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# A REAGENT FOR THE SIMULTANEOUS MICROSCOPIC DETERMINATION OF QUARTZ AND HALIDES

By  
Henry Nusbaum

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**ATMOSPHERIC SCIENCES LABORATORY**  
WHITE SANDS MISSILE RANGE, NEW MEXICO

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## ABSTRACT

A reagent has been discovered whereby the techniques of dispersion staining microscopy and spot testing may be combined to distinguish halite from quartz in samples of atmospheric dust. The preparation of the reagent and its application are discussed.

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## INTRODUCTION

In a previous study of the mineral composition of dust in the atmospheric aerosol over White Sands Missile Range (WSMR), New Mexico (Hoidale et al., 1966), quartz was one of several minerals color identified by dispersion staining microscopy. With this method, halite could have been identified as quartz because halite is an optically isotropic mineral having the same refractive index (1.544) as the omega index of quartz. If significant quantities of halite are present in the local dust samples, the differentiation between quartz and halite becomes important in dispersion staining assays of quartz concentration (Hoidale et al., 1966).

In the earlier study (Hoidale et al., 1966) quartz was identified using ethynylbenzene as the immersion fluid. The quartz was distinguished from halite through use of polarized light, but it became obvious that as the particle diameter reached a lower limit of four to five microns, differentiation between the two minerals by dispersion staining microscopy became difficult. Therefore, an immersion fluid was sought which would unequivocally identify quartz to the exclusion of halite. A technique evolved which combines spot testing with dispersion staining whereby a single reagent may be used to eliminate halite from the quartz count by imparting to the soluble halides a characteristic "cocklebur" appearance. Also, this reagent permits a combined count of these halides and an indirect determination of the amount of halite present.

This report discusses the preparation of the reagent and the method of application to be followed in processing a dust sample.

## REAGENT COMPONENTS

The following factors are necessary for the identification of quartz by dispersion staining microscopy:

- a) An immersion fluid having the same refractive index at the sodium D line ( $n_D$ ,  $D = 589.3 \text{ m}\mu$ ) as quartz (1.544) and

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a larger dispersion ( $n_F - n_C$ ), where  $F = 486.1 \text{ m}\mu$  and  $C = 656.3 \text{ m}\mu$ .

b) An absence of other minerals having a refractive index equal to that of quartz.

The reagent having the desired refractive index, dispersion, and stability is a solution of ethyl salicylate, phenol, 1-bromonaphthalene, and mercurous perchlorate. This solution will be referred to here as the "4BR reagent". The function of each component is:

ETHYL SALICYLATE: This liquid ( $n_D = 1.5251^{20}$ ) is the main solvent. It is used to dissolve the solid phenol and bring the original refractive index slightly below 1.54.

PHENOL: In an ethyl salicylate solution, the polar molecules of phenol ( $n_D = 1.5509^{21}$ ) are able to dissolve mercurous perchlorate,  $\text{Hg}_2(\text{ClO}_4)_2$ , but not the halides. The small amount of water absorbed by the phenol from the air probably dampens the surface of the halite particles; this dampening may be necessary for the spot test reaction. This, however, has not been proved.

1-BROMONAPHTHALENE: 1-bromonaphthalene ( $n_D = 1.6588^{19}$ ) is added to adjust the refractive index to 1.544.

MERCUROUS PERCHLORATE: The mercurous ion,  $\text{Hg}_2^{++}$ , reacts with the halide ions to form insoluble mercurous halides. The mercurous reagent was chosen because it is more stable than other insoluble halide-forming ions. The perchlorate salt was selected for its high solubility (368 g/100 cm<sup>3</sup> water at 20<sup>o</sup> C) and good stability.

#### 4BR PREPARATION

The 4BR reagent was prepared by the following method.

Approximately 3 ml (2g) of phenol crystals were poured into a test tube, then enough ethyl salicylate was added to cover 3/4 of these. When the phenol was nearly dissolved, about 10 mg of dried mercurous perchlorate was added.

The addition of mercurous perchlorate (prepared by the method described later) caused the phenol in the solution to turn a medium yellow. This may have been caused by the small trace of mercuric ion that is always present in mercurous compounds.

After the mercurous perchlorate had nearly dissolved, a few drops of 1-bromonaphthalene were added. This appeared to stop the color-forming reaction. After the last of the phenol had dissolved, enough 1-bromonaphthalene was added to adjust the refractive index to 1.544 as read on a Bausch and Lomb "Abbe-3L" Refractometer. From readings obtained on this instrument, the dispersion was calculated to be 0.028 at 25° C.

