

Aitken nuclei measurements in the lower stratosphere

By JOSEF PODZIMEK¹, *Graduate Center for Cloud Physics Research, University of Missouri-Rolla, U.S.A.*, WILLIAM A. SEDLACEK², *Los Alamos Scientific Laboratory, Los Alamos, New Mexico, U.S.A.*, and J. BROOKS HABERL³, *General Electric Company, Pittsfield, Massachusetts, U.S.A.*

(Manuscript received March 29; in final form May 31, 1976)

ABSTRACT

A report is presented on Aitken nuclei (AN) measurements between 6 km and 19 km with the new Stratospheric Aitken Nuclei Detection System (SANDS) which was installed in the nose section of the WB-57F aircraft. Measurements were made between 48° N and 9° S latitudes over the U.S.A., Gulf of Mexico, Central and South America between March, 1974, and February, 1975.

Evaluation of 18 flights led to the following conclusion: The vertical profiles of AN concentration are similar to those found by Junge et al. (1961). However, the AN concentrations at altitudes above 17 km are higher by several tens of AN cm⁻³. Horizontal flights showed a low AN concentration above 18 km over the tropical regions (below 20 AN cm⁻³), and an influence of the Rocky Mountains and the Andes Mountains on the AN measurements at 18 km altitude. Usually, several km above the tropopause, a negative correlation between AN, and ozone concentration was found.

Introduction

The purpose of this article is to summarize the 1974 and 1975 measurements of Aitken nuclei (AN) made with the new General Electric Stratospheric Aitken Nuclei Detection System (SANDS) flown on a WB-57F aircraft. Detailed descriptions of individual flights were presented in two separate reports (Podzimek et al., 1975a, and Podzimek et al., 1975b) as well as the calibration of SANDS (Wegrzyn & Podzimek, 1975). Technical parameters of SANDS and its function were published elsewhere (Haberl, 1975).

This article is based on the evaluation of high altitude flights over middle and lower latitudes of the American continents between March, 1974, and February, 1975. In total, nine vertical aircraft ascents and nine horizontal flights were evaluated. On several flights, ozone measurements accom-

panied AN counting. The main goal of this study, encompassed in the broad Climatic Impact Assessment Program (CIAP) of the U.S. Department of Transportation, was to supply data for the background concentrations of stratospheric pollutants before the SST aircraft began to operate. Also, the comparability of balloon AN measurements by Junge and his fellow workers (1961), Rosen & Hofmann (1974) and Käselau et al. (1974) with the aircraft data was an important objective of this investigation. Finally, SANDS (carried on board a high altitude aircraft) offered a unique opportunity to investigate the space distribution and exchange of AN over large lateral areas including the very interesting tropical regions.

Vertical profiles of Aitken nuclei concentration

The aircraft ascents in New Mexico, Texas and Panama yielded AN concentrations between one and two orders of magnitude higher than those measured by Junge at an altitude of 18 km (Fig. 1). A well-expressed layer of high AN concentration

¹ Support by U.S. Navy Contract ONR N00014-75-C-0413.

² Support by U.S. Dept. of Trans. Interagency Agreement with U.S. Energy Res. and Dev. Agency DOT-AS-20055/AT (29-2)-3139.

³ Support by U.S. Dept. of Trans.—Transportation Systems Center Contract DOT-TSC-419.

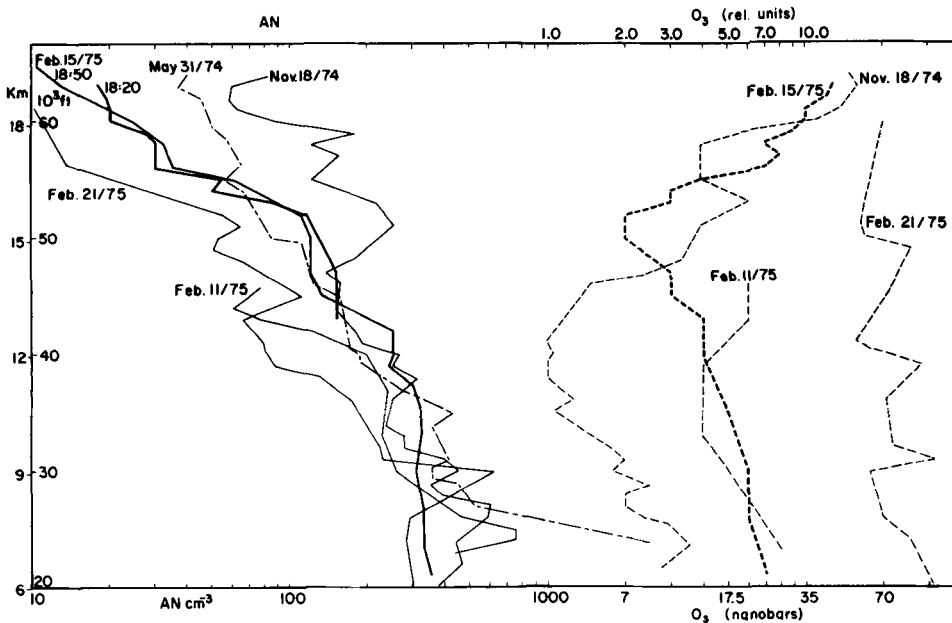


Fig. 1. AN concentration vertical profiles above Albuquerque (May 31, 1974), above Houston (November 18, 1974; February 11 and 21, 1975), and above Panama (February 15, 1975) with the corresponding ozone concentration profiles (in relative and absolute units). Two flights were performed above Panama on February 15: one at 18:20 hrs. GMT and the other at 18:50 hrs. GMT.

