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## TELESCOPES ON THE MOON OR PIE IN THE SKY?

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[The following is a revised version of after-dinner remarks presented to the Workshop on Optical Interferometry on the Moon, Albuquerque, New Mexico, February 9, 1989.]

The title of this talk poses a question of realism. Does it make sense to believe that there will one day be an interferometric array of telescopes on the Moon, or is it just pie in the sky? The question is really one of national commitment to a lunar base, since it is not likely that a scientific undertaking of this magnitude would occur in the absence of permanent human presence on the Moon.

One can argue that of course there will be a permanently occupied lunar base someday, but that sidesteps the key question of what circumstances would lead a nation, the United States in particular, to make the major commitment of resources that a lunar base would require. Fortunately, there is a precedent: the Apollo Program. At its peak it commanded more than 4 percent of the federal budget, a proportion four times that of NASA's share today. Understanding the factors that led to the Apollo commitment may help us understand why the nation might make a similar commitment to return humans permanently to the Moon.

There has been much written about the Apollo decision, but I will draw here principally on Walter McDougall's account in "...the Heavens and the Earth," for which McDougall won the 1986 Pulitzer prize for history. Three events encapsulate the rationale for Apollo. The first was the launch of Sputnik in 1957. Eleven years earlier the RAND Corporation had predicted that satellites would become one of the most potent scientific tools of the twentieth century, and that the orbiting of a satellite by the United States "would inflame the imagination of mankind and would probably produce repercussions in the world comparable to the explosion of the atomic bomb."

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In displaying this remarkable degree of foresight, RAND failed to anticipate one thing: that the Soviets might beat us to it! The launch of Sputnik caused Americans to question the basic assumptions on which their security and prosperity were based. American defense at the time was based on Eisenhower's "New Look," a policy under which nuclear weapons were considered to be as available for use in time of war as other munitions. Suddenly, with the launch of Sputnik, this policy was revealed to be hollow. The Soviet now had the ability, or so it seemed, to lob H-bombs over the U.S. at will! How could the U.S. continue to rely on bomber-based nuclear retaliation to deter a Soviet attack? In fact, the U.S. was well ahead in guidance technology, warhead design, and solid-fuel technology. We were slightly behind only in the development of ICBMs themselves. But that didn't lessen the public outcry.

Perhaps the most important aspect of Sputnik was the implicit political challenge that it posed. It not only undermined the assumptions on which western defense was based, it undermined the very values of western society. Here was the Soviet Union, an agrarian society just 40 years earlier, challenging the U.S. with a demonstration of technological and military might. If 40 years of Communism could so transform one nation, what could it do for others?! McDougall illustrates the point with a cartoon of the time (figure 1), in which Khrushchev romances the "Lesser Nations" under a Soviet moon, while the hapless suitor Uncle Sam drops his gift of candy in astonishment.

The second event occurred less than three months after John Kennedy took the Presidential oath of office. On April 12, 1961, Yuri Gagarin became the first human in space, and the first to orbit the earth. Once again, cartoons illustrate the political power of the Soviet feat (figures 2-4). American newspapers echoed Soviet views: "a psychological victory of the first magnitude"; "new evidence of Soviet superiority"; "cost the nation heavily in prestige"; "marred the political and psychological image of the country abroad"; and "neutral nations may come to believe the wave of the future is Russian." The Soviets were laying claim to the future on the power of their space program.

The third event was the final blow in the sequence of blows to U.S. self-esteem. It came just 5 days after Gagarin's flight, and it was self-inflicted. On April 17, 1961, 1450 CIA-trained Cuban expatriots landed at the Bay of Pigs. Within 24 hours their beachhead was overrun. Two hundred were killed, and 1200 were taken prisoners. The message to the world and to the U.S. public was clear: the U.S. was once again impotent in the face of the Communist revolution.

