CONTINUATION OF MEASUREMENTS OF THE EARTH'S TOTAL MAGNETIC FIELD AND ITS VARIATIONS AT A SITE CLOSE TO THE BRAZILIAN ANOMALY.

RESEARCH PROPOSAL LAFE-050

Submitted by the
Comissão Nacional de Atividades Espaciais (CNAE)
to
Air Force Office of Scientific Research (OAR)
through the
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and AF Cambridge Research Laboratories

São José dos Campos
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The objective of the research program of the present proposal is to continue providing elements of study of phenomena related to geomagnetism.We are already complementing ionospheric measurements made in this laboratory with geomagnetic field measurements made on the ground, and in a near future with rockets.

The study of micropulsations is the primary interest concerning the geomagnetic field measurements on this laboratory at the moment, and this is the reason why a rubidium vapor magnetometer is needed.

The Second International Symposium on Equatorial Aeronomy, held in Brazil (with sponsorship of CNAE,AFCRL, among other organizations) recommended that further measurements of micropulsations in equatorial latitudes be encouraged. Besides, where possible, two or more stations should be operated simultaneously so that phase lags on either side, and under the equatorial electrojet may be determined.

One work has already been done in cooperation with Lamont Geological Observatory searching for correlation between micropulsations measured at conjugate points such as Amapá and Barbacena, two Brazilian cities equally distant from the magnetic equator. This work has been done by Heirtzler,J.R.,F.de Mendonça and H. Montes, under the title of "Rapid Geomagnetic Activity at Very Low Latitude Conjugate Stations", published on the Annales de Géophysique, Vol. 22, nº 3,502,1966. We intend now to start, as soon as possible, another similar task using measurements at São José dos Campos (near the Brazilian Magnet-

ic Anomaly) and Natal (near the Magnetic Equator).For the measurements to be performed at Natal we will use another Rubidium Vapor Magnetometer, loaned to us by Stanford University.We hope that, by the end of this year, enough information about the occurrence of micropulsations in the neighbourhood of the magnetic equator will become available.

By next March we expect to have completed an investigation about the occurrence of micropulsations in São José dos Campos, and we intend to start, as soon as possible, analogous investigations concerning the occurrence of bays and storms.

Research has been started in order to develop an airborne magnetometer to be flown through the equatorial electrojet. We hope to achieve this goal by the beginning of the next year.

It is also our desire to continue the magnetic investigation when the sun becomes more active. The measurement will certainly provide additional relevant data for the study of the Earth's magnetic field.

GRANTEE'S FACILITIES

The Comissão Nacional de Atividades Espaciais (CNAE), which is under the Brazilian National Research Council, has established a non-profit research center (Ionosphere and Space Physics Laboratory) near São José dos Campos (São Paulo) where the principal interest lie within the field of research of radiophysics and space science. CNAE's laboratory is a new institution with a staff of 110 people, which so far has started among others the following research program:

a) Observation of atmospheric noise in various frequencies with sponsorship of the Environmental Science Service Administration;

b) Observations of solar noise in various frequency by means of a sweep-frequency receiver;

c) Studies on the ionospheric electron content and its variation (diurnal, transequatorial, through the Brazilian anomaly,etc.) from satellites observations (NASA loaned equipment);

d) Studies on the ionospheric absorption with riometer (AFCRL equipment Grant nº AF-AFOSR-1019-66);

e) VLF propagation problems;

f) Magnetometry (Rubidium Vapor Magnetometers- one at Natal sponsored by Stanford University and another at São José dos Campos with AFCRL equipment);

g) Experiments made with sounding rockets at our launching site at Natal include measurement of temperature and winds with the grenade method and met-sondes, ions and electron densities,ultraviolet fluxes, galatic X-ray, etc.

In a near future we will be enlarging our program to include "in situ" measurements of the equatorial electron [illegible] the resonant scattering of the helium and hydrogen lines in the night sky,etc.

REQUESTED SCHEDULE FOR THE GRANT

In this proposal we request a grant for 38 more months after the expiring date of 30 April 1967 for the AF-AFOSR-654-64 contract.