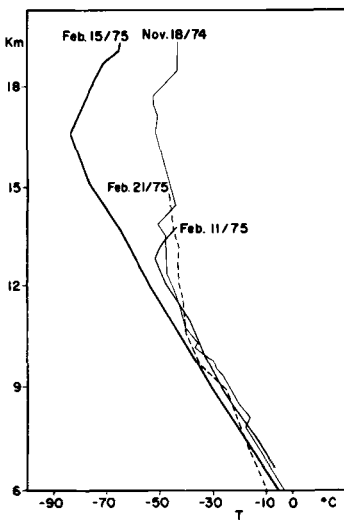


Fig. 2. The temperature vertical profiles corresponding to the aircraft ascents in Fig. 1.

was often located below the tropopause usually amounting to several hundred to one thousand nuclei per cm^3 . This layer was more conspicuous over middle geographical latitudes than over equatorial regions (Figs. 1 and 2).

Vertical AN concentration profiles above Houston and Albuquerque usually showed several polluted layers in the troposphere above 6 km, which was the level where the SANDS started to operate. Those layers were most probably related to local jet aircraft traffic. This was quite obvious above Houston (November 18, 1974, February 11 and 21, 1975). Qualitative proof of the strong influence of air traffic on the AN counts was given by the crew of the instrumented WB-57F which crossed the wake behind a jet aircraft several times. A sudden increase in AN concentrations in the wake was always found, often surpassing 20,000 AN cm^{-3} . On the May 22, 1974 flight a commercial jetway was repeatedly crossed at ascending altitude levels. Numerous increases in AN concentrations were observed where aircraft passage was indicated by FAA traffic controllers.

Aircraft ascents above Panama (February 15, 1975) were characterized by the smooth curve of AN concentrations and almost constant counts between 6 and 12 km altitude (Fig. 1). The AN concentration was approximately 300 AN cm^{-3} up to 12 km and then decreased steeply to 10 AN cm^{-3} at 19 km. This smooth decrease of AN

counts is typical of the lower stratosphere above the tropics and probably corresponds to a value of the vertical concentration gradient of 20 to 30 AN cm^3 per 1 km of altitude. This value was surpassed only during two aircraft ascents over middle latitudes at Albuquerque May 5 and 22, 1974. However, it was often very difficult to obtain a mean vertical gradient of AN concentrations when the curve indicated many polluted layers in the stratosphere over middle geographical latitudes.

Ozone measurements were taken during several ascents with the instrument of Dr J. Rosen from the University of Wyoming. The ozone-measuring instrument, designed by Dr J. Rosen, University of Wyoming, Laramie, and by Dr J. Kroening, University of Minnesota, Duluth, is based on the chemiluminiscent method. The absolute values of the ozone concentration are calculated from the relationship: 100 relative units correspond to 350 nanobars of ozone partial pressure at 25°C. However, the calculated absolute values should be regarded as a rough indication of the ozone concentration rather than an exact amount. There was no correction applied for outside temperature ($298^\circ\text{K}/T^\circ\text{K}$ — environment) and for the time lag of the instrument (which is not well known). Those two factors might change the ozone concentration even by several tens of percent, mainly during vertical ascents and descents. There is a strong indication that at altitudes above 17 km a negative correlation exists (in Fig. 1 the ascent at Houston, November 18, 1974, or at Panama, February 15, 1975). Ozone concentration is plotted in relative units (100 corresponds approximately to 350 nanobars of ozone pressure). No correlation between the two parameters was found just above the tropopause such as was claimed by several authors for larger particulates (i.e., Rosen et al., 1974).

Rough estimates of the size spectrum of the AN were made evaluating the number of charged nuclei deposited on the inner wall of a cylindrical condenser on which different voltages were imposed. The percentage of removed AN versus the applied voltage was converted into the number of AN of a certain size if one assumes a constant ratio of charged and uncharged particles (independent of altitude), the validity of Boltzmann law for the distribution of charges on different sizes of nuclei (Rich et al., 1959) and the applicability of a steady-flow formula for the calculation of the particle

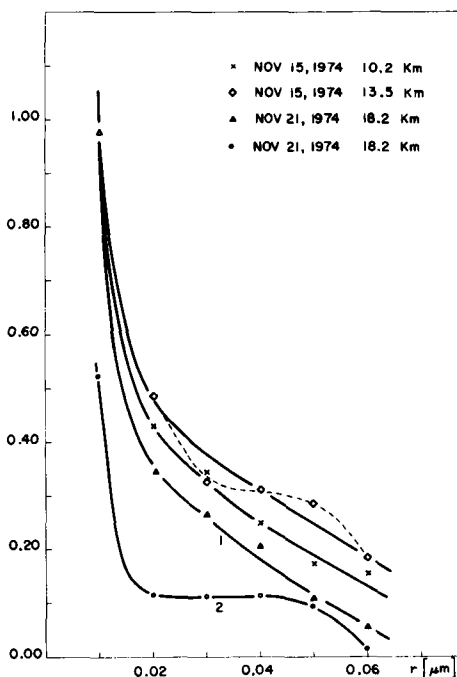


Fig. 3. Rough estimates of the size spectrum of the AN measured over Texas and over the Gulf of Mexico (November 15 and 21, 1974). 1.0 corresponds to the total number of particles.

deposition rate in the cylindrical condenser. The last assumption is not reality because the SANDS airflow pulsates as the valves reroute air during each cycle at a repetition rate of 2.5 samples per second. However, for comparison of the samples taken under the same conditions, the measured size distribution curves serve as an indication of the change in aerosol state.

