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APPENDIX B

DETECTION OF HIGH ALTITUDE TESTS

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No experimental evidence exists so far on the effects of atomic weapons tests at very high altitude (100,000 feet or more). Two tests will be made during the HARDTACK Series, one at 125,000 and one at 250,000 feet. It is not certain whether these tests will succeed because they require the successful firing of the rocket containing the atomic weapon to be tested, followed by proper fusing of the weapon itself in an unusual environment. If the tests are successful, we shall have a good deal of experimental information on the effects of high altitude explosions although much more will be required for complete knowledge. For the present, we must rely entirely on theoretical calculations,

In spite of these uncertainties, it is already clear that there will be a number of easily observable and characteristic effects on the ground if stations are available

purpose of detecting ground and sub-surface tests.

If satellites are available, equipped with appropriate observation equipment, observation and identification of high altitude nuclear tests will be easy.

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I. Effects on the Ground

The following effects of a high altitude test are predicted; there probably will be others as well.

1. Electromagnetic Signal. [REDACTED] will give a signal [REDACTED] according to a theoretical prediction. The signal will decrease very slowly with decreasing yield, [REDACTED] the range for [REDACTED] detecting equipment.

The smallest signal detectable by the present [REDACTED] distance, [REDACTED] At larger [REDACTED]

[REDACTED] The signal will [REDACTED] since it is [REDACTED] the method should be available for all altitudes although with varying sensitivity.

2. Radio and Radar Blackout by X-Rays and γ -Rays. At [REDACTED] the air will be strongly ionized by the X-rays from the bomb. This will lead to a blackout of the reflection of electromagnetic waves from the ionosphere [REDACTED] The blackout will last for a few minutes and can be observed either by means of direct vertical ionosphere echoes or by means of beams from one station to another. [REDACTED]

This blackout effect will be strong for tests [REDACTED] including those conducted above the atmosphere. [REDACTED] (At the lower [REDACTED])



altitudes the ionization is mainly due to γ -rays rather than X-rays.)
It is [REDACTED]

3. Radar Blackout by Fission Product Cloud. The fission product cloud, through its γ -rays, will cause much stronger radar blackout than the direct X-rays and γ -rays from the bomb, but only in the direction in which the cloud travels. Blackout of radar reflection up to several hundred megacycles for some minutes is predicted, [REDACTED]

[REDACTED] The rate of spread of the cloud at the very high altitudes involved cannot be predicted at present. [REDACTED]

4. Acoustic Signal. This signal will be of long period [REDACTED] and of similar strength as the long-period signal from a surface burst. [REDACTED] of stations proposed in Appendix A, lower yields can also be observed. This signal [REDACTED] The short-period signal observed for ground shots will be very weak.

5. Seismic Signal. There may be a long-period, seismic signal which might be observable.

6. Light. [REDACTED] This is so provided the bomb is in the direct line of sight. [REDACTED] for smaller height the light is observable only at smaller distance. Within the horizon, the light can be observed even if there is cloud cover. [REDACTED]



II. Effects Observable in a Satellite

[REDACTED]
neutron counters would detect a nuclear explosion of [REDACTED]

[REDACTED] The light could be observed for any height of detonation down to sea level, [REDACTED]

[REDACTED] From explosions above 200,000 feet, appreciable X-rays would also be received. There could be further [REDACTED] and these might be even larger and of much longer duration.

III. Importance of Effects Tests at High Altitude

In the foregoing it has been shown that high altitude is not a good place to "hide" a weapons development test. On the other hand, the phenomena at high altitude are themselves very interesting for military applications, and some consequences for civilian communica-

[REDACTED]
tests even if these are not directed toward weapons development. A moratorium might provide for such tests to be carried out with stock-pile bombs.

Among the important problems are [REDACTED]
[REDACTED]