The reasons for the continuation have been presented in the preceding pages and the duration of the extension is justified by our desire to continue magnetic investigation when the sun becomes more active, added to the convenience of avoiding yearly research proposal renewal.

The following schedule is proposed:

1 - A no-cost grant for the first 2 months (1 May through 30 June 1967)

2 - A total of US$ 6750.00 (see cost estimate on following page) during the remaining 36 months, i.e., 1 July 1967 through 30 June 1970), with payments starting late 1967.

Cost Estimate for one year	CNAE	AF-OAR
Salaries		US$
F. de Mendonça (10% time)		1200
J.A.A. do Amarante (100% time)	5000	-
J. M. da Costa (100% time)	4000	-
Expendable supplies and equipments		
Chart paper		200
Computer time		300
Books and journals		100
Components (electronics)		300
Reports, data summaries		150
Power, maintenance labor, data clerck, etc.....	1000	-
	10000	2250
Total Cost for 3 years	30000	6750

Overhead not included.

BIOGRAPHIC INFORMATION OF THE INVESTIGATORS

a) FERNANDO DE MENDONÇA

Joined the BAF in 1942 (ROTC) and later graduated from the Brazilian Air Force Academy, at the top of his class becoming a regular officer. Studied engineering (5 years courses majoring in electronics) at the Instituto Tecnológico de Aeronáutica (1954-1958) receiving the degree " Engenheiro de Eletrônica" with a "Summa cum Laude". Did postgraduate work at Stanford University from March 1959 receiving the PhD degree (December 1961), with dissertation on "Ionospheric Electron Content and Variations Measured by Doppler Shifts in Satellite Transmissions", from January through December 1962 was a post doctoral researcher at the Radioscience Laboratory at Stanford University (California) and simultaneously represented CNAE in the United States. Since January 1963 he has been the Scientific Director of CNAE. Dr. Mendonça is member of some scientific organization such as the American Geophysical Union, Institute of Electrical and Electronics Engineers, Society of the Sigma-Xi and others. Presently has retired from the Air Force as a Major.

List of publications in learned journals and reports:

1958 - "Minitrack Station Report-ITA", in coauthorship with J.A.M. Coutinho;

1960 - "Some Characteristics of the Signal Received from 1958δ2", Dec. issue of the Proc. of the IRE; coauthors: O.K. Garriott and O.G. Villard Jr.;

1961 - "Ionospheric Electron Content - Report [illegible]

RsL" - Prepared under a grant from the National Aeronautics and Space Administration (PhD dissertation);

1962 - "Ionospheric Electron Calculate by a Hibrid Faraday-Doppler Technique"; Journal of Atmospheric and Terrestrial Physics, Vol. 24, April; coauthor: O.K. Garriott;

1962 - "The Effect of the Earth's Magnetic Field on Measurement of the Doppler Shift of Satellite Radio Transmissions"; Journal of Gephysical Research, Vol. 67,May;coauthor: O.K. Garriott;

1962 - "Ionospheric Electron Content and Variations Measured by Doppler Shift in Satellite Transmissions " ; Journal of Geophysical Research, Vol. 67, June;

1962 - "Ionospheric Studies with the Differential Doppler Technique"; Tech. Report nº 3 RsL - Stanford University, June; and "Radio Astronomical and Satellite and Studies of Atmosphere"; edited by Jules Aarons, North-Holland Publishing Co., 1963;

1963 - "A Comparison of Methods Used for Obtaining Electron Content from Satellite Observations"; CNAE Tech.Report nº 1 and also in the Sept. 1, 1963 issue of J.G.R.; coauthor:O. K. Garriott;

1963 - "Absorption Measurements with Riometer" - (Data Summary for the period March through August 1963).LAFE-5, Dec.1963, coauthor: M.A. Sette. Research done under the auspices of CNAE and Stanford Research Institute;

1964 - A Report of the Scientific Group of the Committee for the Pacific Use of the Space. Document nº AC-105/17 (Feb.1964) from the United Nations. Coauthors: G.L. Golyshev,B. Hultqvist, K. Mardo, T. Tabanera and J.W. Townsend;

1964 -"Absorption Measurements with Riometer (Data Summary for the period September through December, 1963), Report LAFE-12, May 1964 - and LAFE-16, 17 and 22, same for the periods Jan-Mar; Apr-June and Jul-Sept. 1964; coauthor M.