In Fig. 3 four size distributions of AN are plotted from samples taken over Texas (November 15, 1974) and over the Gulf of Mexico (November 21, 1974) at different altitudes between 10.2 km and 18.2 km. Points on each curve represent the fraction of particles which are larger than a certain size. Unlike the AN size spectra of November 15, 1974, the spectrum of nuclei measured over the Gulf of Mexico showed a quite different character at the same altitude. The first curve (1) of November 21, 1974 sample was deduced from the measurement taken at the beginning of the horizontal flight (Fig. 7) where the aircraft has just climbed to 18.2 km. The second curve (2) is based on the measurement around 27°N latitude, where the

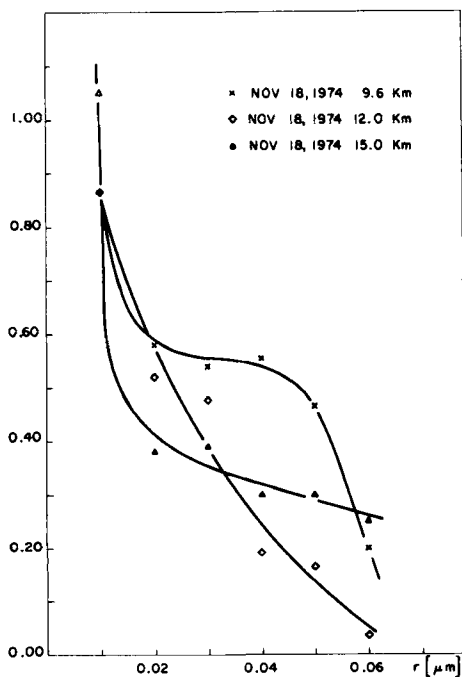


Fig. 4. Size spectrum measurements of the AN above Houston on November 18, 1974.

dramatic change in AN counts and in ozone concentration occurred. This change is apparently responsible for the different shape of the AN size distribution curve revealing a large portion of very small nuclei with radii smaller than $0.02 \mu\text{m}$.

The ascent of November 18, 1974, over Houston offers another example of the importance of AN size spectrum analysis (Fig. 4). In this ascent the layer type structure of the stratospheric AN concentration was accompanied by a different character of AN size distribution curves at different altitudes (Podzimek et al., 1975a). Explanation of the observed peculiarities in AN size spectra is made difficult by the possible influence of contaminants emitted into the stratosphere from the eruption of the Guatemalan volcano, Fuego, in October, 1975 (Podzimek et al., 1975a; Fujiwara et al., 1975).

In general, the evaluated size spectra of AN are not in disagreement with the hypothesis by Uchino & Hirono (1975) that the normal size distribution of AN in the stratosphere followed a power law. Exceptions are situations characterized by particle injection by volcanic eruptions or air exchange between higher and lower altitudes associated with

large frontal systems, jet streams or high mountains. This conclusion is in agreement with the findings of Briehl (1974).

Horizontal profiles of Aitken nuclei concentration

The main aim of the AN measurements at a certain altitude along a path often covering several thousands of kilometers was to check the spatial AN concentration distribution and its time variability. Special attention was paid to the influence of high mountainous masses, frontal systems and the air exchange over tropical regions on the AN distribution in the lower stratosphere and higher troposphere. From this point of view, the horizontal AN concentration profiles described in detail in the two mentioned reports (Podzimek et al., 1975a, and 1975b) will be summarized.

The flights over the Rocky Mountains, the mountainous part of New Mexico and over the Andes support the idea that turbulent exchange and gravity waves over high mountains are responsible for strong variations and increased average AN counts. These results have been recently supported by the measurements of AN near the tropopause by Cadle & Langer (1975). The horizontal flight of March 27, 1974, performed entirely in the stratosphere can document this statement. In Fig. 5 the altitude of the aircraft, the temperature at certain points of the aircraft path (T_p), the wind vectors at the aircraft path (W_p) and at the tropopause level (W_t), and Aitken nuclei counts ($N \text{ cm}^{-3}$) are plotted versus longitude ($^\circ \delta$). The aircraft flew almost exactly along 35°N latitude. On the bottom of Fig. 5 the altitudes of the highest mountains situated along the flight path within a strip of $\pm 25 \text{ km}$ are indicated. Those which were north of the path are shown with a dashed line and the mountains south of it with a solid line. The meteorological situation was characterized by very strong winds reaching almost 50 m sec^{-1} above Vandenberg, Winslow and Albuquerque at an altitude of 10 km. The first part of the flight was performed at an altitude of 16.5 km and the second around the 19.0 km level. The increase in AN counts over high California mountains such as Reyes Peak (2250 m) and Mt. Pinos (2650 m) is conspicuous. Even at an altitude of 19 km the AN concentration fluctuations very often surpass 50% of the mean value. This AN

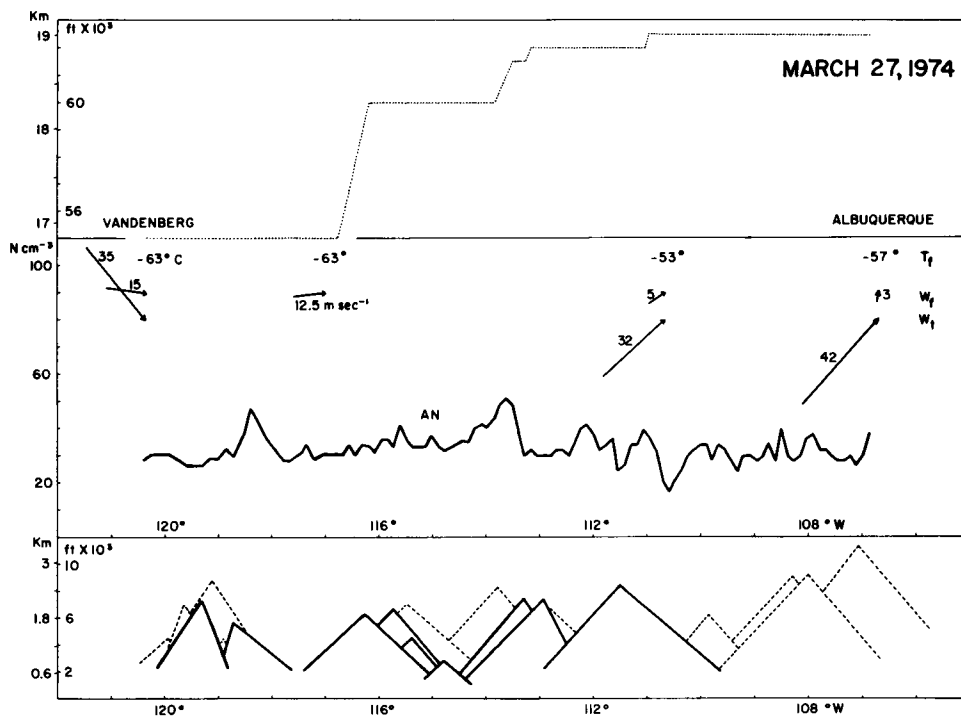


Fig. 5. Horizontal profile of AN concentrations from the flight between Vandenberg and Albuquerque, March 27, 1974.

