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Mr. Michael Minovich  
1344 W. 84th Street  
Los Angeles, California 90044

Dear Mr. Minovich,

I wonder if Mike saw the enclosed clipping from the Los Angeles Times. If not, would you please forward it to him. I am not sure what his address is for the summer.

If Mike is home at all this summer, please tell him to visit us.

Very truly yours,

*Elliott Cutting*

Elliott Cutting  
Manager  
Systems Analysis Section

## EXCITING, SIGNIFICANT

# Mercury Fly-By Called Choicest Plum in Space

BY GEORGE GETZE

Times Science Writer

A Mariner fly-by of the planet Mercury is the "choicest plum ripe for picking in the whole orchard" of possible space explorations, according to Bruce Murray, associate professor of planetary sciences at Caltech.

Dr. Murray said in an interview that such an expedition to the vicinity of Mercury would be as scientifically exciting and significant as any other space project now possible.

Not only would a Mercury fly-by be most significant to science, it is technologically possible with the tools the United States already has, particularly its guidance and communications systems, Dr. Murray said at Caltech.

He was the speaker at a summer scientific meeting of the Astronomical Society of the Pacific, being held at Caltech.

### Only U.S. Is Able

Murray said the United States is the only country now able to send a space vehicle to Mercury, especially along the indirect route he proposes.

"Mercury is by far the least observed of the terrestrial planets of the solar system," he said.

"Think how much the surface pictures of Mars changed the scientific view of that planet," Dr. Murray said.

"The advances in science to be gained from similar pictures of the surface of Mercury could be incomparably greater, if only because we know so much less about Mercury than we knew about Mars."

The fact that we know so little about Mercury, however, is not the most important reason for wanting to know more, Dr. Murray said.

"Mercury is in some ways an anomaly among the planets," he said.

"For instance, although it is not much bigger than our moon, it may be as dense as the earth itself.

"We don't know why it is so dense. Is it just another moon that happens to have an iron core, or is it an earth-like planet with mountains?" he asked.

Murray said science has a great deal to learn about the atmosphere of Mercury.

"It was thought a few years ago that Mercury had a very dense atmosphere, probably of some gas like carbon dioxide," Murray said.

"New radar discoveries of the rotation of Mercury have led to the abandonment of that idea. But we are not sure yet what concept of atmosphere can be substituted."

Dr. Murray said Mercury rotates three times on its axis while going around the sun twice. One day on Mercury is equal to 176 earth days.

"But a few years ago the fact that

Mercury rotated at all on its axis wasn't known. It was thought always to keep the same side turned toward the sun," he said.

He said to send a space vehicle directly from the earth to Mercury would take a Saturn V rocket, too expensive a proposition to be seriously considered by those holding the purse strings of the space program.

"But we will soon have what can almost be called a unique opportunity to do it with cheaper rockets and instruments we have on hand," Dr. Murray said.

The suggestion is that the Atlas Centaur rocket be used (the same one that is used in the Mariner program) and that instead of the vehicle being launched toward Mercury, it be directed toward Venus.

The gravitational force of Venus would be calculated exactly to pull the space vehicle off its original course and deflect it toward Mercury.

This, Dr. Murray said, would be like having a free, extra rocket stage to carry the vehicle on toward Mercury, and would provide the equivalent energy of an enormous propulsive maneuver in space.

### Called 'Bank Shot'

This procedure is known as the "bank shot," as in billiards, and was first proposed in 1963 by M. A. Minovitch.

According to Dr. Murray, the United States is the only country with sophisticated enough guidance and communications systems to bring it off.

To make the bank shot work, Mercury has to be at its farthest from the sun and Venus at its nearest, and this alignment doesn't come about often.

"The next time they will be lined up that way will be in 1970, and that is probably too soon to get everything ready, especially in view of the limited amount of money that is available for planetary exploration," Dr. Murray said.

"The next time after that will be in 1973, when the lineup of Mercury and Venus and the sun will again be favorable.

"After that, they won't be lined up right again until 1982, and then not so perfectly as in 1973.

"You can say that for all practical purposes, it's in 1973 that the shot has to be made or we can forget about it for a decade or two, and then it will be a project for our children," Dr. Murray said.

He said the necessary alignment is so rare because the celestial mechanics involved are very complicated, both Mercury and Venus having eccentric orbits.