#### 4BR STABILITY

This reagent, stored in a tightly stoppered green dropping bottle, retained its original optical and chemical properties for more than a month. Various factors influenced this stability, but the decomposition mechanisms were not investigated. The deterioration of the reagent was indicated in all cases by loss of the yellow color and the formation of a gray precipitate on the bottom of the bottle.

Exposure to light and air caused the reagent to decompose in a few hours. It was apparent that the  $\text{Hg}_2(\text{ClO}_4)_2$  must be free of the mercuric and carbonate impurities which could result from its exposure to air.

Solutions containing 75 percent by weight or more phenol were found to have the best stability and to produce the best spot tests.

#### 4BR APPLICATION

For the microscopic determination of quartz, a small amount of the dust sample is placed on a slide and covered with a drop of 4BR with a cover glass placed over it. The slide is then allowed to "develop" for 20 minutes. Very little if any change was noticed on slides "developed" from approximately 20 minutes to 20 hours.

After the 20 minutes, the quartz exhibited the characteristic sky-blue color with a red-orange halo when viewed with a positive phase contrast microscope. Halite and the other halides appear as light brown "cockleburrs" - a central particle from which dozens of long brown "whiskers" or "needles" are growing. Soluble sulfates take on the appearance of a central particle surrounded by black "bushes" of  $Hg_2SO_4$ . Insoluble halides, sulfates, and other minerals produce no reaction.

It was hoped that by dilution of one or more of the reagent's components, very few whiskers would grow, leaving the halite as blue particles with a few protruding needles. Unfortunately, all attempts to reduce the phenol concentration resulted in an unstable solution, while reducing the mercurous perchlorate concentration caused the needles to break loose from the particles.

Halite concentration can be indirectly determined by subtraction if it is assumed that the mineral concentrations are uniform for the total individual sample collected. This is accomplished by counting one slide, as previously described, then counting a second slide using ethynylbenzene as the immersion fluid. With ethynylbenzene, both quartz and halite appear sky-blue with a red-orange halo. The number of counts from the ethynylbenzene slide minus the quartz count determined with the 4BR reagent would, therefore, be the halite count.

#### PREPARATION OF MERCUROUS PERCHLORATE

Since mercurous perchlorate is not commercially available, an electrolytic preparation was used.

In subdued light, approximately 30 ml of mercury and 60 ml of .5M  $Na_2CO_3$  were placed in a 100 ml beaker. Teflon insulated wire was run through the solution to the bottom of the mercury (anode) and a stainless steel cathode placed in the sodium carbonate. A potential of 1.9 volts was applied for five hours while the cell was being agitated on an oscillating plate. This agitation was continued for thirty minutes after the current was turned off to let the mercury reduce any mercuric ions which may have been formed.



Next, the cathode was removed and the carbonate solution pipetted off. The yellow-brown mercurous carbonate and a small amount of mercury were scooped out and washed with two 50 ml portions of distilled water. Then, most of the mercurous carbonate was titrated with .6N perchloric acid to form a mercurous perchlorate solution. The excess carbonate eliminated the possibility of having perchloric acid in the product, while the mercury again reduced any mercuric ion formed.

The mercurous perchlorate solution, withdrawn with a pipette, was boiled with a Teflon boiling chip and dried at 90° C in a vacuum oven. The solid  $\text{Hg}_2(\text{ClO}_4)_2$  was stored in a tightly capped green bottle. For long storage periods, it is probably best to flush the bottle and crystals with a dry, inert gas before sealing to prevent oxidation and reaction with atmospheric carbon dioxide.

The product was dissolved in distilled water and precipitated with sodium chloride solution to form calomel for quality checking. Sodium carbonate solution was added to the remaining liquid as a test for mercuric ion. No red-brown precipitate (mercuric carbonate) was formed. An additional check for the purity of the mercurous perchlorate crystals was made by running an infrared absorption spectrum on a Perkin-Elmer 521 infrared spectrophotometer using the potassium bromide-pellet technique. There was no indication of decomposition of the perchlorate or presence of carbonate or bicarbonate ions.

#### POSSIBILITIES FOR FURTHER RESEARCH

It is hoped that the technique may be expanded to include the identification of the various halide and sulfate condensation nuclei, since the "whiskers" formed by the 4BR reagent are many times the radius of the particle. Possibly the addition of an absorption indicator to the 4BR reagent will give distinctive appearances to the whiskers formed on the halide and sulfate nuclei. Fluorescein, Congo red, bromophenol-blue, and 3', 3'', 5', 5''-tetrabromophenolsulfonaphthalein were tried but did not accomplish this. Perhaps raising the pH of the 4BR reagent, possibly with sodium or potassium phenoxide, would have permitted them to differentiate the individual halides, but time did not permit this experiment.