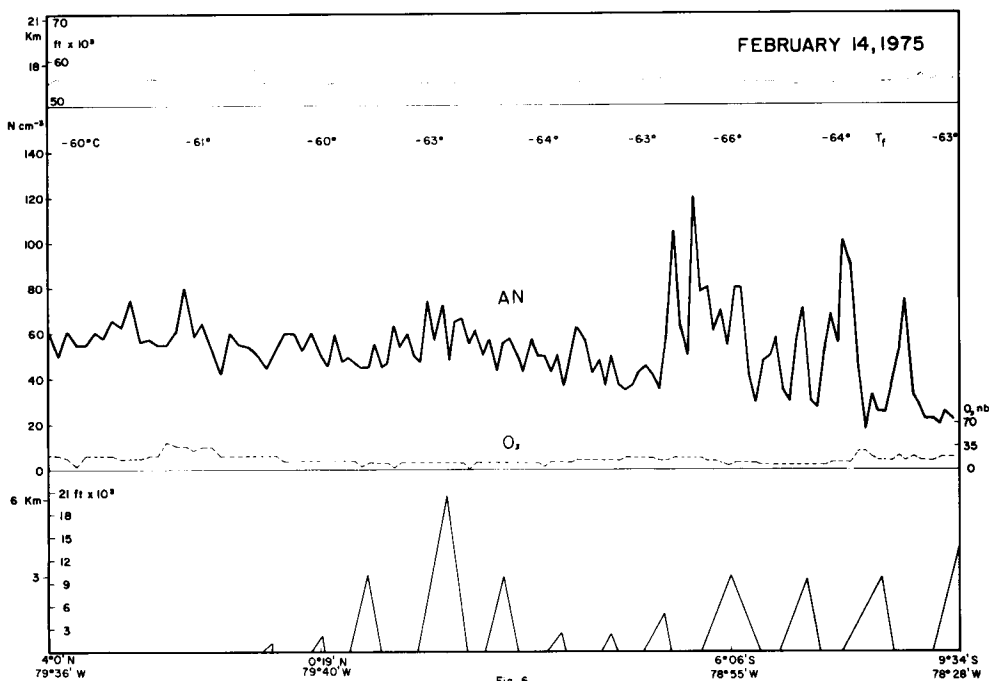


Fig. 6. Horizontal profile of AN and ozone concentrations from the flight across the equator on February 14, 1975.

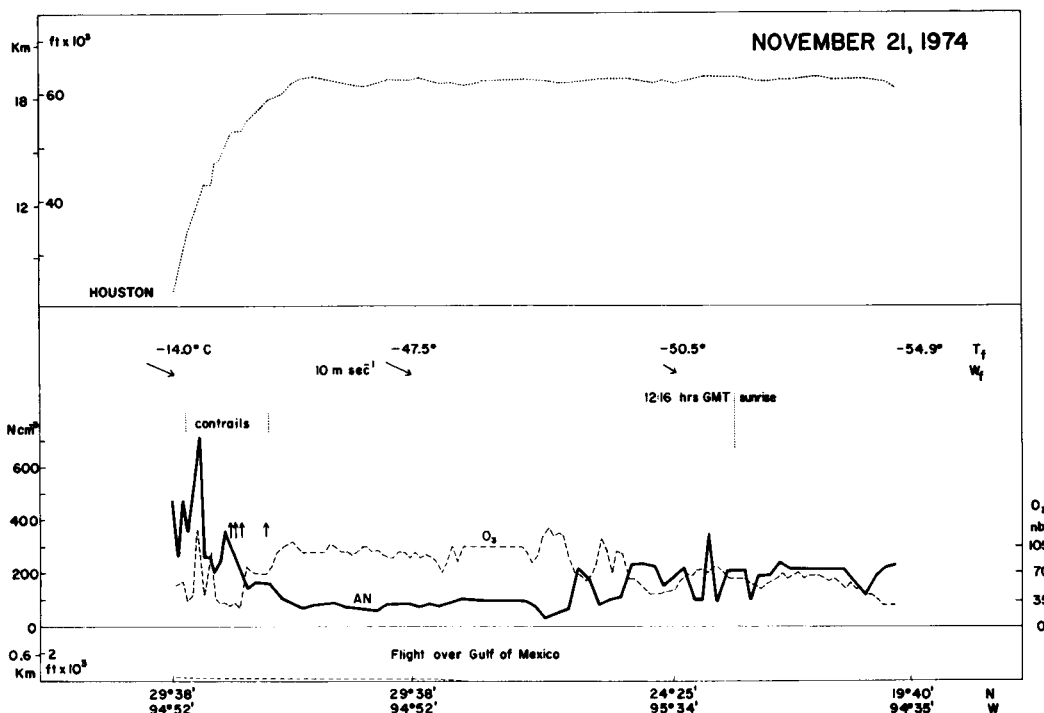


Fig. 7. Horizontal profile of AN and ozone concentrations during the flight over the Gulf of Mexico on November 21, 1974. The aircraft geographical location remained almost unchanged during the climb period.

concentration profile contrasts strongly with the flights over the flat plains of central Texas or over the Gulf of Mexico (Fig. 7).

