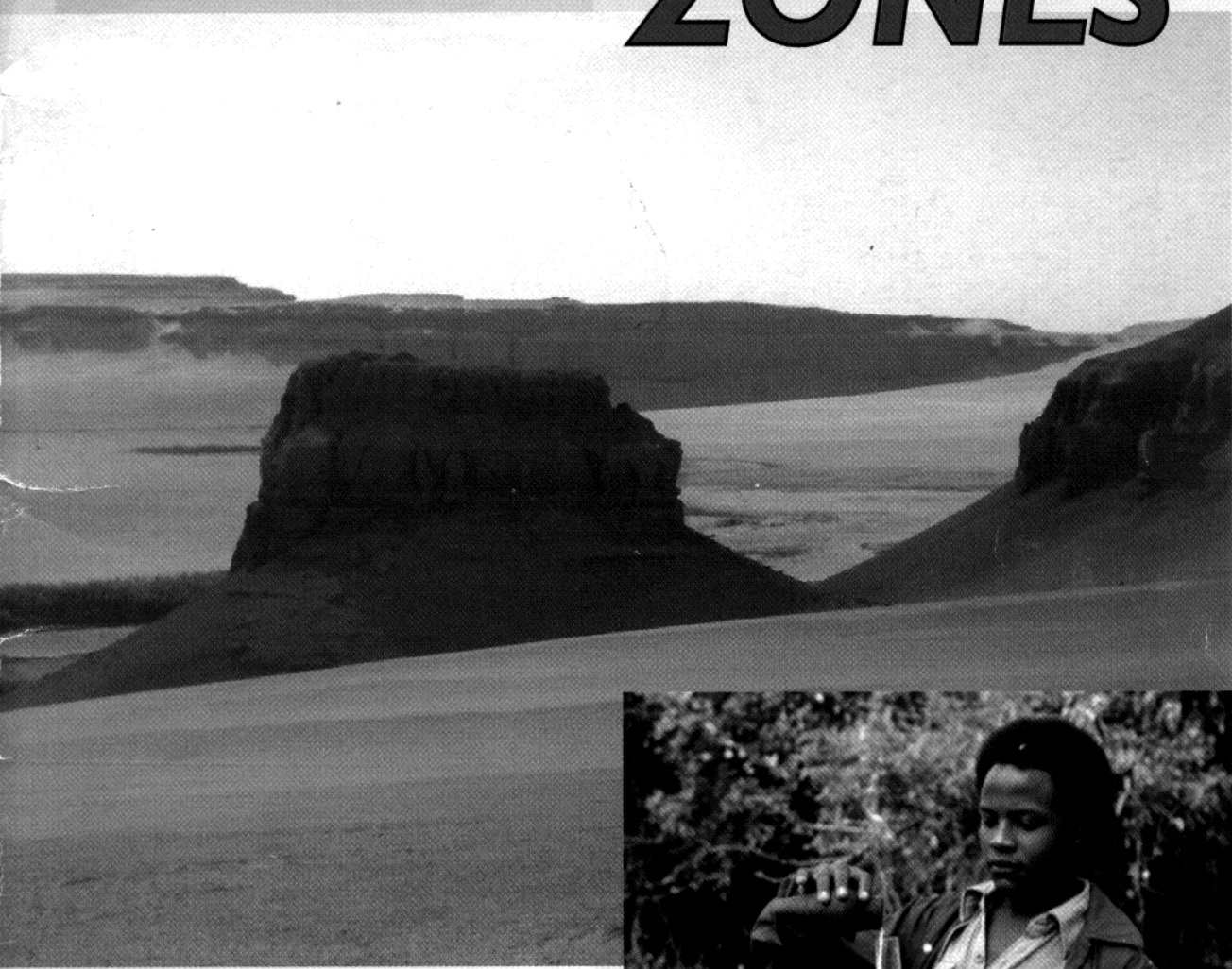


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ARID ZONES



in

UNESCO's

programmes



Arid zones in

91-1000



M. Skouri

UNESCO's programmes

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Desert landscapes have throughout the ages elicited

More prosaically, the scientific community first became interested chiefly in the study of the components of the natural environment (geology, climatology, hydrology, etc.) and, to a lesser degree, in questions concerning human occupation and the other socio-economic aspects.

It is only lately that the international community as a whole has begun to realize the importance of the socio-economic problems affecting the zones situated on the periphery of the great deserts of our planet.



