UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

TECHNICAL LETTER NASA-8

REFLECTANCE MEASUREMENTS IN THE 0.6 TO 2.5 MICRON PART OF THE SPECTRUM*

by

Reinhold Gerharz

William A. Fischer

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Prepared by the Geological Survey
for the National Aeronautics and
Space Administration (NASA)

*Work performed under NASA Contract No. R-146

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DEPARTMENT OF THE INTERIOR

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Technical Letter
NASA-8
February 1, 1966

Dr. Peter C. Badgley
Chief, Natural Resources Program
Manned Space Science Division
Code SM NASA Headquarters
6th and Independence, S.W.
Washington, D.C. 20546

Dear Peter:

Transmitted herewith are 5 copies of:

TECHNICAL LETTER NASA-8

REFLECTANCE MEASUREMENTS IN THE 0.6 TO 2.5

MICRON PART OF THE SPECTRUM

by

Reinhold Gerharz

William A. Fischer**

Sincerely yours,

Bob

Robert M. Moxham
Research Geophysicist
Branch of Theoretical Geophysics

**U.S. Geological Survey, Washington, D.C.

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Introduction

Spectral reflection measurements in the region between the wavelengths of 0.6 and 2.5 microns (μ) have been made on a suite of rock and mineral samples. These measurements had two primary purposes:

1. To make a very preliminary appraisal of the potential significance of the near infrared in terms of facilitating recognition of rock types or characteristics, e.g., water of hydration from a remote position.
2. To evaluate the spectroscopic equipment necessary for making measurements and for studies of a geologic nature.

This part of the spectrum is known to be expecially meaningful in the recognition of certain plants and plant characteristics (Colwell, et al, 1965). The development of knowledge relating to the geologic parameters that effect spectral energy distributions in these wavelengths is, therefore, desirable for supporting botanical interpretations and for gaining corollary geologic data from information gathered primarily for botanical purposes.

Instruments used and method of study

A random selection of rock samples was used in these investigations. Measurements were made with a DK-1 Beckman infrared spectrophotometer equipped with an integrating sphere. The instrument was made available through the courtesy of the Naval Research Laboratory. This spectrophotometer is designed to maintain a constant radiant energy flux to the sample by electronic slit adjustments. A tungsten source, whose infrared energy output progressively diminishes with increasing wavelength, was used to illuminate the samples. Thus, to maintain constant flux and detector sensitivity, the slit increases (as spectral resolution diminishes) with increasing wavelength.

Conclusions

1. Preliminary observations suggest that electromagnetic energy in the 0.6 to 2.5 part of the spectrum is selectively absorbed by some rocks and minerals. Many of the observed absorption bands (figs. 1 through 9) correspond closely in spectral position to known atmospheric absorption bands (fig. 10). Because the path-length in the spectrometer is short, the humidity in the area of the experiment was kept low and these bands are not superimposed on the reflectance spectra of all specimens (all measurements having been made in a relatively short interval of time), these bands are believed to relate to absorption characteristics of the rock specimens and not to absorption by intervening atmosphere.

Specimen no. G-1 (fig. 9, curve numbers 1 and 2) was observed in several orientations and the spectral positions of the absorption bands remained unchanged. The amount of energy absorbed, however, varied with surface condition.

2. The information sought is primarily that related to chemical-mineralogical composition because this information is believed to be conveyed by the spectral position, rather than the amplitude, of the absorption bands. The Beckman DK-1 spectrometer, whose spectral resolution varies with wavelength, is not considered an ideal instrument for these investigations.

Reference

Colwell, R., Gates, D.M., Shay, R., and Keegan, H.J., The applications of remote sensing for the study of forest and agricultural resources and the application of relfectance spectra to reconnaissance of planetary surfaces: in the Proceedings of the Third Goddard Memorial Symposium, American Astronautical Society. (In press.)