The flights on April 10 and May 5, 1974, yielded a picture similar to the horizontal flight on March 27, 1974. The flight from central New Mexico to central Texas on May 5, 1974, however, was not quite as useful for checking the influence of high mountains because the aircraft changed altitude several times between 14 and 18 km. On the other hand, the flight over the Andes in Ecuador and Peru on February 14, 1975 (Fig. 6), is much more supportive of the idea of the injection of tropospheric nuclei into the stratosphere above high mountainous massives. The question of why the strong fluctuations of AN concentrations did not start over Ecuador where many of the peaks of mountains surpass 4.0 km remains unanswered. In order to explain this discrepancy, the existence of a secondary Intertropical Convergence Zone south of the equator (Podzimek et al., 1975b; Hubert et al., 1969) was hypothesized stretching from the Pacific Ocean through Peru to central Brazil. How-

ever, a better knowledge of the exact position of the airplane and of the meteorological parameters in the stratosphere over the Andes on this particular day would be necessary.

Two sunrise missions were performed on May 5, 1974, and on November 21, 1974 (Fig. 7). The measurements began at night and continued past sunrise into daylight. There was no indication that the solar radiation strongly influenced the AN counts in the stratosphere at an altitude around 18 km. Because both of the flights were above the tropopause, one cannot exclude the possibility of photochemically induced AN generation at the tropopause altitude (i.e., Friend et al., 1973).

The flight of November 21, 1974 (Fig. 7), was particularly interesting for two reasons: (1) the AN concentration at an altitude of 18 km showed a negative correlation with ozone concentration, and (2) the dramatic change of AN and ozone concentration around 27°N latitude can be related to the general model of stratospheric air circulation. Because of the higher AN concentrations in general and the finding of other authors, the influence of

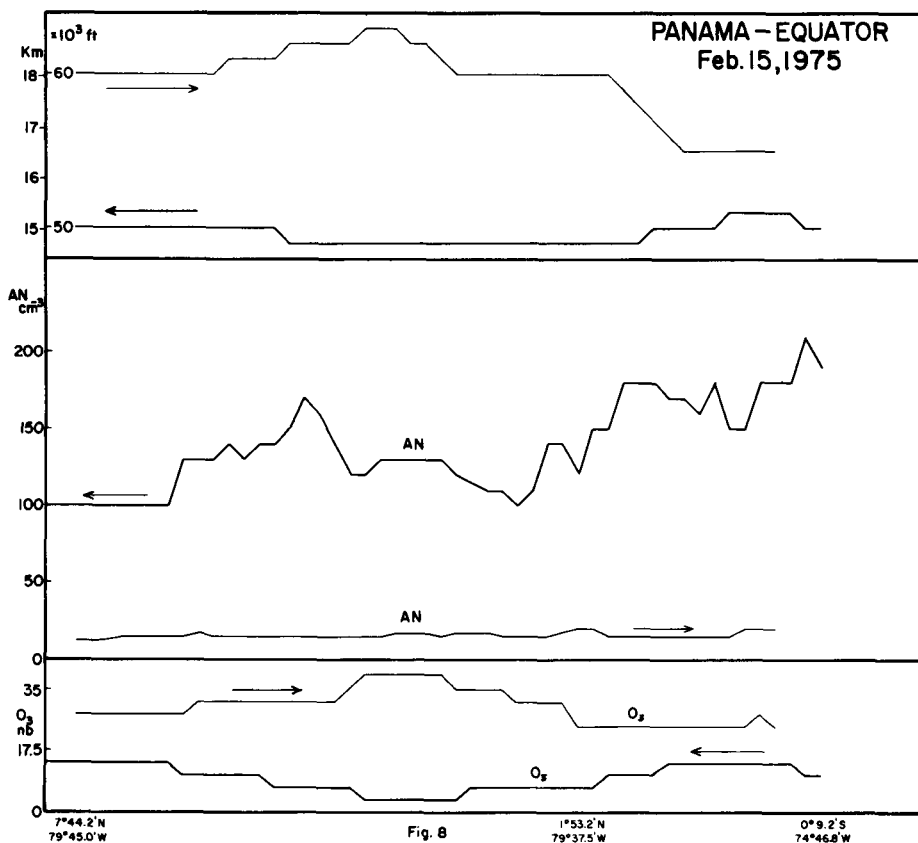


Fig. 8

Fig. 8. Horizontal profile of AN and ozone concentrations between Panama and Ecuador on February 15, 1975.

volcano Fuego activity was suggested (Podzimek et al., 1975a). Filters on this flight confirmed contact with sulfate aerosols from volcano Fuego at about 27° N latitude (Lazrus, 1975).

Fiocco & Grams (1964) found a negative correlation between ozone concentration and aerosol counts in the lower stratosphere. This finding, however, is not supported later by Hofmann et al. (1972) who found no correlation between ozone and aerosols. Little is known about the correlation of AN with ozone. Almost all the data from the flights on November 18 and 21, 1974, February 14, 15, and 21, 1975, support a negative correlation between AN counts and the ozone concentration when the aircraft flew higher than 17 km. The negative correlation was weaker on the February 21, 1975, high altitude portion of the flight when the aircraft flew from the Canadian border back to Houston. A separate article will deal with this topic

(Podzimek, 1976). The material presented here is not consistent with the finding by Schaefer (1973) of a positive correlation between ozone and AN in the subtropical and tropical atmosphere at an altitude of 39,000 ft (which was certainly below the tropopause) as a general rule. However, Schaefer's data on the polar flights were probably in the lower stratosphere most of the time, which may be a quite different case.