Sette, with the colaboration of the Stanford Research Institute and the Air Force Cambridge Research Laboratories;

1964 - "Atmospheric Noise Measurements" - Data Summary nº 1, Station ARN-2 nº 10, Report LAFE-13, May 1964 - Co-author: L.G. Meira Filho - research made under the auspices of CNAE and the National Bureau of Standards;

1964 - "Ionospheric Electron Content Measurements in Regions of Low Magnetic DIP Angles and through the Brazilian Magnetic Anomaly. Report LAFE-14, May, 1964 and also in the Space Research V of North-Holland Publication Co.;

1964 - "Differential Faraday Measurements of Electron Content with the S-66 Satellite, coauthor: J.L.R. Muzzio, Report LAFE-15, published in the vol. 26,J. Atmospheric and Terrestrial Physics, page 1281-1286-1964;

1965 - "Atmospheric Noise Measurements (Data Summary nº 2, Station ARN-2 nº 10) and also (Data Summary nº 3, Station ARN-2 nº 10) - LAFE-24" - Coauthor: L.G. Meira Filho-Report LAFE-23;

1965 - "Absorption Measurements with Riometer (Data Summary for the period October 1964 through March 1965)" coauthor: M.A. Sette - Report LAFE-28;

1965 - "Measurements of the Earth's Total Magnetic Field at Heights of 1000 Km in the Brazilian Magnetic Anomaly", Report LAFE-26 and Space Research VI, North-Holland Pub.Co.;

1965 - "Rapid Geomagnetic Activity at Very Low Latitude Conjugate Stations", coauthors: J.H.Heirtzler and H. Montes from the University of Columbia (EE.UU.),published on the Equatorial Aeronomy book, p. 512-521;

1965 - "Second Order Correction on Electron Content Measurements - with Faraday Rotation Techniques",coauthors: J.L.R. Muzzio and F. Walter, Equatorial Aeronomy, p. 162-166,Equatorial Aeronomy, a book edited by F. de Mendonça with the summaries (550 pages) on the results of the S.I.S.E.A., Nov.,1965:

1965 - "Absorption Measurements with Riometer -(Data Summary nº 7 for the period April 1965 through September 1965), coauthor: M. Lunetta, Report LAFE-38 and LAFE-42;

1966 - "Phase Measurements of VLF Transmissions Over a 11000 Km Transequatorial Path", coauthor: R.R. Scarabucci, LAFE-40 and also to appear in Radio Science;

1966 - "Equatorial Nighttime E-region Ionization Sources, coauthor: L.G. Meira Filho; LAFE-41; presented at Vienna, Austria, COSPAR 1966;

1966 - "Absorption Measurements with Riometer (Data Summary nº 9) coauthor: M. Lunetta, LAFE-45;

1966 - "Meteorological Sounding Rocket Program at Natal" - coauthors: J.A.M. Salgado, U. Belcufine; LAFE-47, presented at the Ascochinga Meeting of EXAMETNET;

1966 - "Rapid Geomagnetic Activity at Very Low Latitude Conjugate Stations" - Annales de Géophysique - Tome 22,nº 3, 1966, pp. 502; coauthors : J.R. Heirtzler and H. Montes.

b) JOSÉ ALBERTO ALBANO DO AMARANTE

Born in 1935. Graduated with honor from the Brazilian Air Force Academy in 1956. Studied engineering (5 years course majoring in electronics) at the Instituto Tecnológico de Aeronáutica (1962-1966), receiving the degree "Engenheiro de Eletrônica" with honorable mention "Cum Laude".

His primary interest at the moment concerns micropulsations studies. He intends to start graduate work toward a PhD degree in Physics in the United States in the near future.

His "Trabalho Individual" (something like an engineering thesis) at ITA will be published as a LAFE Report Nº 48 under the heading: "General Topics on Geomagnetism and Studies about the Occurrence of Micropulsations in São José dos Campos".

c) JOSÉ MARQUES DA COSTA

Born in 1942. Studied at São Paulo University in a 4 years course majoring in Physics (1962-1965) and holds a Bachelor's Degree in Physics.