EXPLANATION OF FIGURES 1 THROUGH 9 SHOWING THE SPECTRAL DISTRIBUTION OF REFLECTED INFRARED ENERGY

Figure No.	Curve No.	Rock Type	USGS No.	Sample Locality
1	1	Fluorite	13	South Park, Colorado
	2	Fluorite	11	Weardale, England
	3	Fluorite	9	Rosiclare, Illinois
	4	Fluorite	10	Rosiclare, Illinois
2	1	Dolomite (weathered)	48	Wise County, Virginia
	2	Dolomite (unweathered)	48	Wise County, Virginia
	3	Dolomite (weathered)	49	Wise County, Virginia
	4	Dolomite (unweathered)	49	Wise County, Virginia
3	1	Rhyolite (altered)	102	Specimens selected as IR
	2	Granodiorite	103	standards by J. Green*. Same as above
	3	Tuff (semi-welded)	104	Same as above
	4	Basalt	101	Same as above
4	1	Kyanite	6	Baker Mountain, Virginia
	2	Scheelite	82a	Timmins, Ontario
	3	Halite	G-3	Wieliczka, Poland
	4	Asbestos	G-2	Unknown
5	1	Gypsum	34	Grand Rapids, Michigan
	2	Topaz	30	Brewer Mine, So. Carolina
	3	Corundum	23	Transvaal, Africa
	4	Cassiterite	29	Bolivia
6	1	Basalt (altered)	98	Steamboat Springs, Nevada
	2	Serpentine	105	Specimens selected as IR standards by J. Green*.
	3	Obsidian	106	Same as above
7	1	MgO		Chemically pure.
	2	Monazite		India
	3	Willemite		Franklin, New Jersey
	4	Quartz		Unknown

* North American Aviation, Downey, California

Figure No.	Curve No.	Rock Type	USGS No.	Sample Locality
8	1	Amazonstone (K-feldspar)	T-1	Amelia Courthouse, Va.
	2	Cleavelandite feldspar	T-5	Amelia Courthouse, Va.
	3	Beryl (& Quartz)	T-4	Amelia Courthouse, Va.
	4	Zinnwaldite	T-3	Amelia Courthouse, Va.
9	1	Calamine (weathered)	G-1	Granby, Mo.
	2	Calamine (unweathered)	G-1	Granby, Mo.
	3	Calcite	87	Shenandoah Cave, Virginia
	4	Sphalerite	84	Ottawa County, Oklahoma

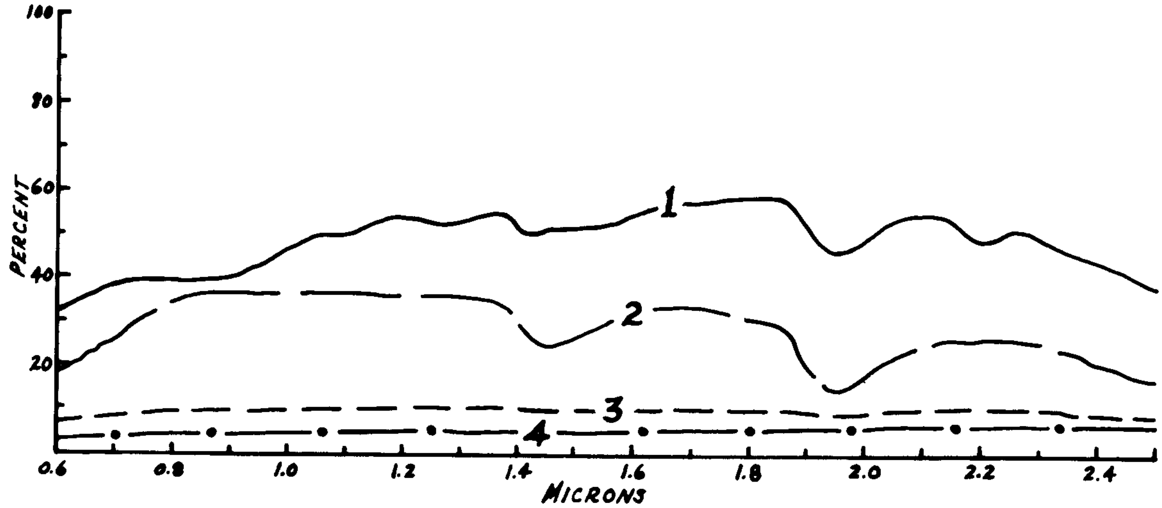
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Fig. 1