## CONCLUSION

The use of 4BR improves the accuracy and ease of counting quartz particles in samples of atmospheric dust by excluding halite from the count. The reagent obviates polarized light and rotation of the microscope stage in distinguishing halite from quartz. The differentiation of these two minerals by dispersion staining microscopy is a problem with the smaller particles.

The simultaneous determination of submicron particles of quartz, halite, other soluble chlorides, soluble fluorides, soluble bromides, soluble iodides, and soluble sulfates may be possible by modifying the composition of the reagent. Such a modification will require more extensive research.

## REFERENCE

Hoidale, G. B., S. M. Smith, G. F. Riedmuller, and T. L. Barber, 1966: A study of atmospheric dust, Atmospheric Sciences Laboratory, U. S. Army Electronics Command, White Sands Missile Range, New Mexico (In Press).

## ATMOSPHERIC SCIENCES RESEARCH PAPERS

1. Webb, W.L., "Development of Droplet Size Distributions in the Atmosphere," June 1954.
2. Hansen, F. V., and H. Rachele, "Wind Structure Analysis and Forecasting Methods for Rockets," June 1954.
3. Webb, W. L., "Net Electrification of Water Droplets at the Earth's Surface," *J. Meteorol.*, December 1954.
4. Mitchell, R., "The Determination of Non-Ballistic Projectile Trajectories," March 1955.
5. Webb, W. L., and A. McPike, "Sound Ranging Technique for Determining the Trajectory of Supersonic Missiles," #1, March 1955.
6. Mitchell, R., and W. L. Webb, "Electromagnetic Radiation through the Atmosphere," #1, April 1955.
7. Webb, W. L., A. McPike, and H. Thompson, "Sound Ranging Technique for Determining the Trajectory of Supersonic Missiles," #2, July 1955.
8. Barichivich, A., "Meteorological Effects on the Refractive Index and Curvature of Microwaves in the Atmosphere," August 1955.
9. Webb, W. L., A. McPike and H. Thompson, "Sound Ranging Technique for Determining the Trajectory of Supersonic Missiles," #3, September 1955.
10. Mitchell, R., "Notes on the Theory of Longitudinal Wave Motion in the Atmosphere," February 1956.
11. Webb, W. L., "Particulate Counts in Natural Clouds," *J. Meteorol.*, April 1956.
12. Webb, W. L., "Wind Effect on the Aerobee," #1, May 1956.
13. Rachele, H., and L. Anderson, "Wind Effect on the Aerobee," #2, August 1956.
14. Beyers, N., "Electromagnetic Radiation through the Atmosphere," #2, January 1957.
15. Hansen, F. V., "Wind Effect on the Aerobee," #3, January 1957.
16. Kershner, J., and H. Bear, "Wind Effect on the Aerobee," #4, January 1957.
17. Hoidale, G., "Electromagnetic Radiation through the Atmosphere," #3, February 1957.
18. Querfeld, C. W., "The Index of Refraction of the Atmosphere for 2.2 Micron Radiation," March 1957.
19. White, Lloyd, "Wind Effect on the Aerobee," #5, March 1957.
20. Kershner, J. G., "Development of a Method for Forecasting Component Ballistic Wind," August 1957.
21. Layton, Ivan, "Atmospheric Particle Size Distribution," December 1957.
22. Rachele, Henry and W. H. Hatch, "Wind Effect on the Aerobee," #6, February 1958.
23. Beyers, N. J., "Electromagnetic Radiation through the Atmosphere," #4, March 1958.
24. Prosser, Shirley J., "Electromagnetic Radiation through the Atmosphere," #5, April 1958.
25. Armendariz, M., and P. H. Taft, "Double Theodolite Ballistic Wind Computations," June 1958.
26. Jenkins, K. R. and W. L. Webb, "Rocket Wind Measurements," June 1958.
27. Jenkins, K. R., "Measurement of High Altitude Winds with Loki," July 1958.
28. Hoidale, G., "Electromagnetic Propagation through the Atmosphere," #6, February 1959.
29. McLardie, M., R. Helvey, and L. Traylor, "Low-Level Wind Profile Prediction Techniques," #1, June 1959.
30. Lamberth, Roy, "Gustiness at White Sands Missile Range," #1, May 1959.
31. Beyers, N. J., B. Hinds, and G. Hoidale, "Electromagnetic Propagation through the Atmosphere," #7, June 1959.
32. Beyers, N. J., "Radar Refraction at Low Elevation Angles (U)," Proceedings of the Army Science Conference, June 1959.
33. White, L., O. W. Thiele and P. H. Taft, "Summary of Ballistic and Meteorological Support During IGY Operations at Fort Churchill, Canada," August 1959.
34. Hainline, D. A., "Drag Cord-Aerovane Equation Analysis for Computer Application," August 1959.
35. Hoidale, G. B., "Slope-Valley Wind at WSMR," October 1959.
36. Webb, W. L., and K. R. Jenkins, "High Altitude Wind Measurements," *J. Meteorol.*, 16, 5, October 1959.

