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Cdr. E. P. Cronkite (MC), USN
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Naval Medical Center
Bethesda 14, Maryland

Dear Gene:

Yesterday Pete Palmer shipped the slides you requested in your letter of 15 December and as I agreed to arrange in our recent telephone conversation.

Regarding ideas relevant to future field work in Nevada dealing with biological blast effects, I believe I made my views fairly clear at the blast conference which was held in Washington, D. C. However, I will attempt to emphasize briefly some of the points below.

We know that appropriate use of underground shelters will minimize or eliminate the effects of ionizing and thermal radiation, and that blast effects must be considered in the design of shelters which may be used by civilians and the military, both strategically and tactically. It follows, it seems to me, that it is quite necessary to understand the biology of blast much better than is now the case.

The English have given us data relating peak static overpressure to weight of exposed animals and these apply only to H. E. with overpressure durations of 1-3 m sec. The experiments of De Saga in Germany and Clemedson in Sweden establish that the duration of the overpressure is a definitive parameter of the air-borne blast phenomena. Exposure of two anesthetized chimps, on a rocket propelled sled, one to sonic (1103 ft/sec) and one to near sonic (1090 ft/sec) wind velocities at Muroc (letter report on Project "Windblast" dated 8 May 1953 by Dr. P. W. Stumm to WADC, Dayton, Ohio) produced deep shock in both animals and supra-clavicular crepitation in one. The animals weighed 70 (1103 ft/sec) and 100 (1090 ft/sec) pounds. Both chimps, treated for shock and with antibiotics, survived.

From the above it is necessary to understand the biological effects of

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blast in terms of (1) local static overpressure, (2) duration of overpressure (impulse - Clemedson), and (3) the dynamic loading due to ram pressures, a function of wind velocity and air density.

Experience last Spring in Nevada with mice and dogs demonstrated that biological damage was associated with overpressures of relatively low magnitude--as do Stumm's data cited above in which ram pressures were in the range of 10 to 12 psi for unspecified, but comparatively long, durations. Also, in Nevada there was evidence of near sonic wind velocities in the shelters. Though the Q tube measurements did not show this, the instruments used, having screens over the leading portion, were not capable of yielding accurate data at high wind velocities.

The Nevada experience also suggested that the rate of initial load applied to the animals might be of significance, and certainly emphasized the importance of geometry and instrumentation more suitably placed in relation to biological specimens in order that the blast phenomena measured could be regarded as a close approximation to that experienced by the animals.

Further, the Nevada experience was confused by the use of anesthesia in the first shot. Though this was proper and may not be an important variable, the fact remains that there are no data to allow a firm and definitive opinion at the present time.

With regard to the rate of loading mentioned above, it is significant that in sled deceleration experiments on human subjects, Colonel J. P. Stapp found that the rate of development of g was a critical factor in producing shock; e.g., about 38 g applied at the rate of 1370 and 331 g/sec produced definite signs and no signs of shock, respectively; near 46 g applied at 493 g/sec produced conjunctival and retinal hemorrhage and resulted in a permanent central scotoma in one subject.

It is quite important that, except for the Nevada work, there has been no definitive and instrumented biological experience with overpressures enduring for times which are realistic in view of present day weaponry. I hope the above statement isn't true, but so far as I know it is, and to my thinking this is a sad commentary indeed.

There is much to be done in the blast field and as you know I favor an intensive program both in the laboratory and in the field.

It is both sensible and really economical to believe that a laboratory attack should be made under realistic circumstances in which equipment (sizable enough to expose large dogs) and suitable instrumentation are made available to allow considerable independent control of the magnitude of shock waves, the rate of rise, magnitude and rate of fall of local static overpressures, and the magnitude and duration of suddenly developing winds which are associated with blast phenomena in which shock waves are present and in which they are not. No such equipment exists at the present time, but a small missile source,

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combining a large tank, diaphragm, a transition section and tube, is now under design and part procurement in Albuquerque. The function of this gun will do much to establish the range over which such gear will be practical.

There is urgent need to confirm or deny data published by the English relating biological damage to peak overpressure and body weight and surface area, and to extend such investigations utilizing exposure circumstances in which the loading due to overpressure, overpressure duration, and ram (wind) are applicable to A and H weapons.

Obviously the underground shelters of Bob Corsbie offer a wonderful opportunity to continue blast investigations in the field. If properly instrumented for local static overpressure, wind velocity determinations, and with proper choice of ground zero, it seems reasonable to believe a wide range of conditions could be attained. Modifications of the entry way or "blast trap" with prior test on the Aberdeen Shock Tube might well allow one--within certain limits--to choose and produce various patterns of overpressure and winds within the shelters which would extend the present potential of the shelters. Certainly the structures are large enough to allow exposure of a significant number of animals which vary in surface area from mice to large dogs, and they are roomy enough to let an investigator take advantage of, rather than be hampered by, the geometry of animal exposure.

It is well to emphasize that any biological study attempting to correlate damage with the physical disturbance responsible for dynamically "loading" or "energizing" the animal will be no better than is the instrumentation and its ability to define the exposure conditions as exactly as possible.

I have already written more than I intended and there seems no point in my detailing specific recommendations for any future Nevada work. What can be done is obvious to you and will be to others after some discussion. What should be done, however, is another matter and is definitely related to a respon sible decision as to the importance of blast as a significant biological parameter of A and H weapons. This to me is the most important point of all. Frankly, I believe the AEC has been one of the few agencies who has had foresight enough to recognize the problem and to appreciate in a consistent way the significance of and the necessity for doing those things which will eliminate biological radiation damage--both ionizing and thermal--and in pointing out the obvious factors which apply when one attempts to survive closerand closer to ground zero. To me this is an urgent matter and its importance to civilians, industry, the Navy, Army, and the Air Force is obvious, and any sound reason why more research has not been done, completely escapes my thinking.

However this may be, I sincerely hope my remarks will be useful and that sound progress is made in future planning. You know that I am willing to help in any way which is consistent with my responsibilities in Albuquerque. Consequently, if there is a possible way I or the Foundation staff can contribute, please feel free to let me know.

Personal regards.

Sincerely yours,

[redacted] Clayton S. White [redacted]

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