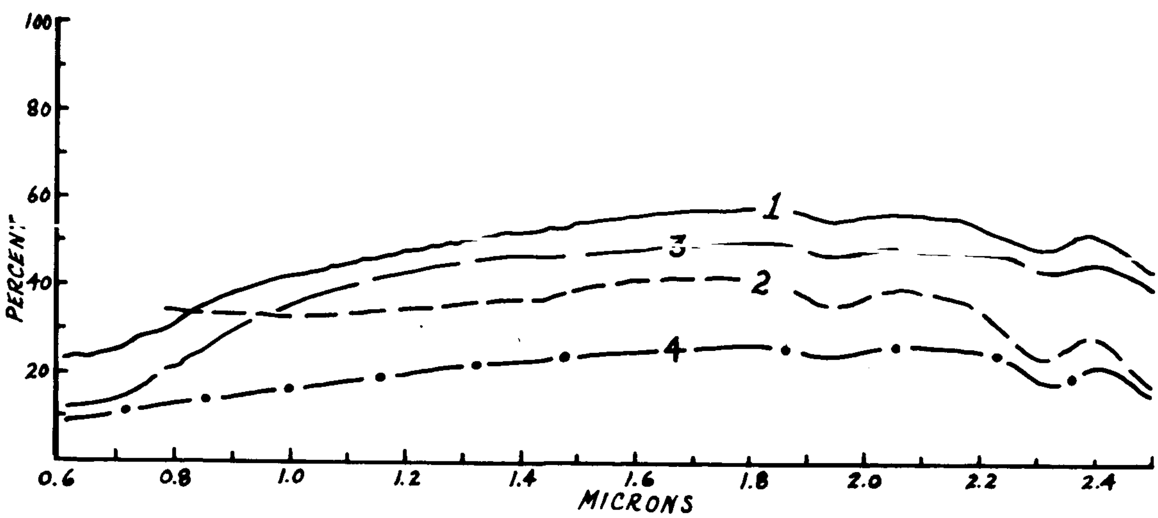
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Fig. 2

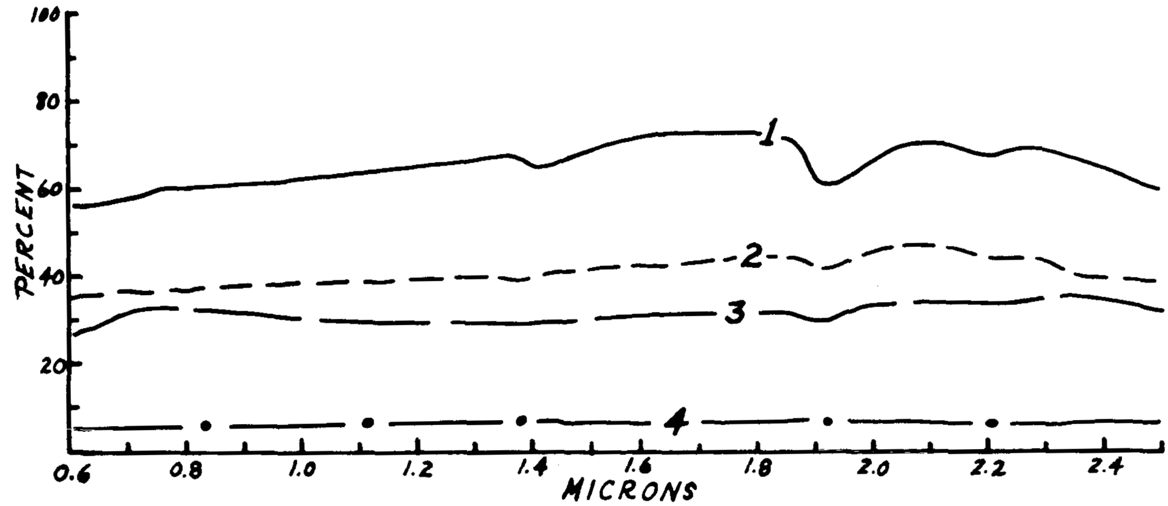
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Fig. 3

