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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF PHYSICS
CAMBRIDGE, MASSACHUSETTS 02139

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Dear Ken:

My perception is that there is a strong current within NRAO in favor of building an offset-feed, clear-aperture successor to the 300-ft telescope. With my radio astronomer's hat firmly on my head, and with 30 years' experience observing at the NRAO, let me protest in strong terms. The protest is grounded on the following propositions: The antenna should be over 100 meters in diameter, it must be built prudently but with dispatch (so it does not interfere with other large capital projects), it must stay within a budget of about $70 million, and it must serve the broad user communities summarized on page 5 of the 2-3 December 1988 Green Bank Workshop Proceedings. This implies conservative design, potential for improvement, and frequency flexibility. The consensus of the workshop was to emphasize size, preferably well over 100-m, and to try to make as much of the interior surface as possible good at 3-mm wavelength. Table I makes the point: three of the four working groups expressed a strong desire for a diameter over 100 meters.

When I arrived at the Workshop, I was enamored of the clear-aperture concept. The Workshop, for me, was a marvelous opportunity to look at the problem in depth, and argue the merits of the concept with one's peers. The problem is that when one considers the concept in detail, there arises fundamental difficulties. The experience with conventional designs has led to several design parameters that one tampers with at one's peril:

i. The f/D of the primary mirror in a radio telescope should be in the range 0.40-0.43.
ii. The secondary must be at least one-tenth the diameter of the primary.

These requirements have influenced feed design (in fact, they evolved because feeds are easier to adapt to these parameters). The larger secondary is favored for low frequencies unless there is provision for prime-focus operation. For focal ratio f, diameter of primary D, diameter of secondary aD, the diameter of the feed exceeds the diameter of the secondary for wavelength > (a^2/fD), or wavelength = 2.25m for a 100 meter dish with the above parameters.

What does this imply for an offset feed? Firstly, for multi-frequency operation, an entirely new feed development-possible, but undesirable when your resources are stretched. Secondly, any

f=0.4 geometry for the clear-aperture case requires a secondary mount on a mast 80 meters high for a 100 meter dish. This again is a soluble but formidable problem. I am convinced that shortening the tower by compromising on the f-ratio would be most unwise. The magic 0.4 ratio was not arrived at arbitrarily, but by years of experience. Thirdly, the ability to carry our polarization studies is not guaranteed unless careful thought goes into the design-soluble again in principle but not an easy or straightforward affair for an offset feed.

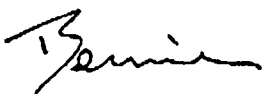
On these grounds, I believe that diversion of NRAO resources into an unsound direction is ill-advised given the urgency of carrying out the project expeditiously and with no embarrassments. The engineering department of NRAO is too thin to risk novelty.

Finally, an unkind cut at the cover of the Workshop is in order. The consensus of the Workshop was that the center-fed geometry was preferred, after the knowledgeable participants had a chance to understand the problems with an offset feed. Given that fact, the use of an offset design on the cover is not well-advised. Beyond the lack of sensitivity to community opinion, however, is the low quality of the draftsmanship.The perspective is atrocious -- the alidade is rotated by at least 30 degrees with respect to the dish axis. The secondary diameter is one-eighteenth that of the primary. Who ordered (or approved) that one? The f-ratio is 0.2 -- worse than the original Jodrell design! This may seem like nit-picking, but the 300 foot successor is not a project welcomed by all astronomers. A poor rendition of the concept on the cover of a widely-circulated document is an invitation to trouble. Shortness of time is not an acceptable excuse. I enclose a copy of the cover, with dimensions marked.

Those specialists who need extra-low sidelobes can get it from a conventional symmetric design by one of two routes -- a guyed bipod gives half a dish, with a small blockage that may or may not be acceptable, and a tripod gives one-third of the aperture with no blockage whatsoever.

In summary, given the limited engineering resources at hand, and the urgency attached to doing the job competently, expeditiously, and within budget, the main emphasis should be on the design of a center-fed, fully steerable telescope bigger than 100 meters. Serious engineering effort should go into worrying about the way to get good long-wave (meter-wave) performance.

Sincerely,



Bernard F. Burke

BFB/wh

cc: R. Brown