Another challenging problem seems to be the relationship between AN counts and the general circulation of the atmosphere, namely over subtropical and tropical regions. This subject has been investigated in the past for larger particulates by several investigators mainly in connection with the formation of Junge's layer and in explaining the origin and exchange of stratospheric aerosols (Junge & Manson, 1961; Ivlev, 1967; Pilipowskyj & Weinman, 1971; Blifford, 1971; Cadle, 1972;

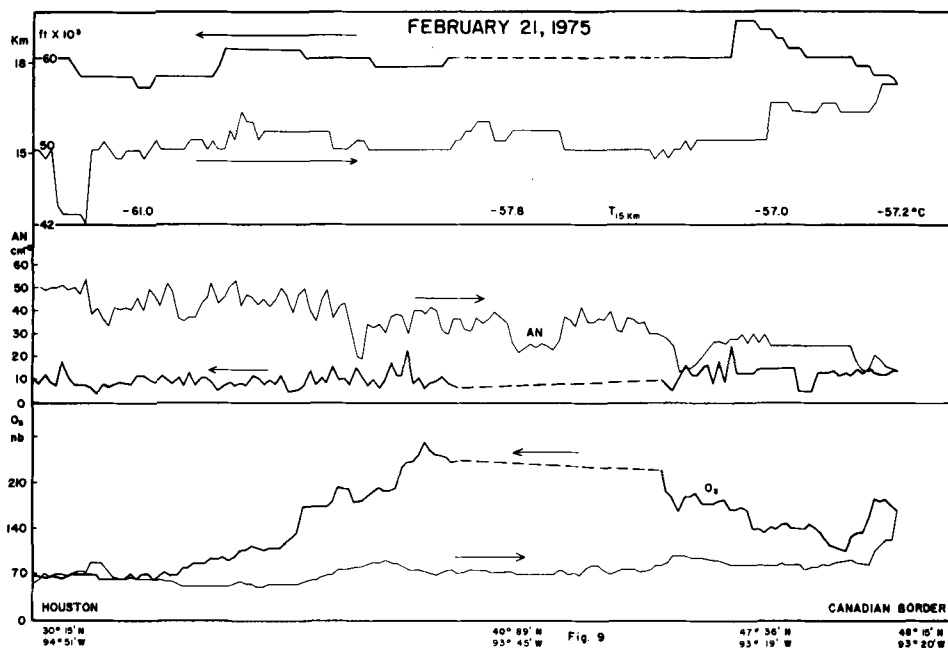


Fig. 9. Horizontal profile of AN and ozone concentrations during the flight from Houston to the Canadian border and back on February 21, 1975.

Friend et al., 1973; Hofmann et al., 1974; Rosen et al., 1974). AN counts were not directly included in most of the models because of the lack of data mainly from the tropical and polar atmosphere.

Several conclusions can be deduced from the AN measurements during the horizontal flights. Above the tropical tropopause the AN concentrations remained low and rarely surpassed 20 AN cm^{-3} at 18 km. Slightly higher counts were found in the lower stratosphere above subtropical regions (flights on February 13 and 15, 1975) and in the middle latitudes (February 21, 1975—Fig. 9) at the same altitude. The flight of February 14, 1975, from Panama to Peru showed a different profile of AN concentration (Fig. 6). The AN counts fluctuated considerably around 50 AN cm^{-3} with a sudden increase in counts and amplitude over the mountainous massives in Peru. This broad band of higher AN concentrations (greater than 80 AN cm^{-3}) extended from 5°S to 9°S latitude. Because the flight was performed near the 17 km altitude, a possible explanation is that it entered the tropical troposphere in at least a part of its path. Besides this, the counts were certainly influenced by the air exchange above the peaks of the Andes. During all

flights in the tropical stratosphere (up to 19 km), the ozone concentration was low and scarcely surpassed the relative value of 10 (corresponding approximately to 35 nanobars of partial pressure).

The flight on February 15, 1975 (Fig. 8), was designed to study in more detail the mechanism of AN exchange in the Intertropical Convergence Zone (ITCZ). It was performed at two different levels: above 18 km from Panama toward the equator and around 15 km on the return flight. Along the path above 18 km, the AN counts were consistently low (between 10 to 20 AN cm^{-3}).

Ozone concentration surpassed the value of 10 units on our relative scale only during the highest part of the flight. On the flight back, the AN concentration fluctuated strongly above 100 AN cm^{-3} , surpassing the level of 150 cm^{-3} above the position of ITCZ and of 200 AN cm^{-3} above the high mountains in Ecuador. The AN increase above the ITCZ was very noticeable and was easily identified using the ESSA satellite's cloud pictures.

The last flight of this series was performed on February 21, 1975, northward of Houston to the Canadian border and back (Fig. 9) for the purpose of checking the distribution of AN as on the