37. White, Lloyd, "Wind Effect on the Aerobee," #9, October 1959.
38. Webb, W. L., J. W. Coffman, and G. Q. Clark, "A High Altitude Acoustic Sensing System," December 1959.
39. Webb, W. L., and K. R. Jenkins, "Application of Meteorological Rocket Systems," *J. Geophys. Res.*, 64, 11, November 1959.
40. Duncan, Louis, "Wind Effect on the Aerobee," #10, February 1960.
41. Helvey, R. A., "Low-Level Wind Profile Prediction Techniques," #2, February 1960.
42. Webb, W. L., and K. R. Jenkins, "Rocket Sounding of High-Altitude Parameters," *Proc. GM Rel. Symp.*, Dept. of Defense, February 1960.
43. Armendariz, M., and H. H. Monahan, "A Comparison Between the Double Theodolite and Single-Theodolite Wind Measuring Systems," April 1960.
44. Jenkins, K. R., and P. H. Taft, "Weather Elements in the Tularosa Basin," July 1960.
45. Beyers, N. J., "Preliminary Radar Performance Data on Passive Rocket-Borne Wind Sensors," *IRE TRANS, MIL ELECT, MIL-4*, 2-3, April-July 1960.
46. Webb, W. L., and K. R. Jenkins, "Speed of Sound in the Stratosphere," June 1960.
47. Webb, W. L., K. R. Jenkins, and G. Q. Clark, "Rocket Sounding of High Atmosphere Meteorological Parameters," *IRE Trans. Mil. Elect.*, MIL-4, 2-3, April-July 1960.
48. Helvey, R. A., "Low-Level Wind Profile Prediction Techniques," #3, September 1960.
49. Beyers, N. J., and O. W. Thiele, "Meteorological Wind Sensors," August 1960.
50. Armijo, Larry, "Determination of Trajectories Using Range Data from Three Non-colinear Radar Stations," September 1960.
51. Carnes, Patsy Sue, "Temperature Variations in the First 200 Feet of the Atmosphere in an Arid Region," July 1961.
52. Springer, H. S., and R. O. Olsen, "Launch Noise Distribution of Nike-Zeus Missiles," July 1961.
53. Thiele, O. W., "Density and Pressure Profiles Derived from Meteorological Rocket Measurements," September 1961.
54. Diamond, M. and A. B. Gray, "Accuracy of Missile Sound Ranging," November 1961.
55. Lamberth, R. L. and D. R. Veith, "Variability of Surface Wind in Short Distances," #1, October 1961.
56. Swanson, R. N., "Low-Level Wind Measurements for Ballistic Missile Application," January 1962.
57. Lamberth, R. L. and J. H. Grace, "Gustiness at White Sands Missile Range," #2, January 1962.
58. Swanson, R. N. and M. M. Hoidale, "Low-Level Wind Profile Prediction Techniques," #4, January 1962.
59. Rachele, Henry, "Surface Wind Model for Unguided Rockets Using Spectrum and Cross Spectrum Techniques," January 1962.
60. Rachele, Henry, "Sound Propagation through a Windy Atmosphere," #2, February 1962.
61. Webb, W. L., and K. R. Jenkins, "Sonic Structure of the Mesosphere," *J. Acous. Soc. Amer.*, 34, 2, February 1962.
62. Tourin, M. H. and M. M. Hoidale, "Low-Level Turbulence Characteristics at White Sands Missile Range," April 1962.
63. Miers, Bruce T., "Mesospheric Wind Reversal over White Sands Missile Range," March 1962.
64. Fisher, E., R. Lee and H. Rachele, "Meteorological Effects on an Acoustic Wave within a Sound Ranging Array," May 1962.
65. Walter, E. L., "Six Variable Ballistic Model for a Rocket," June 1962.
66. Webb, W. L., "Detailed Acoustic Structure Above the Tropopause," *J. Applied Meteorol.*, 1, 2, June 1962.
67. Jenkins, K. R., "Empirical Comparisons of Meteorological Rocket Wind Sensors," *J. Appl. Meteor.*, June 1962.
68. Lamberth, Roy, "Wind Variability Estimates as a Function of Sampling Interval," July 1962.
69. Rachele, Henry, "Surface Wind Sampling Periods for Unguided Rocket Impact Prediction," July 1962.
70. Traylor, Larry, "Coriolis Effects on the Aerobee-Hi Sounding Rocket," August 1962.
71. McCoy, J., and G. Q. Clark, "Meteorological Rocket Thermometry," August 1962.
72. Rachele, Henry, "Real-Time Prelaunch Impact Prediction System," August 1962.