INTRODUCTION

strong feelings of mystery and foreboding and fascinated poets and travellers.

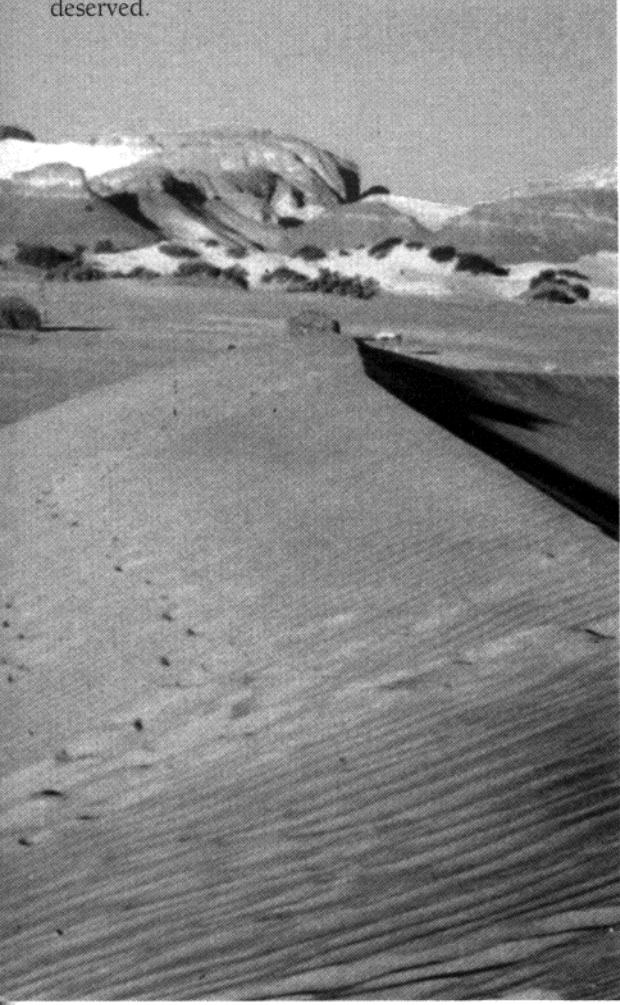
The image of the desert also evokes serenity, spirituality and meditation.

The great drought which affected Sahelian Africa in particular at the end of the 1960s and the beginning of the 1970s made people aware of the human suffering and ecological disasters occasioned by this phenomenon, the causes and magnitude of which remain unexplained even today. The main result of this universal awareness was the organization of the United Nations Conference on Desertification held in Nairobi (Kenya) in August/September 1977, which led to the adoption of a Plan of Action to Combat Desertification. Unfortunately, this Plan did not receive the support it deserved.

Faced with the persistence of ecological and socio-economic problems due to drought and desertification, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro (Brazil) in June 1992 gave the African States an opportunity to reopen the discussion on these questions, which are of the utmost concern to them. The international community, acknowledging that desertification was an environmental problem of global dimensions requiring urgent measures, was thus led to decide, at the highest political level, to draw up an International Convention to Combat Desertification. The Convention was adopted on 17 June 1994 following the Fifth Session of the Intergovernmental Negotiating Committee for its drafting, which was held at UNESCO Headquarters, Paris, at the invitation of the French Government. It was in Paris, too, that the ceremonies for its signature took place on 14 and 15 October 1994. With other relevant components of Agenda 21, the main platform adopted at the Rio Conference (and Chapter 12 of that platform in particular), the Convention was to be the principal frame of reference for the activities to be implemented to ensure the development and protection of the environment in arid, semi-arid and dry sub-humid zones.

UNESCO, after concerning itself for 45 years with arid zone problems, could not fail to take an active part in the implementation of the Convention in the Organization's various spheres of competence, with due regard for the evolution of the international context.

Landscapes on which erosion and human activity have left their mark.



*With its extremely broad mandate,
covering all the sciences,
including the social and
human sciences, education,
culture and communication,
UNESCO is ideally placed
to tackle environmental problems
and their interaction
with development factors.*

WITH an eminent biologist, Sir Julian Huxley, as its first Director-General, UNESCO paid special attention to the natural sciences from the outset, regarding them as an ideal sphere for international co-operation. It was thus led very early to develop various scientific programmes dealing with the different components of the environment in the broadest sense of the term (oceans, water resources, terrestrial ecosystems and the lithosphere). In addition, various activities relating to the basic sciences and the engineering sciences (fundamental and applied microbiology, renewable sources of energy, and so forth) were focused on practical applications to development and the protection of the environment. All this led to an attempt to integrate the environmental dimension in educational curricula at all levels and to develop the concept of environmental education.