These were the challenges facing the Kennedy administration: Sputnik, Gagarin, and the Bay of Pigs. The U.S. response was molded largely by one man: Vice-President Lyndon Johnson. Johnson went to Kennedy and asked for a Presidential mandate to make recommendations about space. He got it, and returned a report so loaded with assumptions that the conclusion was inescapable: the U.S. must go to the Moon! Johnson summarized: "One can predict with confidence that failure to master space means being second-best in the crucial arena of our Cold War world. In the eyes of the world, first in space means first, period; second in space is second in everything." That the U.S. meant to be first is again illustrated in cartoons reproduced by McDougall (figures 5, 6).

Apollo was enormously successful on its own terms. Its objectives were never permanent human presence on the Moon, or even in space. Rather, its goal was to "land a man on the Moon and return him safely to Earth by the end of the decade." In accomplishing this goal, Apollo became the standard by which Americans judged themselves. Standard phraseology became, "If we can put a man on the Moon, why can't we...;" and the ellipsis was filled in with "cure cancer," "end poverty," or any one of a dozen difficult and distant societal objectives.

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The Apollo decision was underlain by a Soviet political challenge posed in technological terms. Apollo was a U.S. response in kind: a technological solution to a political problem. Technology harnessed in the service of broad state interests--technocratic government--is the theme of McDougall's book.

The U.S. and the Soviets were not alone in turning to technocracy. Robert Gilpin of Princeton University documented French technocracy in his 1968 book "France in the Age of the Scientific State." In the mid-1960s, European leaders repeatedly expressed the view that European's independence was threatened by the overwhelming scientific, technological, and economic power of the United States. France had years earlier decided to do something about it. The French "countermeasure" was to develop their own technology base. Three areas were seen as key; aerospace, energy, and electronics. These areas remain to this day the focal points of French science and technology.

French objectives in developing these technologies were at least three-fold: first, to maintain independence from both superpowers, but especially from the U.S.; second to achieve primacy within Europe; and last, to pursue Third World foreign policy objectives, particularly in former French-African colonies.

France developed several specific capabilities in pursuit of these objective. First, the force de frappe, an independent nuclear deterrent that freed France from reliance on the U.S. nuclear umbrella. Second, telecommunications and remote sensing satellite industries that rely on launchers whose development was based in part on force de frappe delivery technology. These satellite industries give France independence from the U.S. in crucial technologies and simultaneously allow it to be a supplier of services to the Third World. Third, an airframe and avionics industry which was developed to some degree at the expense of France's European neighbors. France thus became a supplier to the Third World and a challenger to the U.S., through French partnership in the Airbus Consortium, in the large airframe market, one of the few lucrative world-wide markets the U.S. still dominates. And fourth, a nuclear power industry that makes France relatively independent of Middle Eastern oil, and hence of U.S. guarantees of the continued flow of that oil.

France's post-war embrace of technocratic government was not immediately emulated by the United States. Although the "New Look" was a reliance on technology to address a fundamentally political issue, Eisenhower was wary of the downside of technocracy. He expressed his concerns most eloquently in his Farewell Address, citing economic, political, and even spiritual dangers posed by the growth of a "military-industrial complex"--a phrase he coined--and a "scientific-technological elite."

"Largely responsible for the sweeping changes in our military-industrial posture has been the technological revolution during recent decades. In this revolution, research has become critical; it also becomes more formalized, complex, and costly. A steadily increasing share is conducted by, for, or at the direction of, the Federal government. ...Partly because of the huge costs involved, a government contract becomes virtually a substitute for intellectual curiosity. ...The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present--and is gravely to be regarded. In holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite."

But as McDougall illustrates, with Eisenhower's departure, American political resistance to technocracy faded. John Kennedy proclaimed that the torch had been passed to a younger generation, and this generation proved to be, in David Halberstam's words, the "Best and the Brightest," united in "the belief that sheer intelligence and rationality could answer and solve anything." In turning to Apollo to meet the Soviet challenge, this generation made the final transition to American technocracy.

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One need look no further than the Strategic Defense Initiative to see that America has not retreated from technocratic government. Might technocracy and the issues confronting modern America lead it back to the Moon or beyond it to Mars? Are there factors today that could play the role that Sputnik, Yuri Gagarin, and the Bay of Pigs played two decades ago?