He joined CNAE in October 1966, interested in geomagnetism but not yet decided about the particular subject in this field.

Mr. Costa is presently working toward his Master's Degree.

LISTING OF WORKS RELATED TO THE PROPOSED RESEARCH

Akasofu,S.I.,S. Chapman and D. Venkatesan - "The Main Phase of Great Magnetic Storms" - JGR, Vol.68,Nr.11,June 1,1963.

Akasofu,S.I.,S. Chapman and D. Venkatesan - "The Main Phase of the Great Magnetic Storms",J.Geophys.Res.,68,3345,1964.

Akasofu,S.I. - "A Source of Energy for Geomagnetic Storms and Auroras", Planet Space Sci., 12, 801, 1964.

Akasofu,S.I.,S. Chapman and C.I. Meng - "The Polar Electrojet"- J. Atmosph. Terrest. Phys.,27, 1275, 1965.

Berger, S. - "Giant Pulsations in the Magnetic Field and Pulsating Aurora" - Planetary and Space Science, Vol.11,Nr.7, July 1963.

Brice,N.M. - "Fundamental of Very Low Frequency Emission Generation Mechanism" J. Geophys. Res.,69, 4515, 1964.

Chapman, S. and J. Bartels - "Geomagnetism" - 2 vols. (Oxford: Claredom Press);

Cohen, Robert - "International Symposium on Equatorial Aeronomy" - JGR, Vol. 68, Nr.9, May 1, 1963.

Cain, J.C., and J.R. Neilon - "Automatic Mapping of the Geomagnetic Field" - JGR, Vol.68, Nr.16, August 15, 1963.

Cornwall, J. M. - "Micropulsations and the Outer Radiation Zone", J. Geophys. Res.,71, 2185, 1966.

Dessler, A.J., and J.A. Fejer - "Interpretation of Kp Index and M-Region Geomagnetic Storms" - Planetary and Space Sci. Vol. 11 Nr.5,May 1963;

Dungey, J. W. - "Interactions of Solar Plasma with the Geomagnetic Field" - Planetary and Space Science,Vol.10,1963.

Dessler,A.J., W.B. Hanson and E.N. Parker - "A Mechanism to Stablish the Magnetic Storm Ring Current",J.Phys. S...

Japan,17, Supp. A-I, 178, 1962.

Greifinger, C. and P. Greifinger - "Transmission of Micropulsations through the Lower Ionosphere", J. Geophys.Res., 70, 2217,1965.

Hines, C.O. - "The Energization of Plasma in the Magnetosphere: Hydromagnetic and Particle - Drift Approaches" - Planetary and Space Science, Vol. 10, 1963.

Heirtzler, J.R., F. de Mendonça and H. Montes - "Rapid Geomagnetic Activity at Very Low Latitude Conjugate Stations",Annales de Géophysique, Vol. 22, Nr. 3, 502,1966.

Jacobs,J.A., and T. Watanabe - "Trapped Charged Particles as the Origin of Short Period Geomagnetic Pulsations"- Planetary and Space Science, Vol.11, Nr. 8, August 1963.

Jacobs, J.A., and T. Watanabe - "The Equatorial Enhancement of Sudden Commencements of Geomagnetic Storms" - J. Atm. Terr. Ph.,Vol. 25, Nr. 5, May 1963.

Jacobs, J.A.and K. Sinno - "World-wide Characteristics of Geomagnetic Micropulsations", Geophys. Journ. Roy.Astr. Soc., 3,333, 1960.

Lepping, R.P. - "Transient Micropulsation Associate with Geomagnetic Bays and Evidence of Hydromagnetic Origin on the Earth's Outer Atmosphere", Report Nr. NADC-AW-6419,Anti Submarine Warface Laboratory. U.S. Naval Air Development Center, 1964.

Mead, G.D. - "Shape of the Geomagnetic Field Solar Wind Boundary", J. Geophys. Res., 69, 1169, 1964.

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Siebert, M. - "Geomagnetic Pulsations with Latitude-Dependent Periods and their Relation to the Structure of the Magnetosphere", Planet. Space Sci., 12, 137, 1964.

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