As it happened, arid zones were precisely at the centre of UNESCO's earliest efforts at international scientific co-operation in the study of natural resources. The first international study and research programme dealing with these zones was launched back in 1951 under the direction of an international Advisory Committee. It was continued until 1964, after being raised to the status of a Major Project of the Organization in 1957. This Major Project was a pioneer programme in many respects. One of its merits, and not the least, was that it blazed a trail in its interdisciplinary approach to the study of natural resources and its holistic approach to the problems of arid and semi-arid zones. It was followed by a series of other intergovernmental programmes having significant components relating to arid and semi-arid zones.

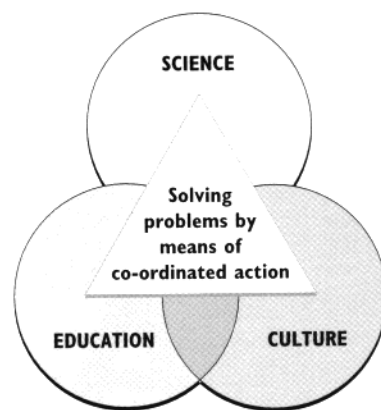
These various scientific programmes included considerable training, education and information components in their respective fields. Since 1975 an international programme on environmental edu-



cation, launched in co-operation with the United Nations Environment Programme (UNEP), has been under way. This programme has evolved in recent years, moreover. In 1993 it became an Environment and Population Education and Information for Human Development Project (EPD). To these scientific and educational programmes should be added various programmes relating to the vast sphere of culture, in which the problems involved in the protection of the environment also occupy a prominent place. These problems are tackled in particular in the context of activities carried out in connection with

UNESCO,

*special features
of its mandate
and the way it works*



Intergovernmental programmes with considerable arid and semi-arid zone components

- ▶ The **International Hydrological Decade (IHD)** (1965-1974), which was relayed in 1975 by the **International Hydrological Programme (IHP)**, water obviously being one of the main factors limiting development in arid and semi-arid zones.
- ▶ The **Man and the Biosphere (MAB) Programme**, launched in 1971, which deals with terrestrial ecology and natural resources management and conservation problems in general. Arid zones occupy an important place in it owing to the impetus given by the International Biological Programme (IBP) and the Major Project on Scientific Research on Arid Lands which preceded it.
- ▶ The **International Geological Correlation Programme (IGCP)**, launched in 1972, which studies various geological phenomena, including palaeoclimatic aspects and their past and present effects on the environment.

These various intergovernmental programmes have a number of features in common, in regard to both their ways of working and their general objectives. For they are intergovernmental programmes aimed at:

- ▶ **mobilizing** the scientific community working in a particular field,
- ▶ **extending** knowledge in that field,
- ▶ **promoting** new approaches, methods and techniques,
- ▶ **improving** the standard of the scientific and technological information circulated,
- ▶ **facilitating** the exchange of ideas, information and expertise,
- ▶ **contributing** to the strengthening of scientific and technological capacities, in particular by facilitating the training of specialists in those countries most short of them.

Organization and supervision of activities at national level are the responsibility of national committees set up for the purpose.

the Convention concerning the Protection of the World Cultural and Natural Heritage, which is designed to safeguard the wonders of nature and the masterpieces of human genius, including those outstanding sites where these two elements are found together.

Before the objectives, main lines and results of the various programmes dealing directly or indirectly with the various aspects of arid and semi-arid zone problems are reviewed, attention must be drawn briefly to the different features and problems of the development and protection of the environment in

these zones and the implications for the focusing of research.

In so far as results are concerned, considerable space is given here to the activities carried out under the Man and the Biosphere (MAB) Programme, for its action is fully in keeping with the purport and the spirit of the new Convention and directly furthers most of its objectives. ||

A jumble of rocks bearing carvings and paintings dating back to the neolithic revolution (Tassili N'Ajjer National Park).

Arid and semi-arid zones account for more than one-third of the Earth's land area and are inhabited by about 16 per cent of its population

High winds blowing away the finer particles of the soil in an area planted with olive trees.

