

NUCLEAR EXPLOSIONS AND THE WEATHER

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(Manuscript received 9th January, 1962)

The following facts and figures were compiled at the time of the nuclear weapon tests that began in October, 1961, and some of them were used in a television weather programme in Melbourne.

Those who claim that the bomb has affected the weather, should first show that the weather has, in fact, changed in any significant way. There seems to be no evidence that it has. Sutton (1955) gives at some length a discussion of the weather in Britain in 1953-4, at the time of a series of thermonuclear tests in the Pacific Ocean, and concludes: "The weather experienced in the British Isles was well within the established climatic range, and it is evident that it would be exceedingly difficult, if not impossible, to establish a "cause - and - effect" sequence on purely meteorological grounds. What evidence exists, points, in fact, to the opposite conclusion". Similar conclusions might be applied to the weather in Australia. Examination of the results of meteorological observations in Melbourne, for instance, shows that in almost any year, some sort of all-time record is established in some element or other, and in recent years the variability in weather has been no greater than in earlier years.

The characteristic of the bomb that leads to speculation about its effect on the weather (speculation of a kind which has antecedents thousands of years old), is its colossal energy. From various sources, the following table of energies (orders of magnitude only) has been drawn up. (Sutton 1955, 1960. Mason 1955).

Total latent heat of precipitable water in the atmosphere	10 ²¹ cals
Kinetic energy of the general circulation	10 ¹⁹ "
Latent heat in a tropical cyclone	10 ¹⁹ "
Kinetic energy of a tropical cyclone	10 ¹⁷ "
Energy released by a 50-megaton bomb	10 ¹⁷ "
Kinetic energy of a small depression	10 ¹⁶ "
Energy released by a "modest thunderstorm"	10 ¹⁴ "
Energy released by an A-bomb	10 ¹³ "

This shows that the energy of the largest nuclear bombs compares with the kinetic energy of atmospheric pressure systems, but that even if it were all converted to kinetic energy in the atmosphere, it would contribute only 1% extra energy, which would rapidly be dissipated by friction. It is also very small in comparison with other necessary forms of available energy, such as latent heat of water vapour. This comparison is not very satisfactory because the kinetic energies referred to are instantaneous values, and pressure systems usually maintain them for some days, dying in two days or so if further energy is not supplied.

A more useful comparison can be made between the power of solar radiation and the energy of the bomb. The sun provides energy at the top of the atmosphere at the rate of 10²¹ calories per day, i.e. at the rate of 10,000 50-megaton bombs per day. The radiation received at the earth's surface in middle latitudes on a summer afternoon is about 10¹² cals. per hour per square mile, i.e., about one Hiroshima bomb per hour for every 10 square miles. Clearly the energy input from even the largest bomb is negligible.

There is still the possibility of the bomb having a trigger effect. However, (Mason 1955) a bomb in only one of a continual series of natural perturbations, most of them rapidly damped. Even if a depression were triggered, it would normally have a life of only a few days, and any seasonal effect is inconceivable. There is little chance of the energy in an instantaneous explosion acting as a trigger for any large scale atmospheric movement. In a thunderstorm, for instance, the condensa-

tion processes require continuous application of energy for periods of the order of 30 minutes. In special circumstances and indirectly, a nuclear explosion may trigger a thunderstorm, as at Bikini in 1946, when an underwater explosion ejected enough water and steam to lift a potentially unstable air mass and produce a convective cloud and rain. At Hiroshima the heat of widespread flash fires triggered a thunderstorm.

A further possible effect of the bomb is by dust and hygroscopic nuclei. The dust thrown up by the largest bombs is much less in quantity (probably by several orders of magnitude) than that released by three recent very violent volcanic explosions (Krakatoa 1883, Mont Pelée 1902 and Katmai 1912), and the effect on weather of these eruptions is problematical, and certainly extremely slight. Condensation nuclei are already present in the atmosphere in sufficient quantity to precipitate the available moisture.

Mason sums up: "Let us therefore combine conviction with caution and say that while there are very good reasons for believing that occasional thermo-nuclear explosions of the present magnitude are very unlikely to have more than very localized and transient effects on the weather, arguments to the contrary have been merely intuitive or based on misleading analogies".

The 50-megaton bomb explosion of 30th October, 1961, did produce a shock wave easily visible on ordinary microbarographs in Australia, travelling at 700 m.p.h. with an amplitude of about half a millibar.

REFERENCES

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