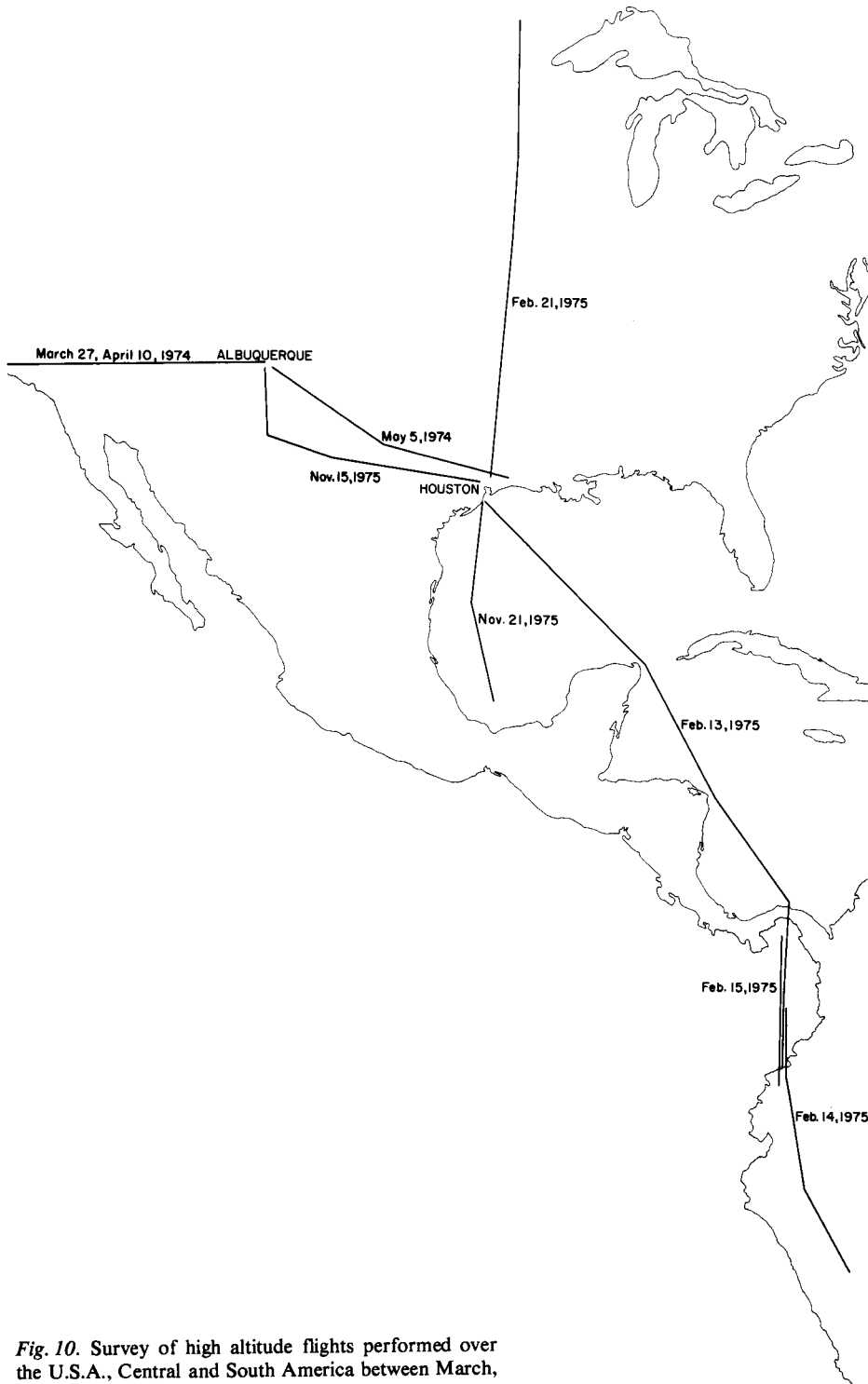


Fig. 10. Survey of high altitude flights performed over the U.S.A., Central and South America between March, 1974, and February, 1975.

February 15, 1975, flight. However, in this specific case, both flights at 18 km and 15 km altitude were performed above the tropopause. The lower flight level was characterized by higher AN counts above the Houston area (50 AN cm^{-3}) and gradually decreasing AN concentration toward the north (20 to 30 AN cm^{-3}). On the flight back AN concentrations remained almost at the same value and fluctuated between 7 and 30 AN cm^{-3} . There is an indication that the low AN counts in the middle latitudes correspond to the high ozone concentration (above 70 relative units, what corresponds approximately to 245 nanobars of partial pressure). Unfortunately, a part of this flight could not be recorded due to limitations on the available data-recording system, hence the missing data between 39°N and 44°N latitude. In general, the ozone concentration was higher at 18 km on the north than on the south of the aircraft path.

Conclusions

The AN concentrations measured by the SANDS in the lower stratosphere over the U.S.A., Central and South America between March 1974 and February 1975 (Fig. 10) can be characterized in the following way:

(1) The vertical profiles are very similar to those found by Junge and his fellow workers (1961) with the exception that at altitudes above 17 km the data presented in this report are of one or two orders of magnitude higher. Also, compared with AN measurements made recently by Rosen et al. (1974) in the U.S.A. and by Käselau et al. (1974) in Germany with balloon-borne AN counters, the data presented in this work are slightly higher for altitudes above 15 km. (The SANDS supersaturation is $\approx 230\%$ compared to $\approx 10\%$ for Rosen's instrument. Hence some very small particles are observed which Rosen's instrument may not sense.) At 18 km AN counts in the tropical and middle latitude stratosphere were around 20 AN cm^{-3} , however, several times they reached almost 70 AN cm^{-3} , mainly over middle latitudes (March 5, 1974; May 22, 1974; November 18, 1974). Usually one can find high concentrations of AN just below the tropopause surpassing 500 AN cm^{-3} and a steep decrease in AN counts above it. AN concentrations greater than 1000 AN cm^{-3} confined to a

relatively thin layer were found in areas with heavy air traffic in the upper troposphere.

(2) The tropopause represents an efficient barrier to the penetration of tropospheric AN into the stratosphere. This was documented mainly on the horizontal AN concentration profiles above and below the tropical and subtropical tropopause. There is an indication of a higher concentration of AN below the tropical tropopause (more than 100 AN cm^{-3}), and of very little transport of AN through it by the Hadley cell circulation.

(3) High mountainous masses act to stimulate air exchange up to the altitudes greater than 18 km over the Rocky Mountains and the Andes.

(4) No noticeable difference was found between the stratospheric AN counts taken before and after sunrise.

(5) Most of the AN concentration measurements above 16.5 km show a negative correlation with ozone on the flights reported here. Only the flight on February 14, 1975, yielded a slightly positive correlation. This particular flight was characterized by very low ozone counts and was performed at an altitude around 17 km, which was apparently at the tropopause level. At altitudes lower than 16.5 km there was no correlation between AN and concentrations which could be characterized by a widely prevailing sign. High ozone concentrations on February 21, 1975, measured over middle latitudes at an altitude of 18 km are not paralleled by the low AN counts corresponding to a supposed perfect negative correlation.

This report is a presentation of rough data accompanied by observations on some interesting peculiarities of the stratospheric AN. It cannot answer many questions which must wait until more data are gathered and analyzed. However, it can contribute, together with other reports on AN and aerosol measurements in the atmosphere, to a more complex interpretation, better understanding and verification of many existing theoretical models.