A feature of arid and semi-arid zones is that they do not easily lend themselves to agricultural production, owing to their climatic conditions (scanty and variable rainfall, high temperatures, parching winds) and their edaphic conditions (degraded soils, etc.). These conditions have led the populations to develop strategies for survival based on certain patterns of social organization, usually involving considerable mobility, entailed by the seeking of watering-places and sources of food for themselves and their herds.

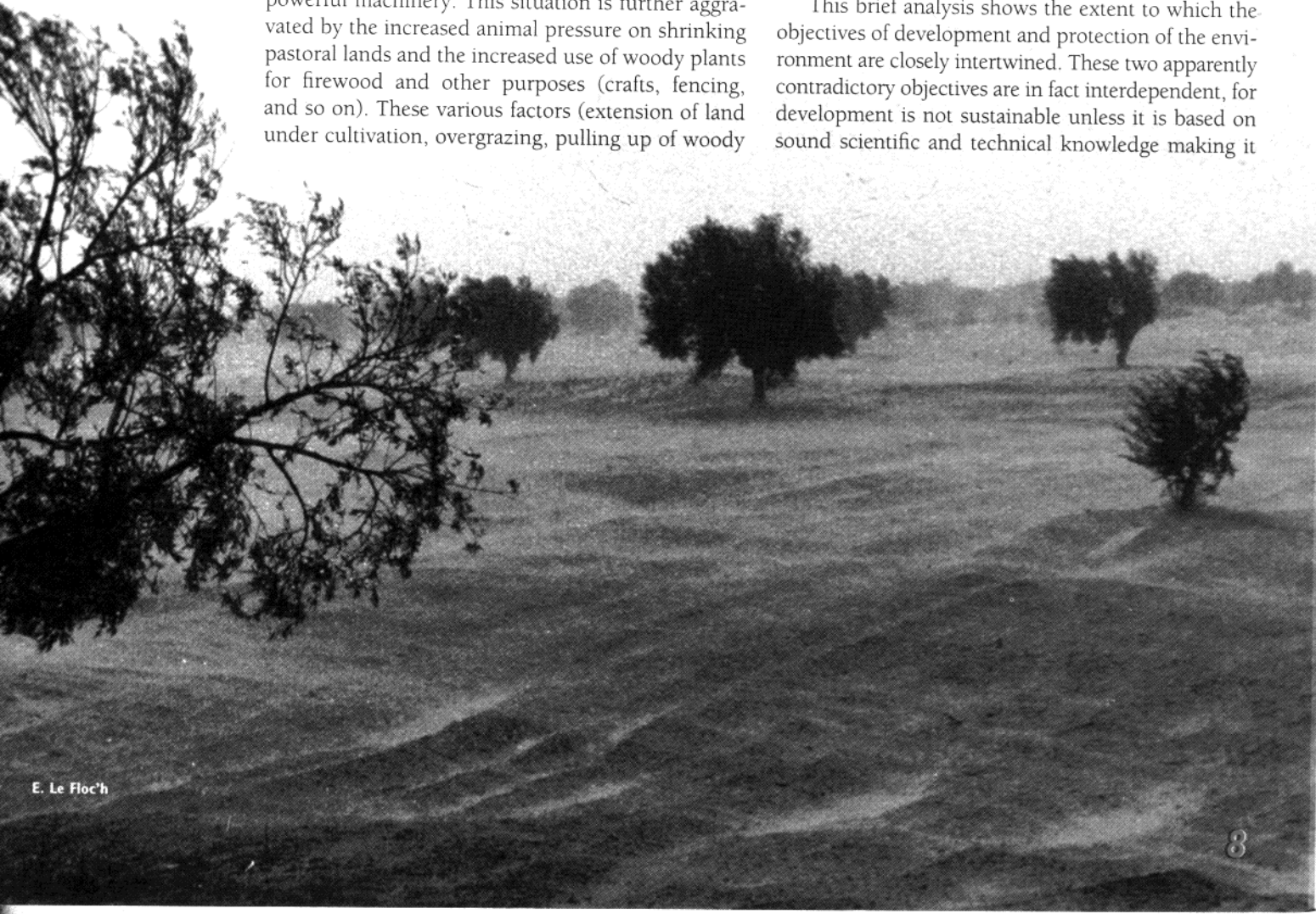
Associated with low human and animal pressure, this mobility made it possible until relatively recently to maintain the balance of the natural ecosystems. However, with the population increase and owing to the settling of a large proportion of the nomadic populations and the smaller range of transhumance, the traditional pastoral methods have given way to agropastoral methods, which have upset that balance. For agriculture has been progressively extended at the expense of the best grazing lands, the natural plant cover of which has been destroyed by increasingly powerful machinery. This situation is further aggravated by the increased animal pressure on shrinking pastoral lands and the increased use of woody plants for firewood and other purposes (crafts, fencing, and so on). These various factors (extension of land under cultivation, overgrazing, pulling up of woody