73. Beyers, N. J., O. W. Thiele, and N. K. Wagner, "Performance Characteristics of Meteorological Rocket Wind and Temperature Sensors," October 1962.
74. Coffman, J., and R. Price, "Some Errors Associated with Acoustical Wind Measurements through a Layer," October 1962.
75. Armendariz, M., E. Fisher, and J. Serna, "Wind Shear in the Jet Stream at WS-MR," November 1962.
76. Armendariz, M., F. Hansen, and S. Carnes, "Wind Variability and its Effect on Rocket Impact Prediction," January 1963.
77. Querfeld, C., and Wayne Yunker, "Pure Rotational Spectrum of Water Vapor, I: Table of Line Parameters," February 1963.
78. Webb, W. L., "Acoustic Component of Turbulence," *J. Applied Meteorol.*, 2, 2, April 1963.
79. Beyers, N. and L. Engberg, "Seasonal Variability in the Upper Atmosphere," May 1963.
80. Williamson, L. E., "Atmospheric Acoustic Structure of the Sub-polar Fall," May 1963.
81. Lamberth, Roy and D. Veith, "Upper Wind Correlations in Southwestern United States," June 1963.
82. Sandlin, E., "An analysis of Wind Shear Differences as Measured by AN/FPS-16 Radar and AN/GMD-1B Rawinsonde," August 1963.
83. Diamond, M. and R. P. Lee, "Statistical Data on Atmospheric Design Properties Above 30 km," August 1963.
84. Thiele, O. W., "Mesospheric Density Variability Based on Recent Meteorological Rocket Measurements," *J. Applied Meteorol.*, 2, 5, October 1963.
85. Diamond, M., and O. Eesenwanger, "Statistical Data on Atmospheric Design Properties to 30 km," *Astro. Aero. Engr.*, December 1963.
86. Hansen, F. V., "Turbulence Characteristics of the First 62 Meters of the Atmosphere," December 1963.
87. Morris, J. E., and B. T. Miers, "Circulation Disturbances Between 25 and 70 kilometers Associated with the Sudden Warming of 1963," *J. of Geophys. Res.*, January 1964.
88. Thiele, O. W., "Some Observed Short Term and Diurnal Variations of Stratospheric Density Above 30 km," January 1964.
89. Sandlin, R. E., Jr. and E. Armijo, "An Analysis of AN/FPS-16 Radar and AN/GMD-1B Rawinsonde Data Differences," January 1964.
90. Miers, B. T., and N. J. Beyers, "Rocketsonde Wind and Temperature Measurements Between 30 and 70 km for Selected Stations," *J. Applied Meteorol.*, February 1964.
91. Webb, W. L., "The Dynamic Stratosphere," *Astronautics and Aerospace Engineering*, March 1964.
92. Low, R. D. H., "Acoustic Measurements of Wind through a Layer," March 1964.
93. Diamond, M., "Cross Wind Effect on Sound Propagation," *J. Applied Meteorol.*, April 1964.
94. Lee, R. P., "Acoustic Ray Tracing," April 1964.
95. Reynolds, R. D., "Investigation of the Effect of Lapse Rate on Balloon Ascent Rate," May 1964.
96. Webb, W. L., "Scale of Stratospheric Detail Structure," *Space Research V*, May 1964.
97. Barber, T. L., "Proposed X-Ray-Infrared Method for Identification of Atmospheric Mineral Dust," June 1964.
98. Thiele, O. W., "Ballistic Procedures for Unguided Rocket Studies of Nuclear Environments (U)," Proceedings of the Army Science Conference, June 1964.
99. Horn, J. D., and E. J. Trawle, "Orographic Effects on Wind Variability," July 1964.
100. Hoidale, G., C. Querfeld, T. Hall, and R. Mireles, "Spectral Transmissivity of the Earth's Atmosphere in the 250 to 500 Wave Number Interval," #1, September 1964.
101. Duncan, L. D., R. Ensey, and B. Engebos, "Athena Launch Angle Determination," September 1964.
102. Thiele, O. W., "Feasibility Experiment for Measuring Atmospheric Density Through the Altitude Range of 60 to 100 KM Over White Sands Missile Range," October 1964.
103. Duncan, L. D., and R. Ensey, "Six-Degree-of-Freedom Digital Simulation Model for Unguided, Fin-Stabilized Rockets," November 1964.

