established that the carrier of the observed microwave spectrum is a triatomic molecule of C_{2v} symmetry with fluorine atoms in the off-axis postions. The identity of the third atom in this molecule can be confirmed from the effects of isotopic substitution. Assuming the molecule in question to be $^{32}SF_2$ the following structure was obtained from the moments of inertia given in Table 1:

$$r_0(\text{S-F}) = 1.589 \text{ Å}$$
$$\angle \text{FSF} = 98°16'$$

The mass 34 isotope of sulfur occurs in 4.22 percent natural abundance which should yield sufficient concentration of a species bearing this isotope to be observable. A new spectrum was calculated for $^{34}SF_2$ based on the structure determined above. Six transitions were observed very close to the predicted frequencies, thus confirming that the central atom is sulfur. The observed frequencies and constants for the $^{34}SF_2$ species are given in Table 2. It may be noted that the moment of inertia I_B remains essentially unchanged upon isotopic substitution, as would be expected for an atom on an axis of symmetry.

Questions concerning reactivity and lifetime can be answered only in a qualitative fashion because of the method used to prepare SF_2. Sulfur difluoride was trapped in the waveguide by simultaneously closing the inlet and outlet valves while it was being synthesized in the discharge. In this static system the microwave signals decreased to half-intensity in about 12 minutes. However, the method of generation appears to produce such a wide variety of other substances of unknown reactivity that this measurement may not be meaningful. On the basis of the relatively long time required for the apparent destruction of SF_2, it appears that if this substance is prepared in reasonable purity it should be stable enough to permit studies in a static system, especially if reduced temperatures are employed.

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Interhemispheric Transport of Atmospheric Fission Debris from French Nuclear Tests

Abstract. *Radioactive iodine-131 (half-life, 8.06 days) and barium-140 (half-life, 12.8 days), released into the atmosphere (21°S, 137°W) by the French nuclear tests conducted during the period 24 August to 8 September 1968, have been observed in rainfall at Arkadelphia, Arkansas (34°N, 94°W). The maximum time required for the transport of the debris from a mid-southern to a mid-northern latitude appears to be about 3 weeks.*

The study of fission debris from single-event nuclear tests has increased our knowledge of the worldwide transport processes that occur within the atmosphere. Debris injected into the atmosphere halfway around the world (but at approximately the same latitude) can circle the earth several times before the occurrence of complete dispersal or washout or both (*1*). Each cycle about the earth requires about 3 weeks.

The recent nuclear tests conducted by the French provided a unique opportunity to study the possible transport of nuclear debris from a mid-southern to a mid-northern latitude. Samples of rainfall were collected by means of a sampling system installed on the campus of Henderson State College. Gross activities were determined by acidifying a 0.5-liter sample of rainfall, evaporating it to dryness on a planchet 2.5 cm in diameter, and counting the activity. All radioactivity measurements were made with a Tracerlab low-background beta counting system with a background of about 0.8 count/min.

A day-to-day observation of each such sample showed no significant short-time decrease in activity until the occurrence of a heavy rainfall on 16 to 17 September 1968. This particular sample showed a rather abrupt increase in gross activity over that of the previous sample of 6 September (3950 count sec^{-1} m^{-2} as compared to 610 count sec^{-1} m^{-2}) in addition to an apparent day-to-day decrease in activity.

Samples (each 3 liters) of the rainfall from 15 to 16 September and 3 October 1968 were analyzed for radioactive Ba^{140} and I^{131} by standard radiochemical procedures. A 12-liter sample of the rainfall from 5 October was analyzed for Ba^{140}. The results are shown in Table 1.

According to published news releases (*2*), U^{235} was used as the fissioning material for the French thermonuclear tests. In theory, it should therefore be possible to date the time

Table 1. Rainfall analyzed for radioactive Ba^{140} and I^{131}.

Rainfall date (1968)	Gross activity (count min^{-1} m^{-2})	Apparent half-life (gross activity in days)	Activity as of date of rainfall (disintegration min^{-1} $liter^{-1}$)	
			Ba^{140}	I^{131}
13 August	103	> 100		
15 August	199	> 100		
25 August	422	> 100		
6 September	610	> 100		
15–16 September	3950	< 25	32.7 ± 3.5	4.7 ± 0.9
24 September	288	< 25	*	*
3 October	895	< 25	†	1.0 ± 0.2
5 October	980	< 25	5.8 ± 0.8	‡
9 October	215	~70		‡
13 October	78	~70	*	*
3 November	660	> 70		‡
10 November	218	> 100		
15 November	207	> 100		
23 November	240	> 100		
26–27 November	737	> 100		
30 November	176	> 100		
3 December	162	> 100		

* Analysis not attempted; less than 2 liters collected. † Sample lost. ‡ Analysis run; no activity detected.

of detonation by means of data on the production ratio based on yields of thermal-neutron fission production from U^{235} (*3*). However, I^{131} and Ba^{140} suffer heavily from fractionation effects in the atmosphere (*4*). A calculated date far removed from any reported test date (26 July 1968) is therefore not too surprising. If one instead assumes a production date of 24 August (date of first French thermonuclear test), the production ratio of I^{131} to Ba^{140} calculated from the experimental data is 0.23 ± 0.08. This is in good agreement with the observed production ratio of I^{131} to Ba^{140} (0.17 ± 0.05) obtained for the Chinese test of 16 October 1964 in which U^{235} was used as the fissioning material (*5*). Thus the time required for the transport of the fission debris from a mid-southern to a mid-northern latitude is of the order of 22 days.