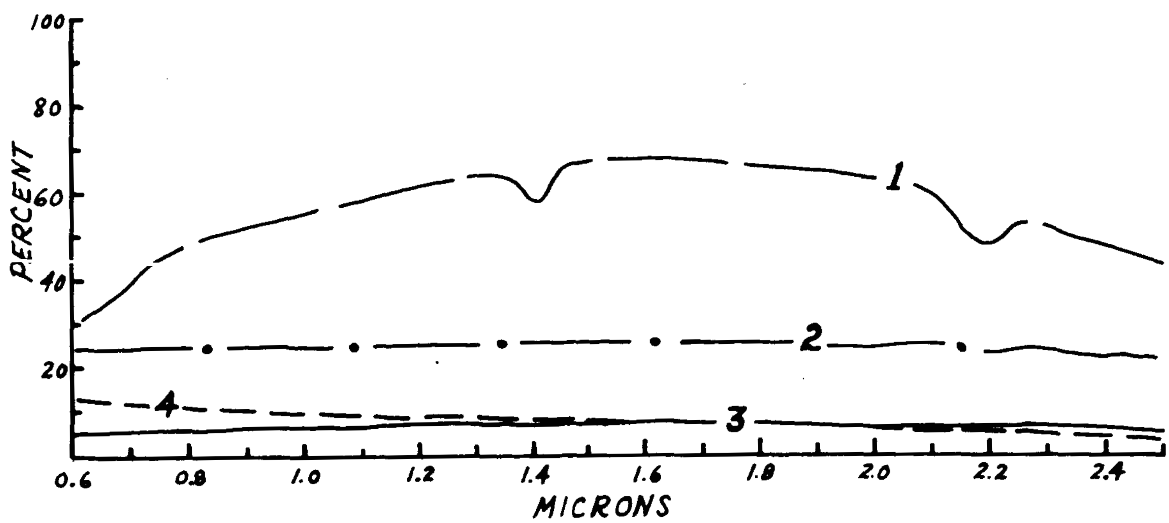
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Fig. 4

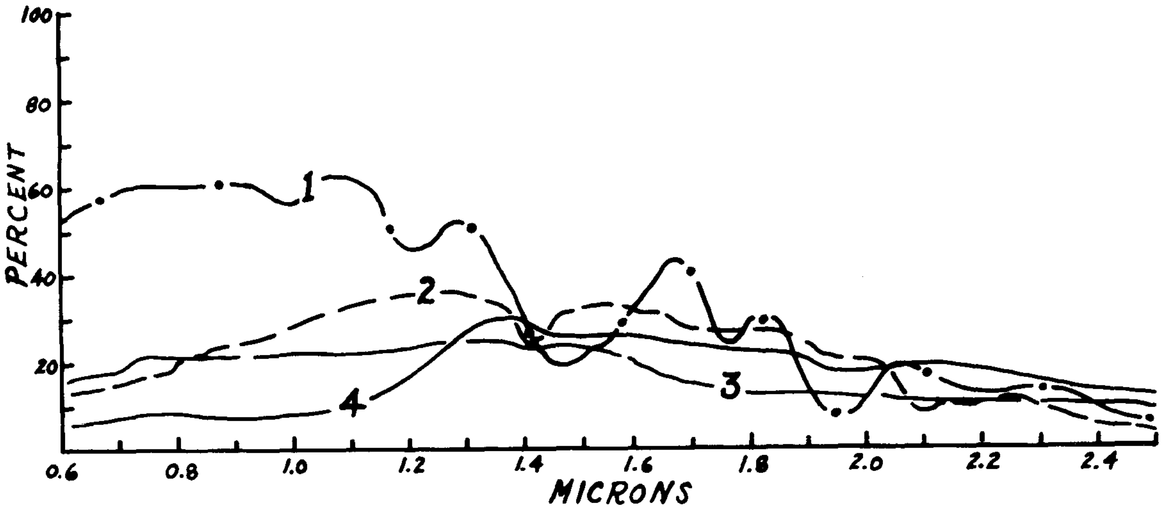
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Fig. 5