I think the answer is yes, and the factors are at least three. First, a redefinition of the U.S.-Soviet relationship. There is general agreement today that fundamental change is occurring in the Soviet Union. This change may lead to an equally fundamental change in the U.S.-Soviet relationship. But the process of change in that relationship is apt to be long and complex. We need to learn to work together toward common objectives - not an easy task. The intermediate Nuclear Force Treaty is a major step. Simply developing the procedures for implementing the treaty will us a lot about how to work together, and will lay both psychological and organizational foundations for future cooperation. A major space initiative with the Soviet could play a similar role. We would develop procedures and precedents for working together that could in turn provide part of a framework for cooperation in other areas. We would not transform the U.S.-Soviet relationship, but we would take a major step toward its redefinition.

The second factor acts somewhat in tension with the first, but I believe points in the same direction. That factor is the need to preserve defense industry capability in an era of arms control and declining defense budgets. Let us say the Strategic Arms Reduction Talks succeed and the U.S. and Soviet Union cut their nuclear arsenals by 50 percent. Even more important, let us say that major conventional arms cuts are also made. These developments would almost certainly lead to significant declines in real defense spending, particularly in an era of \$100-billion-dollar plus fiscal deficits. But we cannot afford to let defense industry R&D capability decline along with defense spending. Gorbachev could be overthrown tomorrow and replaced by a neo-Stalinist.

The opposition to reform in the Soviet Union is strong, and the U.S. is not about to bet its security on Gorbachev's success. Few projects have both the magnitude and character that could allow them to substitute in part for decreased defense spending. The construction of a lunar or Martian base could serve this role.

The third factor involves the Western alliance. Europe is anxious to join a major space initiative begun by the U.S. and the Soviets, since this will allow Europe to pursue its relations with both superpowers, while simultaneously developing its own technology base. But what if the United States decides to sit it out? There is little doubt that the Soviets intend to send humans beyond low earth orbit, perhaps to the Moon and eventually to Mars. The Europeans have already shown their willingness to work with the Soviets. The French have a long history of cooperation with the Soviets in space. The Germans and Soviets have just signed a space cooperation agreement. If the Soviets go out into the Solar System while the U.S. stays home, the Soviets will almost surely take our allies along with them. And that will be unacceptable to the leaders of the United States.

So what does this all boil down to? I think it boils down to a program undertaken largely for foreign policy and domestic reasons. The program would involve not only the U.S. and the Soviet Union, but Europe and Japan as well, and eventually other nations. We would not rely on the Soviets for any critical technologies or systems, but we might place such reliance on our allies. The initial goal could be either the Moon or Mars, but my hunch is the Moon won't be overlooked. And someday an array of lunar telescopes will be revealing the secrets of distant stars and galaxies.