plants, etc.) have resulted in the further weakening of ecosystems, the lessening of their capacity for regeneration and a decrease in their production potential. In the most fragile zones, the overexploitation of natural resources has made the land more prone to desertification and led to almost irreversible forms of degradation.

What is more, different forms of fairly intensive irrigated agriculture have been developed, water resources permitting. While helping to increase and regularize farm-produce, the extension of irrigation has often given rise to excessive exploitation of groundwater reserves and degradation of a part of the land by salinization and/or alkalization. This degradation is a consequence of inadequate drainage and of the high salt content of the water ... These forms of desertification are even more disastrous than those which affect the unirrigated zones.

All of these factors combine to accentuate the degradation of natural resources and the deterioration of the living conditions of the populations in a large part of the world's arid and semi-arid regions.

This brief analysis shows the extent to which the objectives of development and protection of the environment are closely intertwined. These two apparently contradictory objectives are in fact interdependent, for development is not sustainable unless it is based on sound scientific and technical knowledge making it



THE PROBLEMS INVOLVED

in rural development in arid zones and lines of research

possible to establish the optimal conditions for the use and regeneration of the resources available. If ecological constraints are not observed, the process of degradation of the environment, and hence desertification, will inexorably be hastened and the objectives of development will in the long run be jeopardized.

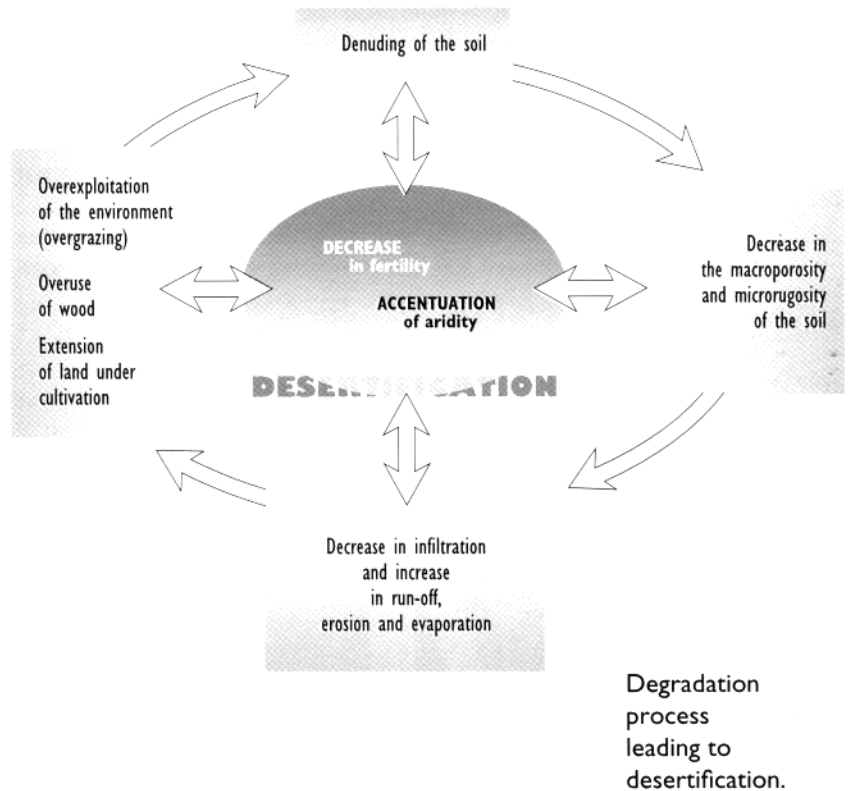
Traditional patterns of organizing and managing the land were developed in the course of time with a view to making the best of its microdiversity and turning to account the limited available resources, water resources in particular. In most cases, however, these systems have reached their limits, as a result, in particular, of the steady increase in the human pressure. It has thus become necessary to have recourse to more effective systems based on new technologies and a thorough knowledge of the environment.

