they could be made quickly and easily as the need became apparent. But it is a fact of life in large bureaucracies that decisions are difficult to unmake and remake and that the process is time consuming. The military research and development establishments are not an exception to this general rule. As a result much time is lost in obtaining authorization for changes in specifications through all the echelons of authority. Even more time is lost in attempting to find a way around obsolete or excessively optimistic specifications to obviate the necessity of appealing through the echelons of the hierarchy for new decisions.

An important reason for early, fairly detailed specification of weapon systems is the need to match the various components under development — for example, in the case of a missile, the airframe, power plant, warhead, and guidance. This need is real, and must be achieved at the appropriate stage. Where a system is being put together from previously developed and tested components (as was the Air Force's Thor), matching and the detailed specifications required by matching may be imposed without too much risk at the preliminary design stage. But where a new system is really advanced, where the components have yet to be developed and tested for feasibility and performance, premature concern over physical matching can delay development by years. The urgent thing is usually to get the critical components developed to the point where they can be tested (having "duplicate" efforts on the most critical ones to gain quality, time, or both). When it is known that they work is early enough to worry about matching configurations *in detail*.

PREMATURE COMMITMENT OF LARGE FUNDS

The illusion that the future can be foreseen with something approaching certainty, plus pressure from the contractor, plus a desire by the military Services to save time and to guarantee the availability of a budget to complete the development, produce a tendency to commit large funds prematurely to highly uncertain weapon system developments. Because of the great uncertainties that affect technological development, and the equally great uncertainties regarding the military usefulness of particular developments, it is desirable to retain the flexibility to terminate developments at short notice and low cost.

One type of premature commitment is the commitment to production tooling at an early stage of the development. There are exceptional cases where some commitment may be justified at an early stage, but most of the tooling ordered before the testing of prototypes has to be scrapped because of changes in specifications. This appears to be the sort of gamble where you gain little if you win (six months of lead time at most except in periods of heavy pressure on the capacity of tool producers); lose a