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COMENTÁRIOS - *COMMENTS*

ON THE FUTURE DEVELOPMENT OF GEOMAGNETISM IN BRAZIL

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From the geophysical standpoint, in particular with respect to geomagnetism, Brazil is a country full of important and interesting tasks to deal with. Brazil has both the geographic and magnetic equator (unique in the world), and the intensity of the geomagnetic field is the weakest over the entire earth. The world community of geophysicists has appreciated very much the great effort of Brazilian surveyers (belonging to Observatório Nacional) to trace the secular variation of the geomagnetic field in the past since the middle of the 19th century, in particular the rapid shifting of the magnetic equator along the eastern coast of Brazil.

Historical document for the International Geophysical Year (IGY) shows that Brazil is the first country in South Americana that joined in this world enterprise, stating its wish to study the geomagnetic field variations, with the establishment of a new magnetic observatory at Tatuoca (situated near the mouth of the Amazon river) in addition to Vassouras Observatory (near Rio de Janeiro) operating since 1915. At the time of IGY, the observation of the geomagnetic field variations was carried out with a set of classical magnetometers placed in an underground room free from the temperature change. This constraint for the observation was removed recently by new automatic-recording magnetometers (called fluxgate magnetometers, based on a new electronic technique), and it became possible for Brazilian geophysicists to install even three N-S chains across the magnetic equator to study the geomagnetic variations at low latitudes.

I feel that the geophysical data have not yet been sufficiently utilized to obtain full scientific achievement from individual observatories. We need some enthusiastic research workers who bring out important scientific outcomes from the observational data. If the data-providing institutions could have some scholarship (their own or by CNPq) for young graduate students with an obligation to analyze the observational data, it will be expected thath such institutions would produce scientific outcomes one after another, and they would keep a desirable academic atmosphere for promoting geophysical sciences in Brazil.

Let me mention here the development of geophysical sciences in Japan, just for information. The predecessor of the Japan Meteorological Agency before World War II was the Central Meteorological Observatory (abbreviated hereafter to CMO), wich was responsible for all kind of routine geophysical observations, not only in meteorology and aerology, but also in oceanography, geomagnetism, seismology, and volcanology. CMO had an excellent academic atmosphere, and many young research workers published scientific papers after analyzing the data by CMO. When new Departments of Geophysics were created in some national universities in Japan since 1930's, CMO provided with a number of professors of geophysics to the new departments of geophysics. CMO played a role of not only geophysical observatories but also research organizations for extracting scientific outcomes from routine observations.

Since IGY 1957-58, the World Data Centres were established for each discipline of geophysical observations, to collect and preserve the world data for their effective utilization by research workers over the world. Each observatory has been requested to send its data in a standard format, at its own expense. The World Data Centres were charged with a duty to offer all the collected data to visiting scientists, and also to send their copies at a reasonable cost of reproduction and mailing, on request from individual

research workers. [The World Data Centres were established in 1957, following a successful collection of the world magnetogram copies of the Second International Polar Year 1932-33 data at the Danish Meteorological Institute in Copenhagen. In 1951 we purchased a set of microfilms of the magnetograms, and my thesis paper on "polar magnetic storms and geomagnetic bays" was written in 1953 after analyzing these world data.]

In the field of "geomagnetism" a number of scientific papers appeared in early 1960's in some leading international journals, which reported the observed results specific to new stations, such as those at some remote islands or deep inside unpopulated areas. In the middle of 1960's some leading research workers made extensive study of the world morphology of geomagnetic variations by means of IGY data through the spherical harmonic analysis with high-speed computer. All of these valuable works seem to have given to young research workers an impression that the world morphology for geomagnetic daily variations might have been completely clarified through the analysis of the IGY data, and no new thema will be left to them for their thesis work.

I have to point out that the impression of young workers (described in the preceding paragraph) is not at all true. According to my own opinion, the geomagnetic field variations observed on the ground still provide us with a number of important unsolved tasks, in particular in South America; these tasks are to be studied by young scientists or students in all Latin-American countries. Their studies will become their own thesis papers, and they will understand the significance of "geomagnetism" in geophysical sciences and applications.

Geomagnetic field variations observed on the earth are originated from the following two contributions, i.e.,

1- electric currents flowing in the ionosphere, magnetosphere, and at the outer magnetosphere boundary, dependent on the solar energy incidence to the earth and its environmental space; and
2- the electric current within the earth, which are induced there by the time-change of the magnetic field produced by currentes of (1), and the permanent magnetic field originated from the crustal magnetization and the dynamo current in the earth's core.

At each magnetic observatory, the contribution from (2) depends on the subterranean structure (such as the conductivity of soil and underground material, presence of high-permeable matter, etc.) immediately below and near the magnetic observatory. If some portable magnetometers are available, it is possible to carry out the electromagnetic sounding of the subterranean structure, and this kind of study will contribute to the exploration of natural resources.

On the other hand, the research workers interested in contribution (1) to the ground magnetic field variation, they can infer the temporal variation of electric currents and hydromagnetic waves in space high above the magnetic observatory, although three-dimensional structure of electric currents in the region above the ionosphere can be known only with the aid of in situ observation by space vehicles.

The long-series records of magnetic observatories in South America have not been analyzed yet in detail, and it is desirable to clarify the geomagnetic variations specific to each observatory. Although the data despatch might be a final action of technicians at each observatory, however, the data must be utilized by scientists (possibly by new young scientists for their thesis work) to obtain significant scientific outcomes. In the near future it is desirable to install several more magnetic observatories or temporary stations within the South American continent, for understanding peculiar electrodynamics over South America (a unique region in the world with the greatest deviation of the magnetic equator from the geographic equator, and the weakest intensity of the geomagnetic field).

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