The rehabilitation and improvement of the traditional systems and the development of new, more appropriate systems can be effected only by means of an integrated ecological approach to rural development, an approach aimed at reconciling socio-economic development objectives with the imperatives of protection of the environment.

The research required to work out and apply such an approach comes under three heads:

- scientific research to go more deeply into the structure and working of ecological systems, their breaking points and the conditions of their rehabilitation;
- technological (agricultural) research, which consists in developing practical solutions to ensure an increase in biological production and halt the different processes that degrade the environment;
- socio-economic studies of the viability and profitability of the solutions and techniques proposed, the conditions of their acceptance and adoption by the populations concerned.

The distinguishing of these three lines of investigation should not allow us to forget that they are often closely intertwined. It is therefore essential to see all



three as a continuum so that research is conducted in an interdependent and complementary fashion in the context of a comprehensive and coherent view of the problems to be solved and the objectives to be attained. This presupposes that research is conducted as far as possible by research teams with an interdisciplinary approach, working in close liaison with planners, decision-makers, extension workers and the populations concerned.

This approach was tried out in a number of research and experimental projects undertaken in the field as part of the Man and the Biosphere (MAB) Programme, the results of which will be presented later.

THE main activities carried out and the action taken under the Man and the Biosphere (MAB) Programme and the Major Project on Scientific Research on Arid Lands which preceded it can be grouped under three broad heads: pilot projects in the field; training and capacity-building activities; comprehensive surveys and exchanges of information.

P ILOT PROJECTS

Pilot projects are projects with an integrated multi-disciplinary approach combining research and experimentation, monitoring, training and demonstration, and associating from the outset extension workers (popularizers, planners) and the populations involved. In so far as research proper is concerned, special emphasis is laid on the study of socio-economic factors. For it has become increasingly clear that failure in the implementation of development projects in rural environments is more often than not due to neglect of these factors and the concomitant constraints. Besides, pilot projects are designed in such a way as to enable different specialists working on the same type of problem in the same country, or in countries or regions with similar conditions, to meet and exchange information and pool their experience.

Among the main projects dealing with arid zone problems and the combating of desertification with

which the Division of Ecological Sciences has been closely associated, special mention should be made of: the Integrated Project on Arid Lands in Northern Kenya (IPAL-Kenya) and the Integrated Project on Arid Lands in Southern Tunisia (IPAL-Tunisia). Although inspired by the same scientific approach, which is that of the Intergovernmental Programme on Man and the Biosphere (MAB), these projects have distinctly specific features, owing to the very different conditions under which they were implemented and the diversity of the needs identified and the problems tackled. Taking that diversity into account is itself a part of the scientific approach adopted.

The IPAL-Kenya Project

The IPAL-Kenya project was started in 1976 with the co-operation of the United Nations Environment Programme (UNEP) and continued from 1980 to the end of 1987 with aid from Germany. In this project the emphasis was on analysis of the methods of the traditional stockbreeding systems in the arid part of Kenya and on finding ways of enabling changes to be made in those systems with a view to improving the living conditions of the populations concerned and effectively protecting the natural environment. The zone studied covered an area of 22,500 km², extending between Lake Turkana and the Marsabit range. As well as yielding different scientific and technical findings concerning the various components of the natural environment (climate, soil, vegetation, flora, fauna, water resources) and the human environment, the project led to the preparation of a Management Plan for almost half of the zone studied.

The last stage of the project consisted in setting up the Kenyan Arid Land Research Station (KALRES) for the purpose of following up the research, training and demonstration activities launched under the project and