104. Hoidale, G., C. Querfeld, T. Hall, and R. Mireles, "Spectral Transmissivity of the Earth's Atmosphere in the 250 to 500 Wave Number Interval," #2, November 1964.
105. Webb, W. L., "Stratospheric Solar Response," *J. Atmos. Sci.*, November 1964.
106. McCoy, J. and G. Clark, "Rocketsonde Measurement of Stratospheric Temperature," December 1964.
107. Farone, W. A., "Electromagnetic Scattering from Radially Inhomogeneous Spheres as Applied to the Problem of Clear Atmosphere Radar Echoes," December 1964.
108. Farone, W. A., "The Effect of the Solid Angle of Illumination or Observation on the Color Spectra of 'White Light' Scattered by Cylinders," January 1965.
109. Williamson, L. E., "Seasonal and Regional Characteristics of Acoustic Atmospheres," *J. Geophys. Res.*, January 1965.
110. Armendariz, M., "Ballistic Wind Variability at Green River, Utah," January 1965.
111. Low, R. D. H., "Sound Speed Variability Due to Atmospheric Composition," January 1965.
112. Querfeld, C. W., "Mie Atmospheric Optics," *J. Opt. Soc. Amer.*, January 1965.
113. Coffman, J., "A Measurement of the Effect of Atmospheric Turbulence on the Coherent Properties of a Sound Wave," January 1965.
114. Rachele, H., and D. Veith, "Surface Wind Sampling for Unguided Rocket Impact Prediction," January 1965.
115. Ballard, H., and M. Izquierdo, "Reduction of Microphone Wind Noise by the Generation of a Proper Turbulent Flow," February 1965.
116. Mireles, R., "An Algorithm for Computing Half Widths of Overlapping Lines on Experimental Spectra," February 1965.
117. Richart, H., "Inaccuracies of the Single-Theodolite Wind Measuring System in Ballistic Application," February 1965.
118. D'Arcy, M., "Theoretical and Practical Study of Aerobee-150 Ballistics," March 1965.
119. McCoy, J., "Improved Method for the Reduction of Rocketsonde Temperature Data," March 1965.
120. Mireles, R., "Uniqueness Theorem in Inverse Electromagnetic Cylindrical Scattering," April 1965.
121. Coffman, J., "The Focusing of Sound Propagating Vertically in a Horizontally Stratified Medium," April 1965.
122. Farone, W. A., and C. Querfeld, "Electromagnetic Scattering from an Infinite Circular Cylinder at Oblique Incidence," April 1965.
123. Rachele, H., "Sound Propagation through a Windy Atmosphere," April 1965.
124. Miers, B., "Upper Stratospheric Circulation over Ascension Island," April 1965.
125. Rider, L., and M. Armendariz, "A Comparison of Pibal and Tower Wind Measurements," April 1965.
126. Hoidale, G. B., "Meteorological Conditions Allowing a Rare Observation of 24 Micron Solar Radiation Near Sea Level," *Meteorol. Magazine*, May 1965.
127. Beyers, N. J., and B. T. Miers, "Diurnal Temperature Change in the Atmosphere Between 30 and 60 km over White Sands Missile Range," *J. Atmos. Sci.*, May 1965.
128. Querfeld, C., and W. A. Farone, "Tables of the Mie Forward Lobe," May 1965.
129. Farone, W. A., "Generalization of Rayleigh-Gans Scattering from Radially Inhomogeneous Spheres," *J. Opt. Soc. Amer.*, June 1965.
130. Diamond, M., "Note on Mesospheric Winds Above White Sands Missile Range," *J. Applied Meteorol.*, June 1965.
131. Clark, G. Q., and J. G. McCoy, "Measurement of Stratospheric Temperature," *J. Applied Meteorol.*, June 1965.
132. Hall, T., G. Hoidale, R. Mireles, and C. Querfeld, "Spectral Transmissivity of the Earth's Atmosphere in the 250 to 500 Wave Number Interval," #3, July 1965.
133. McCoy, J., and C. Tate, "The Delta-T Meteorological Rocket Payload," June 1964.
134. Horn, J. D., "Obstacle Influence in a Wind Funnel," July 1965.
135. McCoy, J., "An AC Probe for the Measurement of Electron Density and Collision Frequency in the Lower Ionosphere," July 1965.
136. Miers, B. T., M. D. Kays, O. W. Thiele and E. M. Newby, "Investigation of Short Term Variations of Several Atmospheric Parameters Above 30 KM," July 1965.

