uplift northeast of Albuquerque and possibly the Sangre de Cristo uplift of Colorado. When the blocks approach pyramidal shape, abnormally high motion upward (possibly Pikes Peak) or downward (the Albuquerque Basin) may result.

What's intriguing about Sales's studies of the creation of present-day mountains and basins along the Rio Grande Rift is that he has managed to duplicate the effects in the laboratory. Using plaster models, he has shown that when particular fault geometries undergo extension, various blocks tilt, drop, rise, and so forth, in just the way they have in nature to create particular mountains along the Rio Grande Rift. It is an elegant laboratory demonstration of the workings of nature. □

Smokey Bear dies; buried in own park

In die VIII Novembris, anno domine MCMLXXVI, obiit Fumulus, ursus amatus noster. Requiescat in pace.

Smokey Bear, the orphaned cub that became a living symbol of forest fire prevention, died peacefully in his sleep Nov. 8 at the National Zoo. He was returned to his native New Mexico for burial in Smokey Bear Historical State Park.

Officially, of course, Smokey still lives. Last May the original Smokey and his mate, Goldie, were quietly moved out of their official residence to make way for a frisky 6-year-old, who has now been given the title and symbol of the Smokey legend—a ranger's hat and fire-fighter's shovel. When the original, "Old Smokey" died, he had been living in a simple grotto on the zoo's Bear Row, his only identification "American Black Bear."

As they say in the advertising trade, Smokey was too valuable a "property" to let go. The only animal in America with his own zip code (20252), Smokey brought in more than \$1.5 million to the National Forest Service through license agreements on his trademark. Yet, when it came time for him to retire, Congress could never get around to allocating funds for a proposed new grotto in New Mexico.

Old Smokey's relationship with the Forest Service went back to June 1950, when a Forest Ranger found him as a five-pound cub, less than a year old, clinging to a charred tree after a forest fire in New Mexico's Lincoln National Forest. Veterinarians treated his burned paws (he walked with a limp the rest of his life) and a game warden's daughter fed him from a bottle until he was well enough to be taken to Washington.

There he became the living representative of the already famous Smokey Bear poster character and tapped a deep source of respect for wildlife that is the latest expression of a frontier heritage. Through animated commercials, his gruff bass voice supplied by a local radio announcer, Smokey contributed substantially to the growing environmental consciousness of a generation of Americans. His simple message became one of the best-recognized slogans of the emerging television age: "Remember, only *you* can prevent forest fires."

The effectiveness of this message could be seen in Smokey's own popularity. At times he received 13,000 letters a week, and so many people started sending flowers for his "funeral" that the Forest Service last week scurried about trying to find some more constructive outlet for the spontaneous outpouring of affection. Young Smokey has already inherited much of this goodwill, and almost any Sunday afternoon at the National Zoo will find a group of children pressing on the glass partition to watch the rambunctious young bear climbing and running.

By contrast, Old Smokey was always "an easy going bear," and toward the end mostly slept or lay about. By human standards Old Smokey was 26-going-on-80, and his keepers were considering euthanasia as his arthritis got steadily worse. Then one morning he didn't come out of his den and Goldie would not leave his side. □

NAS adds support for DNA guidelines

All research on recombinant DNA, regardless of whether it is funded by government or private industry, should follow the guidelines set by the National Institutes of Health, according to a resolution passed by the Council of the National Academy of Sciences.

The NIH guidelines (SN: 7/3/76, p. 3) ban certain types of experiments and establish levels of safety precautions to match estimated potential hazards of other experiments. Currently only researchers funded by NIH are required to adhere to these restrictions.

The National Academy of Sciences, the country's most prestigious organization of scientists and an official adviser to the federal government, will set up a standing committee to aid NIH in future revisions of the guidelines. The committee will also encourage continuous assessment of the benefits and risks of DNA research. □