MAB

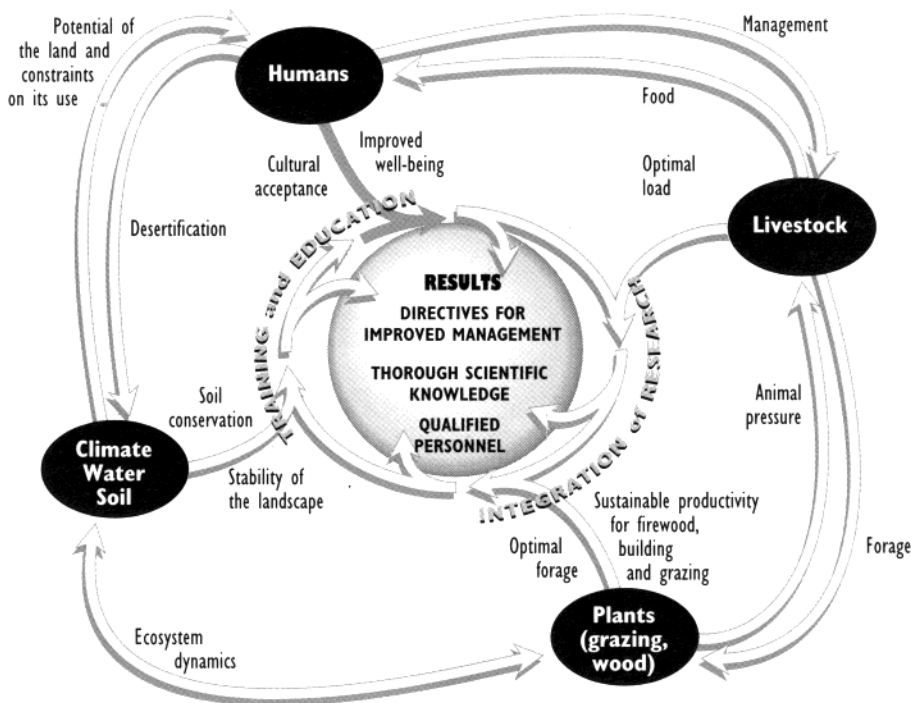
THE MAB PROGRAMME,

*integrated approaches
and practical action*

S. Schwartz

developing further applied research to ensure the smooth implementation of the Management Plan, or any other development programme drawn up for the arid part of Kenya.

This project gave rise to much scientific and technical literature (more than 120 articles and documents of various kinds). It was visited by more than a thousand people from 56 countries and hosted four regional and international briefing and discussion seminars, which were attended by 68 specialists from 33 different countries. These figures are a measure of the interest aroused by such a project, both regionally and internationally, and the great effort made to ensure that its results were widely known.



Above:
Under the IPAL-Kenya Project, the training of key personnel, experimentation in the field and extension work are carried on simultaneously.

Left:
Interaction of the main factors involved in the degradation of the environment.

