and meso- and submesoscale oceanic and atmospheric turbulence were all of high quality.

The scientific program for the assembly contained other symposia covering the many fields of interest of the Society (see *Terra Cognita, 4*, p. 3, 1984 for published abstracts) and the custom of inviting three distinguished scientists to deliver Society Lectures was continued. P. Tapponier (who lectured on tectonics of Asia), P. Melchior (on the role of tides in earth sciences), and M. Nicolet (solar activity, variations of UV and X ray fluxes), the nominated scientists for the 1984 assembly, presented stimulating expositions of their topics.

It is a pleasure to pay tribute to the efforts of A. Berger and his team in Louvain La Neuve for ensuring the success of the assembly. The next such General Assembly of the EGS will be hosted by the University of Kiel, Federal Republic of Germany, in August 1986.

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This meeting report was contributed by Peter A. Davies *of the Department of Civil Engineering, The University of Dundee, Dundee, Scotland, U.K.*

Geophysical and Solar Activity Indices

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A large number of geophysicists try to correlate their observations with one or even a series of different geophysical or solar activity indices. Yet the right choice of the most appropriate index with which to correlate depends mainly on our understanding of the physical cause-effect relationship between the new set of observations and the index chosen. This best choice will therefore depend on our good understanding of the methods of measurement and derivation of the adopted index in such correlative studies. It relies also on our awareness of the range of applicability of the indices presently available as well as on our understanding of their limitations. It was to achieve these goals that a series of general lectures on geophysical and solar activity indices was organized by L. Bossy and J. Lemaire (Institut d'Aeronomie Spatiale de Belgique (IASB), Brussels), March 26–29, 1984 at Han-sur-Lesse, Belgium.

The intention was also to give the younger scientists in Belgium an introduction to this older but basic field of investigations. Additionally, it was intended to give confirmed researchers an opportunity to update their knowledge in this widely diversified arena. A third series of objectives certainly included (1) emphasizing the current importance of this area of geophysics, where significant progress has recently been made and (2) indicating the usefulness of long time series of observations for intercalibration purposes and for checking future theoretical models for solar terrestrial relationships. These goals were largely achieved during this meeting at the Domaine Les Masures in Han-sur-Lesse.

The list of lectures presented is given below. All speakers must be acknowledged for their efforts to make their presentation clear and as attractive as possible.

- The Sun: Photosphere, Chromosphere, Corona—N. Grevesse (Université de Liège (ULg), Liège, Belgium)
- Solar Flares and Indices—J. Sauval (Observatoire Royal de Belgique (ORB), Brussels)
- Calcium Plages—M. Nicolet (IASB, Brussels)
- Recurrent and Periodic Stochastic Series: Theory and Application—R. Sneyers (Institut Royal Météorologique (IRM), Brussels)
- Estimation, Detection, and Interpretation of Spectral Properties as Tools for Geophysical Modeling—P. Pestiaux and A. Berger (Université Catholique de Louvaint (UCL), Louvain-la-Neuve, Belgium)
- Sunspot Numbers and Sunspot Faculae Areas—A. Koeckelenbergh (ORB, Brussels)
- Solar Constant "Variations"—D. Crommelynck (IRM, Brussels); V. Domingo (European Space Research and Technology (ESTEC), Noordwijk, the Netherlands)
- Solar Radio Fluxes—R. Gonze (ORB, Brussels)
- Solar UV and X Ray Variations—M. Nicolet, P. C. Simon, and L. Bossy (IASB, Brussels)
- Solar Wind Indices—J. Lemaire and M. Roth (IASB, Brussels)
- Geomagnetic Indices (Part 1)—M. Menvielle (Institut de Physique du Globe de Paris (IPGP))
- Geomagnetic Indices (Part 2)—M. Menvielle (IPGP)
- Ionospheric Indices—C. M. Minnis (Union Radio Scientifique Internationale (URSI), Brussels)
- Abnormal Quiet Days—G. M. Brown (University College of Wales, Aberystwyth, U.K.)
- Cosmic Ray Variations—J.-C. Jodogne (IRM, Brussels)
- Geomagnetic Activity and Solar Activity—P. A. Simon (DASOP, Meudon, France)
- Solar Radio Fluxes and UV and X Ray Variation—M. Nicolet and L. Bossy (IASB, Brussels)
- Correlation Between the Interplanetary Magnetic Field and the Pressure in the Troposphere—E. Page (ESTEC, Noordwijk, the Netherlands)
- Geomagnetic Indices (Part 3)—M. Menvielle (IPGP, Paris)
- Correlation Between Solar Wind and Geomagnetic Variations—L. Svalgaard (Stanford University, Stanford, Calif.)

These presentations, the notes prepared by the lecturers, and the fruitful discussions between all participants have inspired P. A. Simon (DASOP, Meudon, France) to reach some general conclusions. These comments and remarks are given below.