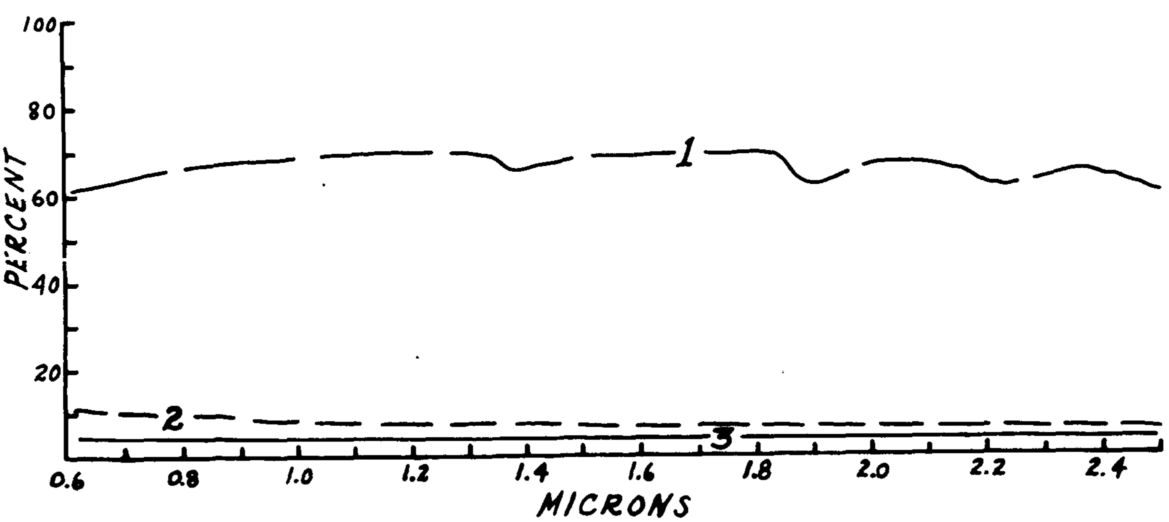
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Fig. 6

