fluctuations. Experiment[9] confirms the prediction of the linear theory[5-7] that the strength of the initiating quantum noise is such that, on average, SF is set off by the first photon emitted spontaneously in the solid angle $\Delta\Omega$. The relative standard deviation in the delay time of 12% at $N = 10^8$ atoms, as predicted by both the linear and the more complete nonlinear[8] theory, is in good agreement with preliminary measurements by one of us[3].

It is amazing indeed that such large fluctuations, quantum mechanical in origin, can be observed in nearly classical coherent pulses containing as many as 10^8 photons. □

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100 years ago

A Parisian speculator has inaugurated the aëronautical season by a private ascent on April 25 at La Villette gasworks. The baloon, of only 300 cubic meters capacity, bore one aëronaut, with 30 kilograms of handbills, which were distributed all over Paris. The wind being slight, with a favourable direction, thousands of these prospectuses were picked up by street passengers and largely read. The whole expense of the aërial expedition, gas and everything, did not exceed 10*l.* sterling.

The French Minister of Fine Arts has entered into an agreement with the Jablochkoff Electric Light Company to light the palace during the whole of the two months devoted to the exhibition. The number of lights fed by the machinery is about 400, and the motive power regarded at about 320 horses. The inauguration was to take place on May 1, and a large crowd had congregated to witness the process. But the crank of one of the principal engines broke, and it was necessary to postpone the opening for a few days. In spite of the growing opposition of the friends of the gas company, M. Garnier, the architect of the Paris Opera, will establish a trial of the principal electrical burners, to decide which is the more really fit for use in the house.

We learn from Catania, under date April 26, that the inhabitants were apprehending an eruption of Etna. An immense cloud of smoke has been observed.

A contemporary gives the following method of illustrating the indestructibility of matter: — Two sealed glass tubes of equal weight, one of them containing oxygen and a little powdered charcoal, are prepared. The charcoal may be caused to burn away completely by heating it by means of a small flame. On placing the two tubes on a balance it will be seen that there has been no variation in weight.
from *Nature* **22**; May 6, 17&18; 1880.

Sun-weather effects

from R. Gareth Williams

In a recent paper, Nastrom and Belmont (*J. geophys. Res.*, **85 C1**, 443; 1980) have found an interesting correlation between the 11-year sunspot cycle and the upper troposphere and lower stratosphere. They have thoroughly and carefully analysed data from the Northern Hemisphere for a period covering 1949 to 1973, i.e., just over two solar cycles. Their results indicate that during the winters of this period, the average position and, to a lesser extent, the strength of the jet stream and the intensity of features such as the Siberian upper level trough, have a strong correlation with solar activity. It is not so much the statistical significance of the results which is surprising, but rather that in certain areas of the hemisphere 50% of the interannual variance is explained.

In order to consider the significance of these new findings, it is necessary first to review the general state of sun-weather effects. Despite almost 180 years of study, we have little evidence to support the hypothesis that solar activity significantly effects the troposphere. There is a plethora of statistical correlations, but many of these have been produced by over-filtering and selecting the data and the remainder have nearly all failed where the data sets have been extended in time. Also, there are no thoroughly evaluated mechanisms which explain how solar activity may affect either the climate or day-to-day weather. Indeed, there is a good reason why it is difficult to establish such a causal link; the energies associated with solar activity are very small when compared with tropospheric values (see, for example, Willis, *J. Atmos. Terr. Phys.*, **40**, 513; 1974). This means that any proposed mechanism will necessarily be indirect and complicated, and also that any statistical correlations, on their own, must be viewed with caution.

So, with this particular study by Nastrom and Belmont, although there is no doubt that the correlations are real (question marks raised by the authors over spatial coverage and the number of independent stations should only alter the details of the conclusions) the crucial, unanswered question is: 'Are the correlations caused by the changes in solar activity?'. The authors suggest that their findings may eventually be explained in terms of a direct solar effect on the stratosphere/mesosphere which, in turn, could modulate the upward propagation of tropospheric energy. There is clear theoretical and experimental evidence for the August 4th, 1972 solar proton event affecting stratospheric ozone. However, relationships between the solar cycle and ozone are somewhat controversial and thought at best to be small (< 1%) (Dutsch *J. Atmos. Terr. Phys.* **41**, 771; 1979). Correlations between other stratospheric parameters and the solar cycle are similarly not yet fully accepted and are generally based on short time series. The authors refer to the atmospheric model of Bates (*Quart. J. R. Met. Soc.*, **103**, 397; 1977) which had a troposphere that was very responsive to changes in the stratosphere. More recent work by Shutts (*Quart. J. R. Met. Soc.*, **104**, 331; 1978) shows that this sensitivity is model dependent. Both studies use linearised equations. Nastrom and Belmont cannot indicate which aspect of the solar output is thought to be causing their correlations, so we do not know where in the atmosphere any proposed mechanism should start.

If we jump the gun (by quite probably at least a decade) and assume that these correlations are solar induced, well understood physically and that these upper troposphere effects manifest themselves at the surface, then it is appropriate to consider what their impact on climate forecasting might be. Since 11-year trends in seasonal averages have been analysed, there will be no effect on day-to-day weather forecasts, nor on the 'long range' forecasts produced a month or so in advance. However, in localised regions of the globe it might become possible, for example, to forecast a run of 2 or 3 years with, on the average, cold winters. Such forecasts could, of course, have enormous economic impact. The drawback is that it is also necessary to be able to predict solar activity!

In conclusion, it seems unlikely that this present study will, on its own, alter the opinions of most meteorologists who view sun-weather effects with extreme scepticism. Only some very solid physics will do that and much theoretical work, coupled with further data analysis, will be needed to provide such firm footing. Even though it is free of the criticisms levelled at so many previous studies in this field, this paper will undoubtedly suffer, rightly or wrongly, from so many past correlations which were later found to be invalid. □

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