137. Serna, J., "An Acoustic Ray Tracing Method for Digital Computation," September 1965.
138. Webb, W. L., "Morphology of Noctilucent Clouds," *J. Geophys. Res.*, 70, 18, 4463-4475, September 1965.
139. Kays, M., and R. A. Craig, "On the Order of Magnitude of Large-Scale Vertical Motions in the Upper Stratosphere," *J. Geophys. Res.*, 70, 18, 4453-4462, September 1965.
140. Rider, L., "Low-Level Jet at White Sands Missile Range," September 1965.
141. Lamberth, R. L., R. Reynolds, and Morton Wurtele, "The Mountain Lee Wave at White Sands Missile Range," *Bull. Amer. Meteorol. Soc.*, 46, 10, October 1965.
142. Reynolds, R. and R. L. Lamberth, "Ambient Temperature Measurements from Radiosondes Flown on Constant-Level Balloons," October 1965.
143. McCluney, E., "Theoretical Trajectory Performance of the Five-Inch Gun Probe System," October 1965.
144. Pena, R. and M. Diamond, "Atmospheric Sound Propagation near the Earth's Surface," October 1965.
145. Mason, J. B., "A Study of the Feasibility of Using Radar Chaff For Stratospheric Temperature Measurements," November 1965.
146. Diamond, M., and R. P. Lee, "Long-Range Atmospheric Sound Propagation," *J. Geophys. Res.*, 70, 22, November 1965.
147. Lamberth, R. L., "On the Measurement of Dust Devil Parameters," November 1965.
148. Hansen, F. V., and P. S. Hansen, "Formation of an Internal Boundary over Heterogeneous Terrain," November 1965.
149. Webb, W. L., "Mechanics of Stratospheric Seasonal Reversals," November 1965.
150. U. S. Army Electronics R & D Activity, "U. S. Army Participation in the Meteorological Rocket Network," January 1966.
151. Rider, L. J., and M. Armendariz, "Low-Level Jet Winds at Green River, Utah," February 1966.
152. Webb, W. L., "Diurnal Variations in the Stratospheric Circulation," February 1966.
153. Beyers, N. J., B. T. Miers, and R. J. Reed, "Diurnal Tidal Motions near the Stratosphere During 48 Hours at WSMR," February 1966.
154. Webb, W. L., "The Stratospheric Tidal Jet," February 1966.
155. Hall, J. T., "Focal Properties of a Plane Grating in a Convergent Beam," February 1966.
156. Duncan, L. D., and Henry Rachele, "Real-Time Meteorological System for Firing of Unguided Rockets," February 1966.
157. Kays, M. D., "A Note on the Comparison of Rocket and Estimated Geostrophic Winds at the 10-mb Level," *J. Appl. Meteor.*, February 1966.
158. Rider, L., and M. Armendariz, "A Comparison of Pibal and Tower Wind Measurements," *J. Appl. Meteor.*, 5, February 1966.
159. Duncan, L. D., "Coordinate Transformations in Trajectory Simulations," February 1966.
160. Williamson, L. E., "Gun-Launched Vertical Probes at White Sands Missile Range," February 1966.
161. Randhawa, J. S., "Ozone Measurements with Rocket-Borne Ozonesondes," March 1966.
162. Armendariz, Manuel, and Laurence J. Rider, "Wind Shear for Small Thickness Layers," March 1966.
163. Low, R. D. H., "Continuous Determination of the Average Sound Velocity over an Arbitrary Path," March 1966.
164. Hansen, Frank V., "Richardson Number Tables for the Surface Boundary Layer," March 1966.
165. Cochran, V. C., E. M. D'Arcy, and Florencio Ramirez, "Digital Computer Program for Five-Degree-of-Freedom Trajectory," March 1966.
166. Thiele, O. W., and N. J. Beyers, "Comparison of Rocketsonde and Radiosonde Temperatures and a Verification of Computed Rocketsonde Pressure and Density," April 1966.
167. Thiele, O. W., "Observed Diurnal Oscillations of Pressure and Density in the Upper Stratosphere and Lower Mesosphere," April 1966.
168. Kays, M. D., and R. A. Craig, "On the Order of Magnitude of Large-Scale Vertical Motions in the Upper Stratosphere," *J. Geophys. Res.*, April 1966.
169. Hansen, F. V., "The Richardson Number in the Planetary Boundary Layer," May 1966.