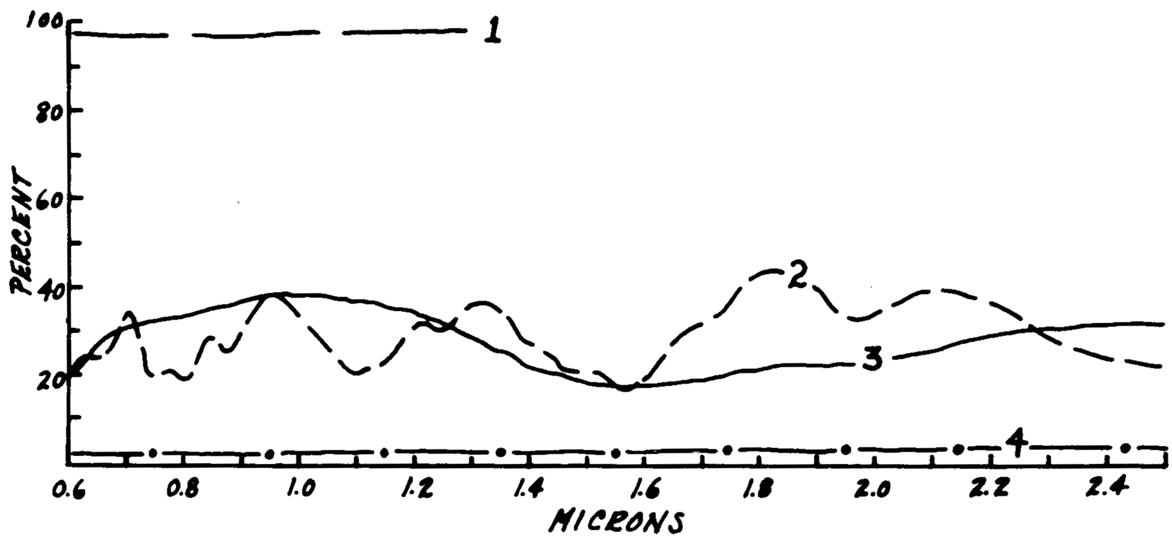
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Fig. 7

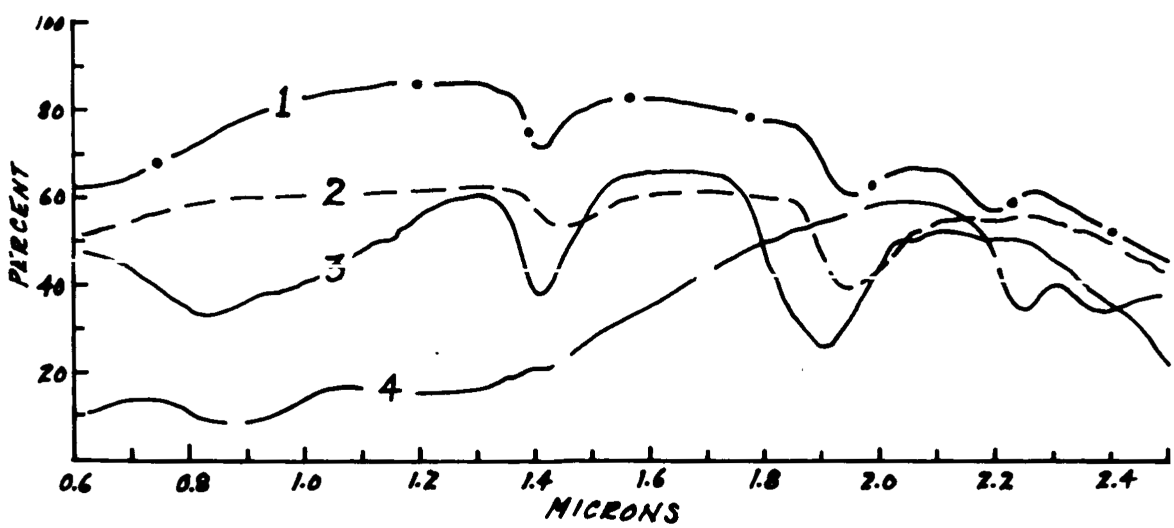
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Fig. 8

