# COMETARY DUST AND THE PERIODICITY OF RAINFALL SINGULARITIES

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ABSTRACT. Periodicity in rainfall singularities in the U.S.A. corresponds to the periods of two comets whose orbits are sufficiently close to Earth's orbit. These effects are connected with the position of a stratospheric jet stream over the territory of the U.S.A. This investigation indicates that some processes, so far not properly understood, could be responsible for the influence of cometary dust on the triggering of atmospheric precipitation.

More than thirty years ago Bowen (1953) unfolded a hypothesis on the influence of meteoric dust on precipitation. Thirty days after the maximum activity of a meteor stream the amount of precipitation seemed to be generally higher in many regions in the world than on other calendar days. According to Bowen's original hypothesis the meteoric dust acts as a rain trigger introducing freezing nuclei into the clouds in the sense of "natural cloud seeding". A clear connection between meteor streams and a singularity in precipitation was found by Bowen (1956) for the meteor stream of $\gamma$-Draconids (Giacobinids) on 9th October and the rainfall peak on 9th November. This rainfall peak shows the same periodicity as the orbital period of the meteor stream and the comet Giacobini-Zinner, namely 6.6 years.

In order to check the possible influence of other comets without known meteor streams, the present author selected the comet Grigg-Skjellerup with orbital period 5 years as the most suitable. The last third of the month of May was tested in the 120-year series of Prague rainfall data (1840-1960). The date of close approach between the orbits of the Earth and of the comet is 26th April and thus the rainfall peak should be expected on 26th May if the dust is concentrated in the cometary orbit and if the seeding effect or any other trigger mechanism exists. Such a peak with the periodicity of 5 years was found in the Prague rainfall records by the autocorrelation and power spectra method (Kviz 1964) - see Figure 1. A tentative conclusion was drawn that the invisible and fine cometary dust may actually act as a rain trigger supplying more nucleating material than visible meteors.

In 1969 the author was given an opportunity to study such a



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periodicity of rainfall peaks for Australian rainfall records during a 3-year Fellowship at the CSIRO, Division of Radiophysics, Sydney, Australia. Only two comets were studied, Giacobini-Zinner and Grigg-Skjellerup. These are the only comets with suitable orbital periods and with a sufficiently close approach to the Earth's orbit. Many localities with longer rainfall records (more than 70 years) were studied by the method of auto-correlation and power spectrum for Australia and a few other countries as well (New Zealand, U.S.S.R., France, Rhodesia).

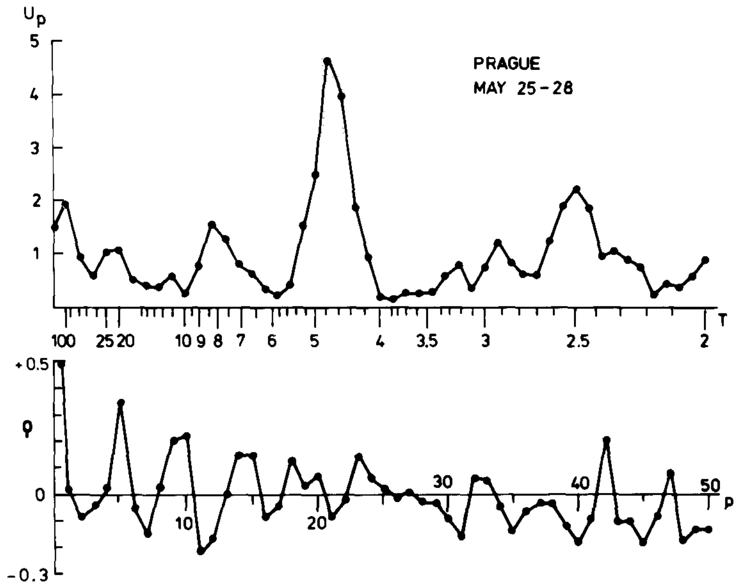


Figure 1. Autocorrelation of Prague rainfall (120 years) occurring between 24th-28th May - lower curve. Upper curve represents the power spectrum and indicates clearly the peak around 5 years.

Many localities revealed the expected periodicity, but not all of them. The geographical grouping of the localities with positive correlation was obvious but no clear clue could be found to explain this geographical grouping.

Unfortunately, localities in Australia with rainfall records long enough for autocorrelation treatment are concentrated along the coast, especially the eastern coast, and a full pattern of geographical dependence of the effect could not be revealed. The only suitable area on the globe, large enough and with evenly distributed meteorological stations and with long uninterrupted series of rainfall records, is the United States of America. However, the autocorrelation method did not reveal any clear clue even for the network of US meteorological stations.

As the autocorrelation and power spectrum method gives only the

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period and not the phase, another method was tried. The orbital period of a comet was divided into several equal sections and the amount of rainfall which occurred in each individual section of the period was added together. This method was tested for two localities with long series of records - Prague, Czechoslovakia and Sydney, Australia. The series were split into two parts in order to test the persistence of the effect. Graphs in Figure 2 show the result.