Rainfall activity was continuously checked through 3 December 1968 for the possible arrival of a second "wave" of debris from the second French thermonuclear test of 8 September 1968. No additional fresh debris was observed at this laboratory (Table 1). Therefore, even though it is impossible to definitely assign the observed short-lived activity to the first French thermonuclear test, it can be concluded that debris from the French tests required a maximum of only about 3 weeks for the interhemispheric transport.

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Cell Population Kinetics: A Modified Interpretation of the Graph of Labeled Mitoses

Abstract. *Graphs of labeled mitoses, derived from autoradiographs of cell populations with ^{3}H-thymidine, show depressions in the curves at their midpoints. These depressions reflect interruption of DNA synthesis midway through S phase. Such interruptions revealed by the method of labeled mitoses should be considered when determining cell-cycle times.*

The method of labeled mitoses (*1*) has been used extensively in studies of cell population kinetics of tissues to determine duration of the cell reproductive cycle and its components. One such study (*2*), of oral mucosal epithelium of the rat, has given a graph (Fig. 1) which differs from that of Quastler in that the plateau of each curve has a depression at approximately the midpoint. These depressions are not unique to this investigation; similar configurations, though not always described, are evident in other published graphs of cell population kinetics (*1, 3, 4*). These depressions are phenomena revealed by the method of labeled mitoses, and the second curve, despite its two peaks, represents only one population of cells. When the graph is interpreted in this way, cell-cycle time is represented by the horizontal distance between the two curves at the deepest points of their depressions.

Data (Fig. 1) were obtained from autoradiographs of Feulgen-stained squash preparations of the mucosal epithelium on the hard palate of 6-month-old male Wistar albino rats. Rats were injected intraperitoneally, at the same time of day, with ^{3}H-thymidine (specific activity, 3.0 c/m*M*; concentration, 1 mc/ml; dose, 0.2 μc per gram of body weight). Autoradiographs were prepared with Kodak AR.10 fine-grain stripping emulsion and were exposed for 6 weeks. The proportion of labeled mitoses was derived, in each instance, from 100 mitoses.

Heretofore no attempt has been made to explain the depression in the first curve although, in one instance, a low point has been attributed to the possibility of a faulty injection of radioisotope (*4*).

There are two possible explanations for the shape of the second curve if it is assumed to be bimodal and to represent two subpopulations of cells, each with a different cycle time: (i) The two peaks of the second curve may represent two subpopulations of cells differing in the duration of the G_1 phase (*4*). (ii) One peak may represent a subpopulation of cells dividing for the first time after a prolonged G_2 period (*5*).

The first hypothesis is rejected because, whereas two subpopulations with different cycle times should manifest an increasing separation of peaks at each subsequent division, in this study—even when there is a third curve representing a third wave of labeled mitoses—the separation of its peaks differs only slightly from the original (Fig. 2). Furthermore, this hypothesis does not explain the dip in the first curve.

The second hypothesis is also rejected because in a given area in tissue section autoradiographs the number of labeled cells present at 1½ hours had doubled by 16 hours, thus indicating that all of the cells, or almost all of them, had divided by this time. Furthermore, if one of the peaks in the second curve were to represent a subpopulation of cells with a G_2 period exceeding 2 hours, the proportion of labeled mitoses would not have reached 100 percent at 2 hours; nor does this hypothesis account for the dip in the first curve.

It is more likely that the depressions in the curves are manifestations of interruption of DNA synthesis, for an hour or so, midway through S phase. That such a discontinuity in DNA synthesis, or a change in its rate, can occur has been demonstrated (*6*). For a cell in S phase to escape labeling after the introduction of ^{3}H-thymidine into the system, DNA synthesis must cease, or be reduced in rate, for at least the interval during which the radioactive thymidine is available. The duration of this interval is not known precisely but it has been estimated to be 30 to 120 minutes (*7*). For 2 percent of S-phase cells in an asynchronous population to remain unlabeled, as in this experiment, the interruption of DNA synthesis must be further prolonged by a period equal to 2 percent of the 8-hour synthesis time, or approximately 10 minutes. Consequently, it is estimated that DNA synthesis in this system is interrupted for about 1½ hours. Cells which enter this period of interrupted DNA synthesis shortly after the radioisotope is available, and cells which resume DNA synthesis shortly before the radio-