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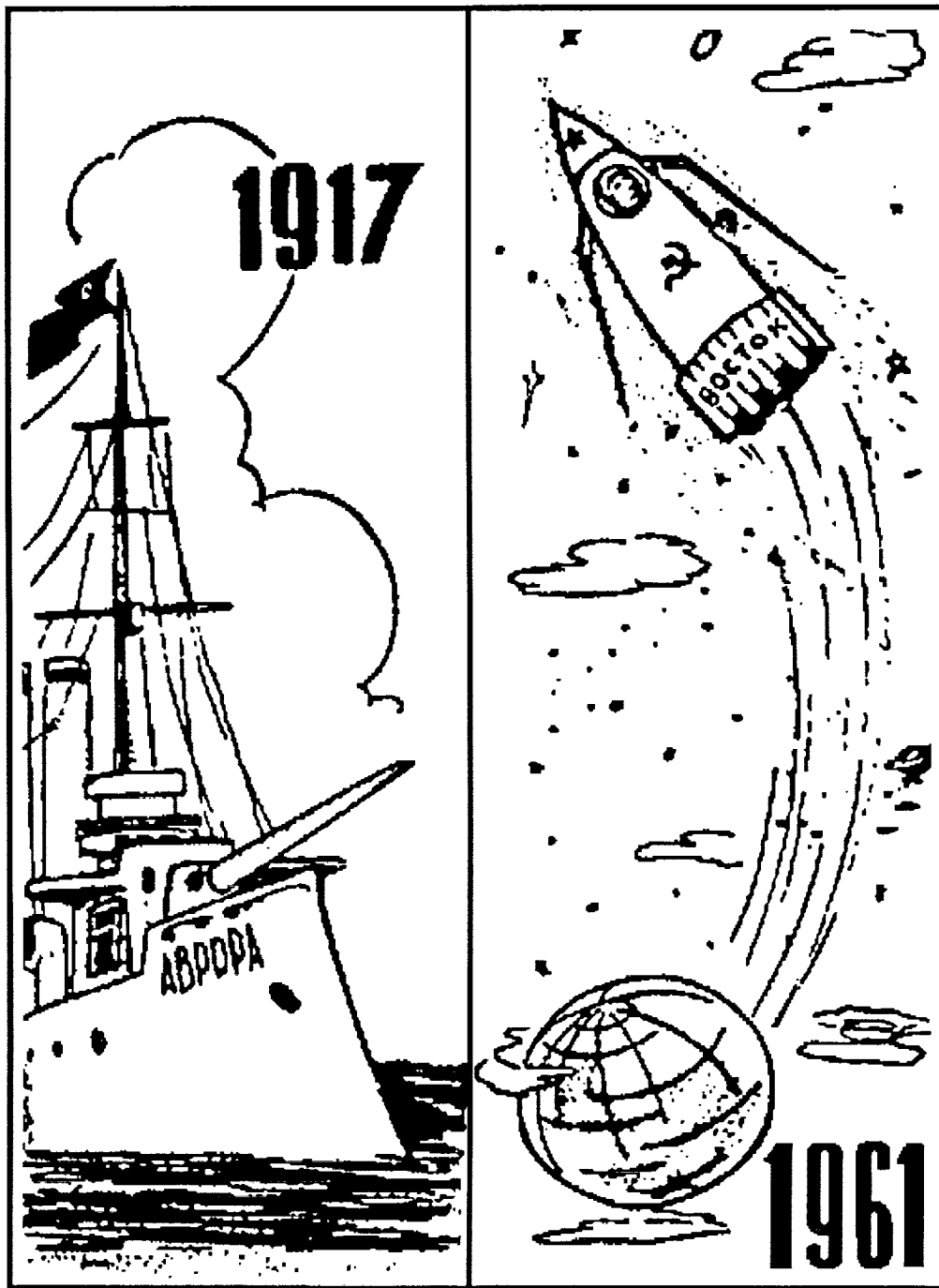


## WHO ELSE CAN GIVE YOU A MOON?

October 13, 1957. Courtesy of the *Sacramento Bee*.

Figure 1.

*Used by permission.*



**"The Dawn (Aurora) Always Heralds a New Day"**

The cartoon plays on the names of the naval ship *Aurora* (the dawn), a cradle of Russian Revolutionary agitation, and *Vostok* (the East), the first manned spacecraft, implying that the future is always made in the Soviet Union. From *The Morning of the Cosmic Era* (Moscow, 1961).

Figure 2.

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**"In Tune with the Times....Africa!"**

The cartoon depicts Yuri Gagarin saluting the African people from space, implying that each is engaged in the same, mutually supporting struggle against imperialism. From *The Morning of the Cosmic Era* (Moscow, 1961).

**Figure 3.**

*Used by permission.*



**"Even His Compass Won't Help Him. Which Way is West?"**

The cartoon depicts two "ten-foot-tall" cosmonauts riding Vostoks III and IV to glory, while an American on his hobby-horse, intimidated by Soviet technical superiority, can no longer tell West from East. From *Izvestia*, August 1962.

**Figure 4.**



**"Fill 'Er Up---I'm in a Race"**

Herblock, May 24, 1961. Copyright 1961 by Herblock in the *Washington Post*.

**Figure 5.**

*Used by permission.*



### "They Went Thataway"

From *Straight Herblock* (Simon & Schuster, 1964). Originally appeared in the *Washington Post*.

Figure 6.

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