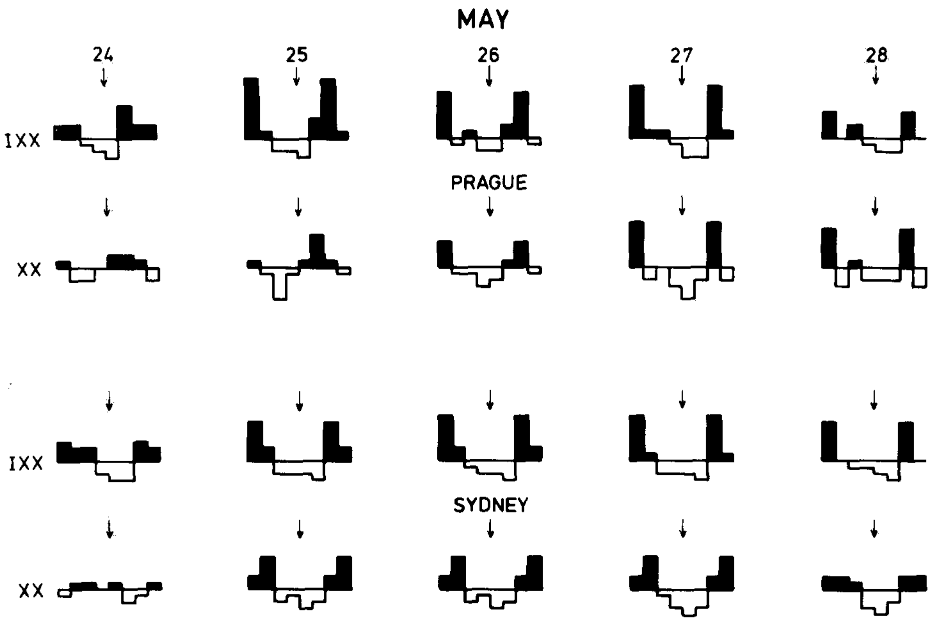


Figure 2a. Test of the "phase method" for Prague and Sydney. Each histogram represents the normalized amount of precipitation between 24th-28th May,in each individual sixth of the orbital period of the respective comet. The closest approach of the comet is indicated by an arrow. Data is separated for 19th and 20th century.

This was considered as an indication that for some localities, and for the season of the year considered, the rainfall occurs when the comet is closer to the Earth and for the others when the comet is further away from the Earth. Using this phase method for some US meteorological stations it has been possible to find some pattern in the geographical grouping of localities with high rainfall when a comet is close to the Earth. It seems that such localities lie under the jet stream - see Figure 3.

These results indicate that there may exist some, so far not understood, processes in the atmosphere, responsible for the influence of cometary dust on the rainfall predominantly under the jet stream. Perhaps by studying this influence on other continental areas of the globe we could gain information on the average behaviour of jet streams in the past.

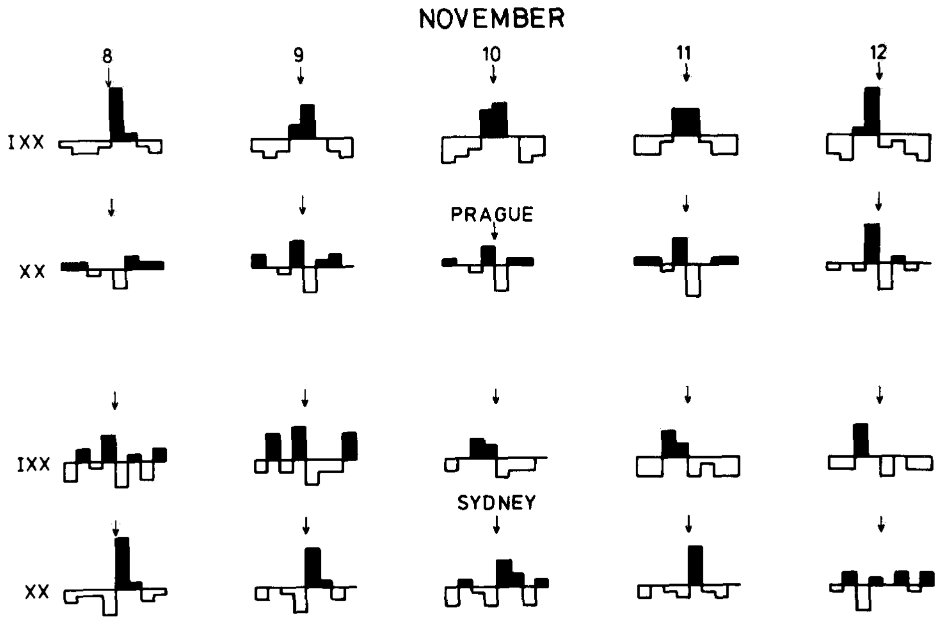


Figure 2b. Test of the "phase method" for Prague and Sydney. Each histogram represents the normalized amount of precipitation between 8th-12th November, in each individual sixth of the orbital period of the respective comet. The closest approach of the comet is indicated by an arrow. Data is separated for 19th and 20th century.