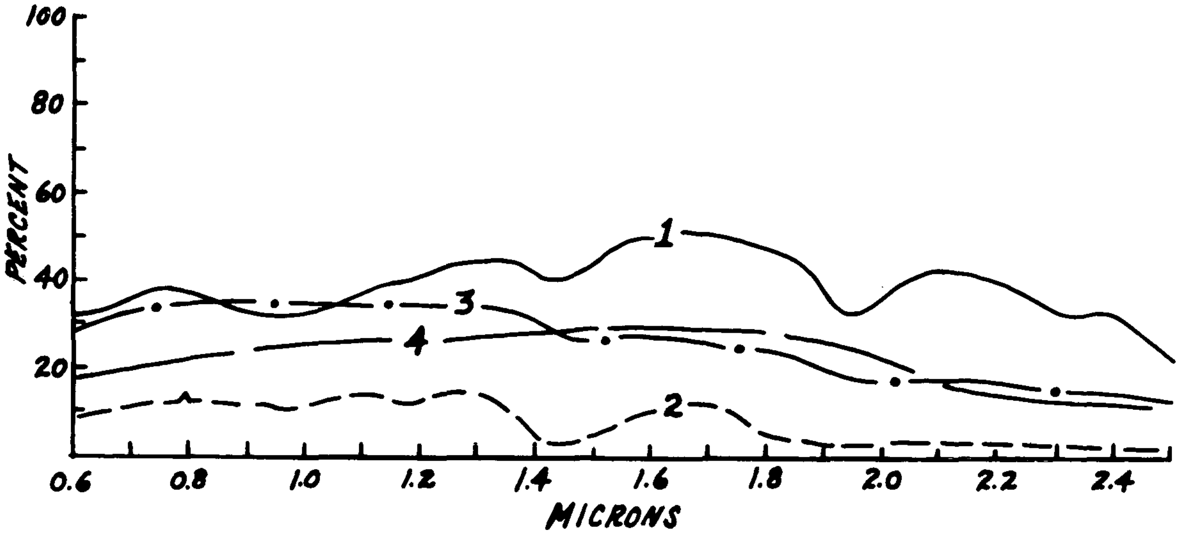

Fig. 9

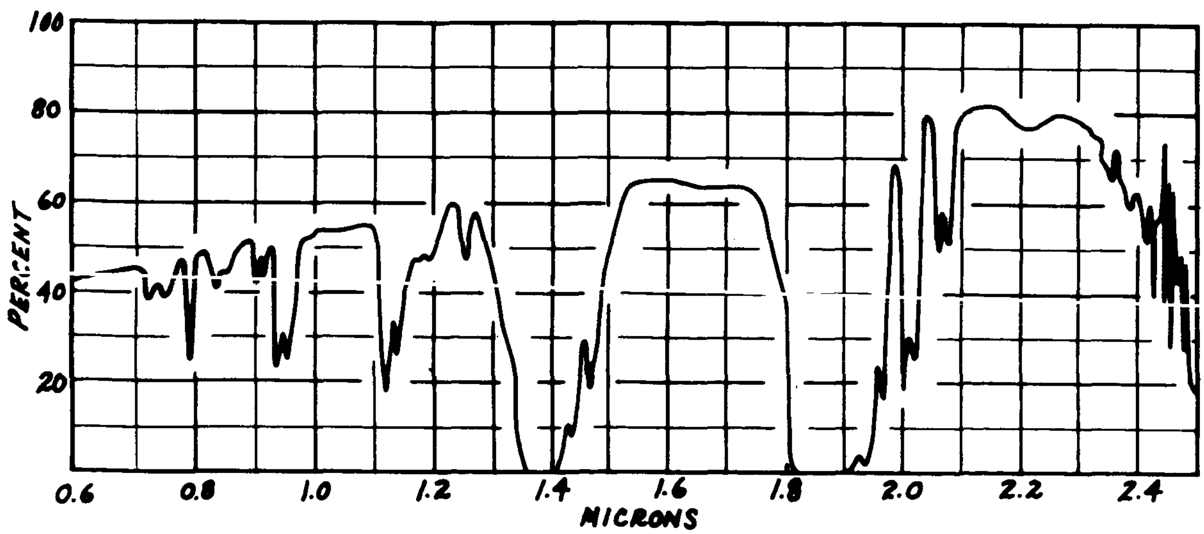

Fig. 10 - Curve showing the gross atmospheric absorption characteristics in the 0.6 to 2.5 micron part of the spectrum.