In any survey of the indices in use at present, it is necessary to note first that many indices have been proposed and have later been abandoned. Presently, the most widely used indices have resulted from selection by groups of scientists, one of the roles of the scientific unions; other indices have failed to be adopted because of weak points which have later become evident: for example, their complexity or the difficulty in acquiring the necessary data. It is wrong to assume that observations of any kind whatever are suitable for use as the basis for an index of some natural phenomenon. The scientific community must therefore accept with caution suggestions relating either to the abandonment of an index in current use or to the adoption of a new index.

Indices and Measurements

The fact that this meeting has been organized is a sign of a certain uneasiness within the scientific community as regards the indices. All current indices result from historical circumstances: the systematic observation of sunspots by H. Shwabe presented evidence for the existence of a cyclic solar activity, and R. Wolf introduced what he called the "relative sunspot number" in order to study this new phenomenon. This happened by the middle of the last century. Now observations ranging over the whole electromagnetic spectrum from the X to the radioelectric domain, as well as observations of solar particles and of various magnetic fields, are available. It is clear that an index based only on sunspots appears obsolete when the fullness of modern observations is taken into account.

Two questions are then to be asked: first, what could replace the current indices, and second, when should the publication of these obsolete indices be discontinued, especially those belonging to the longest series, which are the oldest and therefore the most out of date?

The first question is essentially related to the use of the indices. This use has two aspects: technological and scientific. The utilization of the indices for technological applications appears undoubtedly paradoxical. For example, the relative sunspot number is used for the prediction; some years in advance, of the conditions of propagation of the radio waves used for the communication via the ionosphere. It is evident that the sunspots, which are cold regions of the photosphere, are not responsible for the ionization of the high atmosphere. As another example, the radio flux at 10.7 cm is used for the evaluation of the drag of the satellite motion by the neutral atmosphere, whereas the radio emissions have no noticeable effect on the neutral atmosphere. In both cases the only reason why these indices are used is that there exists a more or less close statistical correlation between the phenomenon chosen as the index and those governing the state of the ionosphere or of the neutral atmosphere. Such a correlation implies, of course, a statistical relation between a great number of data with an appreciable dispersion when only small series of events are considered.

The replacement of indices requires, for each special application, that the physical processes which are implicated be well understood. The decisions needed are not easy to make. One soon realizes that for each application, one or several series of measurements have to be undertaken, often on board a satellite. Recent experiments have shown that, for instance, in the domain of the UV fluxes the reliability of those measurements is not obvious. Disregarding the high cost of such programs, it follows that one tends toward a splitting of the few series of indices into a multiplicity of measurements more appropriate for one or the other application but with a restricted field of use. This emphasizes the simplicity and, in general, the relatively low cost of acquisition of the present indices as

well as their character of "universality." The latter results from the choice of the basical phenomenon which, fortunately, has generally been made with a fair intuition. In order to continue with the previous examples, one may say that the connection between the time of appearance and the complexity of sunspot groups on the one hand and the radiation in the UV and X domains on the other hand is close enough to use the spots as fair indicators of the intensity of those radiations, at least from a statistical point of view. In contrast, measurements of the so-called "solar constant," which give much more fundamental information, since they cover the whole solar spectrum, would be a very bad index of solar activity: on the one hand the total solar flux is mainly affected by the photospheric cooling due to the big spots, whereas on the other hand the UV and X fluxes belong to one "wing" of the solar spectrum, a region with a small contribution (10^{-5} to 10^{-6}) to the total energy radiated. From this point of view the solar fluxes in the centimetric domain are also fair indices of activity and, as recently demonstrated, can be used to homogenize UV observations, although they refer to the other extremity of the spectrum.

Until now, the scientific applications of the indices were mainly concerned with the study of the properties of the solar cycle (duration, amplitude, etc.). In this type of research, one looks inside the deep layers of the sun for the phenomena which give rise to the magnetic field which causes the solar activity. Then one must get rid of the effects on the indices of the solar rotation and of the lifetime of the active centers. This is achieved by smoothing and harmonic analysis procedures for which the length of the series plays an important role in regard to their reliability. From this standpoint, any new series of measurements would presently be unable to provide the same assistance as the current indices. These are therefore irreplaceable for the time being.

Conclusion

In spite of their imperfections, it is necessary to continue the programs of observation and data reduction leading to the publication of the longest series of indices; such indices are indispensable as indicators of the long-term components of certain phenomena and also for making long-term forecasts. More recent indices, such as those based on 10-cm solar noise or ionospheric measurements, are also very valuable and are especially useful in several scientific and technical fields, for example, in checking the correct functioning of instruments on satellites. Finally, it is most likely that long series of observations, in some cases extending over several centuries, contain scientific information which it will eventually be possible to interpret in terms of the physics of the corresponding indices. So far as new indices are concerned, they must cover a period including at least one solar cycle of high activity; the preparation of such indices should be encouraged because, apart from the knowledge acquired about the phenomena observed, they will make it possible to refine the uses made of the older indices and to extract more of the information which is most probably contained in these long series. To achieve this objective, it will be necessary to encourage the continuation, over a period of several decades, of programs of observations and measurement, leading not only to new indices but also to the long established indices.

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