Results presented in this paper are obviously the first step based on the investigation of 45 US meteorological stations and the research should be extended to a larger number of stations and also for other countries, especially these with a dense network of meteorological stations, such as India. Perhaps the countries close to the Himalayas may yield the best results because of the relatively stable position of the subtropical jet stream in that region.

The investigation of comets and other bodies of our planetary system proved that they bear quite a high amount of water ice. This fact has not been known at the time of publication of Bowen's hypothesis. The water itself, passing through low temperature layers of the stratosphere, perhaps may provide the best freezing nuclei to trigger the rainfall. This question should be the topic of future research concerning the meteor-rainfall correlation.

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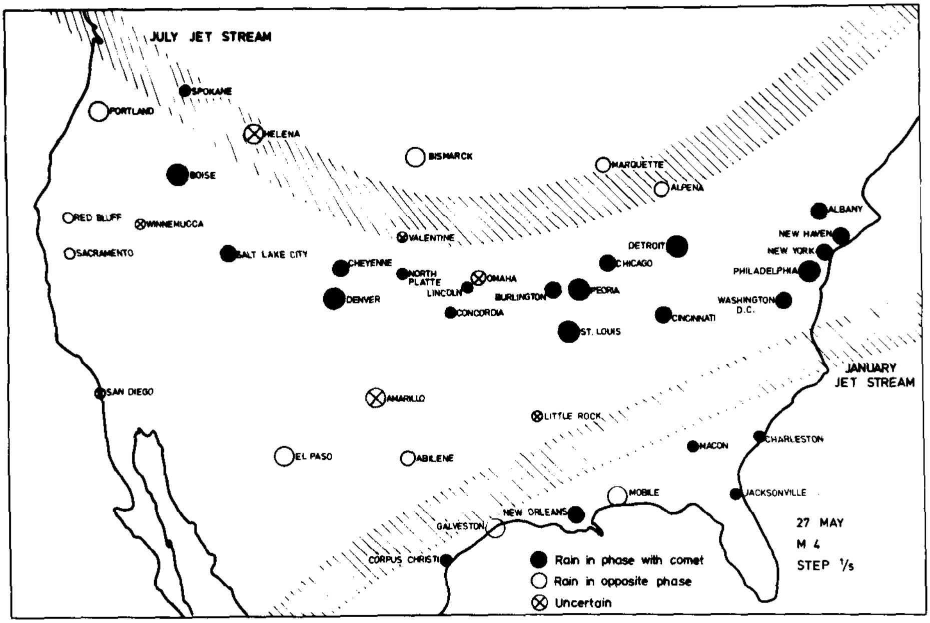


Figure 3a. Distribution of the tested meteorological stations in USA for 24th-28th May with the rain "in phase" with the comet Grigg-Skjellerup, stations with rain "out of phase" and stations with no clear results.

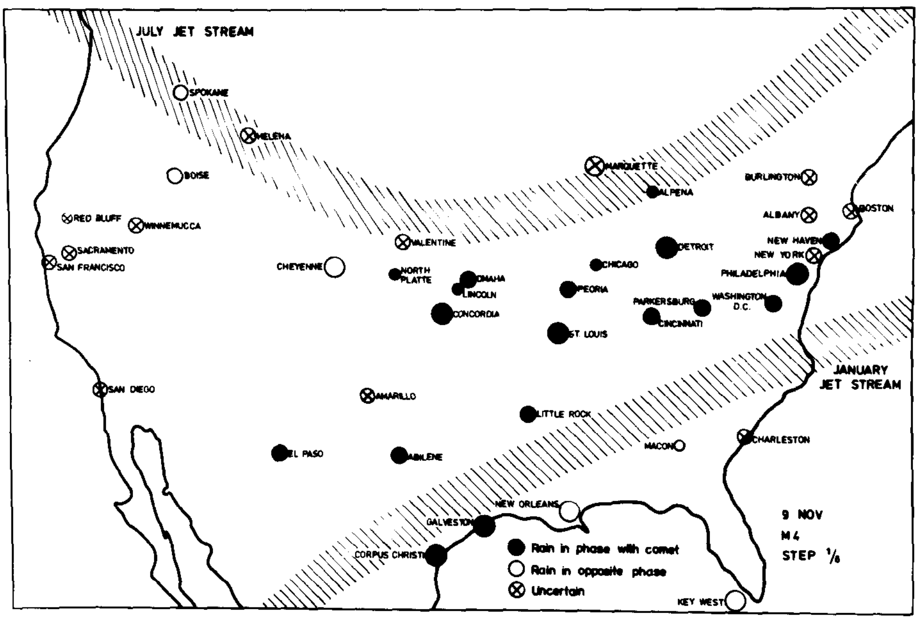


Figure 3b. As for 3a but for 9th-12th November and for the comet Giacobini-Zinner.

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