Acknowledgment

The authors are indebted to Dr S. C. Coroniti from the U.S. Department of Transportation and to Mr P. Guthals from the Los Alamos Scientific Laboratories for their support in this work which required a wide cooperation of the staff of the

U.S.A.F. 58th Weather Reconnaissance Squadron and of the NASA Johnson Space Center, Houston. Also very gratefully acknowledged is the technical assistance of Mrs S. Shults, Miss E. Podzimek, Mr

J. Wegrzyn, Mr R. Elliott, M. D. Shay, and G. Hamilton from the Graduate Center for Cloud Physics Research, University of Missouri-Rolla, Rolla, Missouri.

REFERENCES

- Blifford, I. H., Jr 1971. Global aerosol model. Particulate models: their validity and application. NCAR—TN/Proc.—68, Boulder, Aug. 61–65.
- Briehl, D. 1974. In situ measurement on particulate number density and size distribution from an aircraft. NASA Tech. Memo., X-71577, Lewis Res. Center, Cleveland, July.
- Cadle, R. D. 1972. Composition of the stratospheric "sulfate" layer. CIAP Sympos., DOT, Cambridge, Febr. 15 and 16.
- Cadle, R. D. & Langer, G. 1975. Stratospheric Aitken particles near the tropopause. *Geophys. Res. Lett.* 2, 329–332.
- Friend, J. P., Leifer, R. & Trichon, M. 1973. On the formation of stratospheric aerosols. *J. Atmos. Sci.* 30, 465–479.
- Fujiwara, M., Itabe, T. & Hirono, M. 1975. Sudden increase of stratospheric aerosol content after the eruption of Fuego volcano; Lidar observations in Fukuoka. *Rep. on Ionosphere and Space Research in Japan* 29, 74–78.
- Haberl, J. B. 1975. Stratospheric Aitken nuclei counter. *Rev. Sci. Instrum.* 46, 443–447.
- Hofmann, D. J., Rosen J. M. & Pepin, T. J. 1974. Stratospheric aerosol measurements I: Time variations at northern midlatitudes. Rep. GM-21, Univ. of Wyoming, Laramie, Aug.
- Ivlev, L. S. 1967. K voprosu o roli mekhanizmov raspredelenia i istochnikov atmosfernogo aerizolija. *Problemy fiziki atmosfery, Leningrad* 5, 240–244.
- Junge, Ch. E. & Manson, J. E. 1961. Stratospheric aerosol studies. *J. Geophys. Res.* 66, 2163–2182.
- Junge, Ch. E., Chagnon, Ch. W. & Manson, J. E. 1961. Stratospheric aerosols. *J. Met.* 18, 81–108.
- Käselau, K. H., Fabian, P. & Röhrs, H. 1974. Measurements of aerosol concentration up to a height of 27 km. *Pure and Appl. Geophys.* 112/6, 877–885.
- Lazrus, L. 1975. private communication.
- Pilipovskij, S. & Weinman, J. 1971. *Global distribution of stratospheric aerosols as derived from balloon-borne infrared flux measurements, particulate models: their validity and application*, Ed. I. H. Blifford, Jr. NCAR—TN/Proc.—68, Boulder, Aug., 227–236.
- Podzimek, J. 1976. Peculiarities in the pollution of the lower stratosphere as indicated by the Aitken nuclei measurements. *Proc. Missouri Academy of Science*, Rolla, April 23.
- Podzimek, J., Sedlacek, W. A. & Haberl, J. B. 1975a. Aircraft measurements of Aitken nuclei in the lower stratosphere. Tech. Rep. GCCPR—Univ. of Missouri—Rolla, April 24.
- Podzimek, J., Sedlacek, W. A. & Haberl, J. B. 1975b. Peculiarities in Aitken nuclei counts in the tropical and subtropical stratosphere. Tech. Rep. GCCPR—Univ. of Missouri—Rolla, Nov. 27.
- Rich, T. A., Pollak, L. W. & Metnieks, A. L. 1959. Estimation of average size of submicron particles from the number of all and uncharged particles. *Geofis. Pura e Appl.* 44, 233–241.
- Rosen, J. M. & Hofmann, D. J. 1974. Recent measurements of condensation nuclei from ground level to 25 km. Rep. No. CN-2, Univ. of Wyoming, Laramie, Aug.
- Rosen, J. M., Hofmann, D. J. & Laby, J. 1974. Stratospheric aerosol measurements II: The worldwide distribution. Rep. No. GM-22, Univ. of Wyoming, Laramie, Aug.
- Schaefer, V. J. 1973. High concentrations of condensation nuclei in the lower stratosphere. *J. Rech. Atmos.* 7, 161–165.
- Uchino, O. & Hirono, M. 1975. On stratospheric aerosol size distributions from recent optical radar observations. *Rep. on Ionosphere and Space Research in Japan* 29, 69–73.
- Wegrzyn, J. E. & Podzimek, J. 1975. Calibration of the Stratospheric Aitken Nuclei Detection System (SANDS). Tech. Rep. GCCPR—Univ. of Missouri—Rolla, March 19.

ИЗМЕРЕНИЕ АИТКЕНОВЫХ ЯДЕР В НИЖНЕЙ СТРАТОСФЕРЕ

Для измерения Аиткеновых ядер (АН) на высоте от 6 км до 19 км был использован новый стратосферический счётчик (SANDS), который был помещён в носовой части самолёта WB-57F. Измерение было произведено в диапазоне географической широты между 48°И и 9°S над

территорией USA, средней и южной Америки от марта 1974 до февраля 1975.

Оценка данных из 18 полётов показала, что вертикальный профиль АН концентрации похож на вертикальный профиль, который получил Юнге (1961). Разница была только на высотах

больших чем 17 км, где концентрация AN см^{-3} была несколько десятков больше. Горизонтальные полёты показали низкую AN концентрацию на высоте больше чем 18 км в тропической области и влияние Rocky Mountains и Andes на AN

измерение на высотах 18 км. Обыкновенно несколько км над тропопаузой была получена негативная корреляция между AN и концентрацией озона.