170. Ballard, H. N., "The Measurement of Temperature in the Stratosphere and Mesosphere," June 1966.
171. Hansen, Frank V., "The Ratio of the Exchange Coefficients for Heat and Momentum in a Homogeneous, Thermally Stratified Atmosphere," June 1966.
172. Hansen, Frank V., "Comparison of Nine Profile Models for the Diabatic Boundary Layer," June 1966.
173. Rachele Henry, "A Sound-Ranging Technique for Locating Supersonic Missiles," May 1966.
174. Farone, W. A., and C. W. Querfeld, "Electromagnetic Scattering from Inhomogeneous Infinite Cylinders at Oblique Incidence," *J. Opt. Soc. Amer.* 56, 4, 476-480, April 1966.
175. Mireles, Ramon, "Determination of Parameters in Absorption Spectra by Numerical Minimization Techniques," *J. Opt. Soc. Amer.* 56, 5, 644-647, May 1966.
176. Reynolds, R., and R. L. Lamberth, "Ambient Temperature Measurements from Radiosondes Flown on Constant-Level Balloons," *J. Appl. Meteorol.*, 5, 3, 304-307, June 1966.
177. Hall, James T., "Focal Properties of a Plane Grating in a Convergent Beam," *Appl. Opt.*, 5, 1051, June 1966.
178. Rider, Laurence J., "Low-Level Jet at White Sands Missile Range," *J. Appl. Meteorol.*, 5, 3, 283-287, June 1966.
179. McCluney, Eugene, "Projectile Dispersion as Caused by Barrel Displacement in the 5-Inch Gun Probe System," July 1966.
180. Armendariz, Manuel, and Laurence J. Rider, "Wind Shear Calculations for Small Shear Layers," June 1966.
181. Lamberth, Roy L., and Manuel Armendariz, "Upper Wind Correlations in the Central Rocky Mountains," June 1966.
182. Hansen, Frank V., and Virgil D. Lang, "The Wind Regime in the First 62 Meters of the Atmosphere," June 1966.
183. Randhawa, Jagir S., "Rocket-Borne Ozonesonde," July 1966.
184. Rachele, Henry, and L. D. Duncan, "The Desirability of Using a Fast Sampling Rate for Computing Wind Velocity from Pilot-Balloon Data," July 1966.
185. Hinds, B. D., and R. G. Pappas, "A Comparison of Three Methods for the Correction of Radar Elevation Angle Refraction Errors," August 1966.
186. Riedmuller, G. F., and T. L. Barber, "A Mineral Transition in Atmospheric Dust Transport," August 1966.
187. Hall, J. T., C. W. Querfeld, and G. B. Hoidale, "Special Transmissivity of the Earth's Atmosphere in the 250 to 500 Wave Number Interval," Part IV (Final), July 1966.
188. Duncan, L. D. and B. F. Engebos, "Techniques for Computing Launcher Settings for Unguided Rockets," September 1966.
189. Duncan, L. D., "Basic Considerations in the Development of an Unguided Rocket Trajectory Simulation Model," September 1966.
190. Miller, Walter B., "Consideration of Some Problems in Curve Fitting," September 1966.
191. Cermak, J. E., and J. D. Horn, "The Tower Shadow Effect," August 1966.
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1. ORIGINATING ACTIVITY <i>(Corporate author)</i> U. S. Army Electronics Command Ft. Monmouth, New Jersey		2a. REPORT SECURITY CLASSIFICATION Unclassified
2b. GROUP		
3. REPORT TITLE A REAGENT FOR THE SIMULTANEOUS MICROSCOPIC DETERMINATION OF QUARTZ AND HALIDES		
4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i>		
5. AUTHOR(S) <i>(Last name, first name, initial)</i> Kusbaum, Henry		
6. REPORT DATE October 1966	7a. TOTAL NO. OF PAGES 6	7b. NO. OF REFS 1
8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S) ECO: - 5085	
a. PROJECT NO.	9b. OTHER REPORT NO(S) <i>(Any other numbers that may be assigned to this report)</i>	
c. DA TASK 1V014501B53A-13		
d.		
10. AVAILABILITY/LIMITATION NOTICES Distribution of this report is unlimited.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY U. S. Army Electronics Command Atmospheric Sciences Laboratory White Sands Missile Range, New Mexico	
13. ABSTRACT <p>A reagent has been discovered whereby the techniques of dispersion staining microscopy and spot testing may be combined to distinguish halite from quartz in samples of atmospheric dust. The preparation of the reagent and its application are discussed.</p>		

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