REMARKS FOR THE GROUNDBREAKING DINNER
FOR THE W.M. KECK TELESCOPE AND OBSERVATORY

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We are so used to the idea that science regularly generates amazing new technologies that we tend to take them for granted. Given the array of breakthroughs that science seems to produce regularly, like rabbits out of a hat, it takes something unusual--even wonderful--to catch our attention.

Tonight we are celebrating one of those wonders, a genuinely new and bold creation. When it is completed, as you know, the Keck Telescope will be the largest optical telescope in the world, a magnificent new tool for exploring the universe. And it is altogether appropriate that this new telescope should also be built in a new--indeed revolutionary--way.

The first telescopes used by astronomers were made of clear glass lenses through which light from the stars passed, either into the eye of the observor or onto a photographic plate. This is the kind of telescope Galileo used in 1609 to look at the Milky Way, the moon, and the planets.

The modern science of astronomy began with such telescopes, but it did not end with them. Since the beginning of this century all the major astronomical telescopes have been built using mirrors rather than lenses to gather the light. This idea is not

new. Isaac Newton, a genius who pioneered in many fields, made the first telescope using a mirror in 1668. Newton understood that a mirror is better than a lens because a lens tends to spread the light out into a smear of many colors, requiring a telescope to have a complicated series of lenses to bring the light back into sharp focus. It is this same limitation of lenses that makes our familiar 35 millimeter cameras of today so complex--and so expensive. Mirrors substantially eliminate this problem, I'm told, because they do not smear the light images.

Making better telescopes has meant, for the most part, making bigger telescopes--and bigger mirrors. UC's Lick Observatory has a telescope with a mirror 10 feet across. Caltech's Palomar Observatory has a telescope with a mirror almost 17 feet across.

But there are technical and financial limits to building bigger and bigger mirrors. When the idea was born of building the world's largest telescope--with a mirror of 10 meters, or about 33 feet, across--it was clear that conventional technologies were inadequate to the job. A new design would have to be found to accommodate a mirror of such unprecendented proportions.

In the late 1970s a group of astronomers and other scientists interested in astronomy proposed making a 10 meter mirror not in a single gigantic piece but as a mosaic of smaller mirrors placed side by side to be arranged and maneuvered by computer. The design that finally emerged is the one now being used for the

Keck Telescope: 36 hexagonal mirrors, each about 6 feet across, laid side by side to form a giant hexagon over 33 feet across.

The advantages of this design are considerable. Because each segment of this mirror is smaller it does not have to be so thick in order to be rigid, and together the segments weigh far less than a large mirror formed as a single piece. Without this savings in weight, a 10 meter telescope would be prohibitively expensive. Of course, the Keck Telescope is hardly inexpensive, but a traditional mirror would have at least quadrupled the cost, even assuming it were technically feasible.

This is not to say that a segmented mirror is trouble-free. Imagine the task of designing a control system that can monitor the location of each of the 36 mirror segments hundreds of times per second and then adjust each of them so that they line up within a millionth of an inch, or one-thousandth part of the width of a human hair! And this system has to work not just most of the time in a carefully controlled clean-room environment, but hour after hour on top of a 13,000 foot mountain. This is the system for which Professor Jerry Nelson, principal designer of the telescope, is responsible, and without which there would be no telescope of ten meters.

What this marvelous descendent of Newton's mirror telescope will make possible is a new partnership involving universities jointly

engaged in pushing forward the frontiers of knowledge. This morning we broke ground not just for a new scientific facility but for a new scientific adventure. I am delighted that the University of California will be a part of this exciting voyage of discovery. And I am more pleased than I can say with this opportunity to pay tribute to those who have made the Keck Telescope and Observatory possible, and especially Howard Keck and the W.M. Keck Foundation, whose vision and enlightened generosity will bear fruit for generations to come.

Let me also add a word of thanks to the many dedicated people from Caltech, the University of California, Braun and Company, and the University of Hawaii who did such an excellent job of handling the arrangements for today's groundbreaking and this evening's dinner. I am grateful to them, and to you, for making this occasion special in every way. Thank you and good night.