The IPAL-Tunisia Project

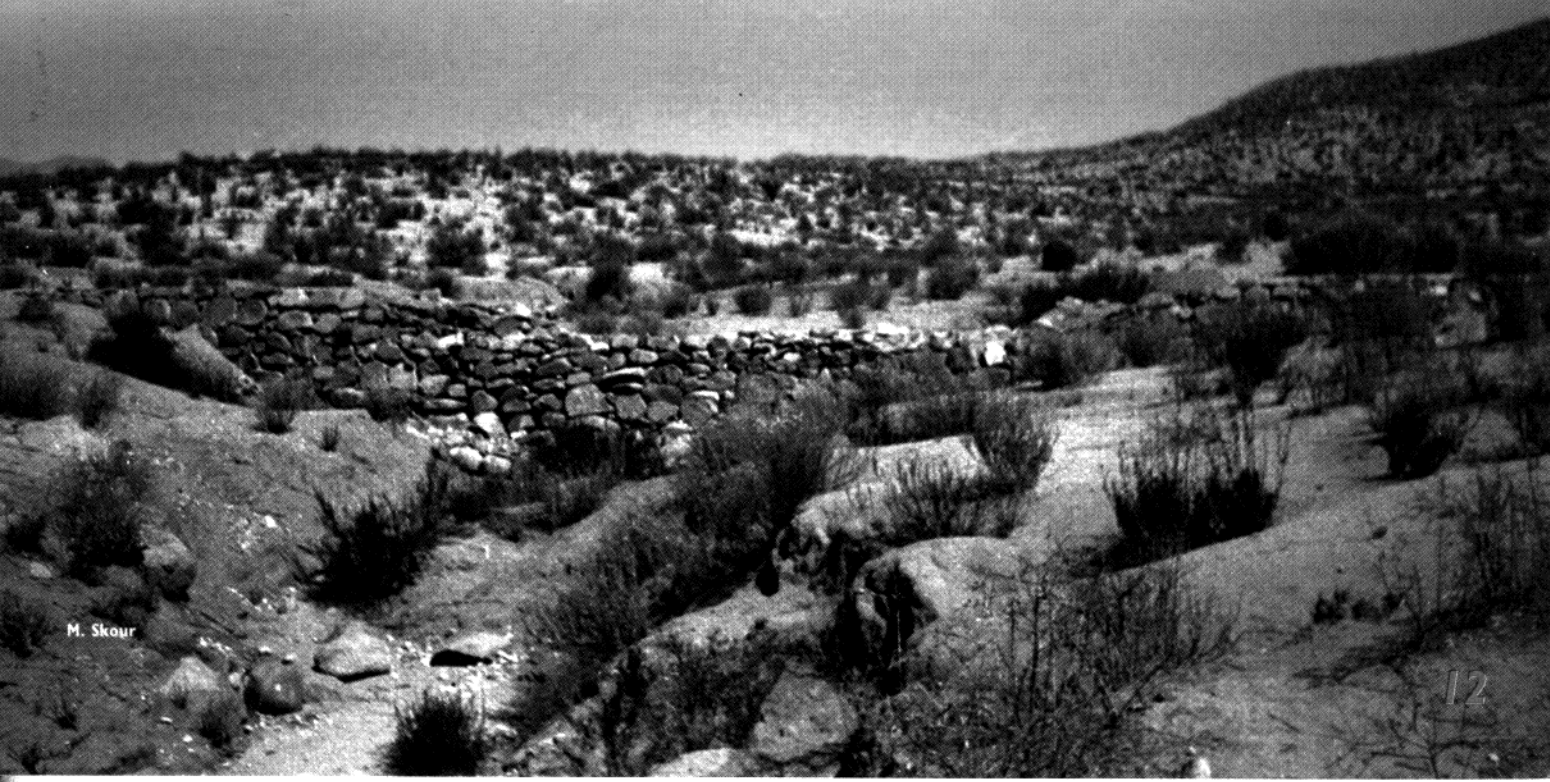
This project went on for four years (early 1980 to early 1984) with UNEP support. It followed other experimental research projects dealing with the problems of the arid and pre-desert zones of Southern Tunisia. It differed considerably from the IPAL-Kenya project both in its approach and objectives and in its organization and way of working. As the area concerned by the IPAL-Tunisia project had already been the subject of comprehensive studies and research, the emphasis was laid on extending scientific knowledge and strengthening of training and demonstration activities, with a view to developing the endogenous capacities of the host-institution and turning to account past and current research findings.

Over the next two years (1985-1986) the IPAL project was followed by a pilot project to combat desertification in Southern Tunisia, which also comprised research, training and demonstration activities.

Two regional seminars were organized - one in late 1983, one in late 1986 - for specialists from countries in the north and the south of the Sahara to make the findings of these projects widely known and to facilitate the pooling of information and experience in regard to problems of common interest. The findings also served as a scientific and technical basis for the preparation of the national strategy to combat desertification, which was adopted by the Tunisian authorities in 1986. This document, drawn up with the help of UNEP and with UNESCO's participation, sums up the position with regard to the natural environment in the areas threatened with desertification, then analyses the causes and effects of desertification. It further reviews the various measures and operations to combat desertification, outlines the objectives to be attained and the means of attaining them and recapitulates the priority projects decided on when the strategy was worked out, these projects being its main operational component.

*A number of other countries,
such as Algeria,
Chile, Egypt, Mexico
and Pakistan,
carried out projects similar
to the IPAL-Tunisia project
as their contribution
to the MAB Programme,
generally finding
the necessary funds themselves.*

Loose stones
piled up across a
'thalweg'
to check run-off
(Chile).



The Pilot project to combat desertification in Southern Tunisia laid emphasis on the following three aspects:

- ▶ use of remote sensing for the monitoring of desertification and the study of the dynamics of plant cover,
- ▶ ecology of sand-stabilizing plants,
- ▶ improvement of plant cover, in particular, through the planting of forage shrubs over larger areas.

View of the Institut des Régions Arides, Médenine (Tunisia). Collection of forage shrubs.



M. Skouri

The project relating to evaluation was entitled 'Monitoring of desertification: Study of the effects of activities relating to development and the combating of desertification'. It deserves special attention for it is the integrating element and the keystone of the strategy. Indeed, one of its purposes was to assemble the ecological and socio-economic data required to evaluate the impact of the action taken on the evolution of desertification, to explain that evolution and to identify the corrective measures which might make it possible to reverse the different degradation processes.

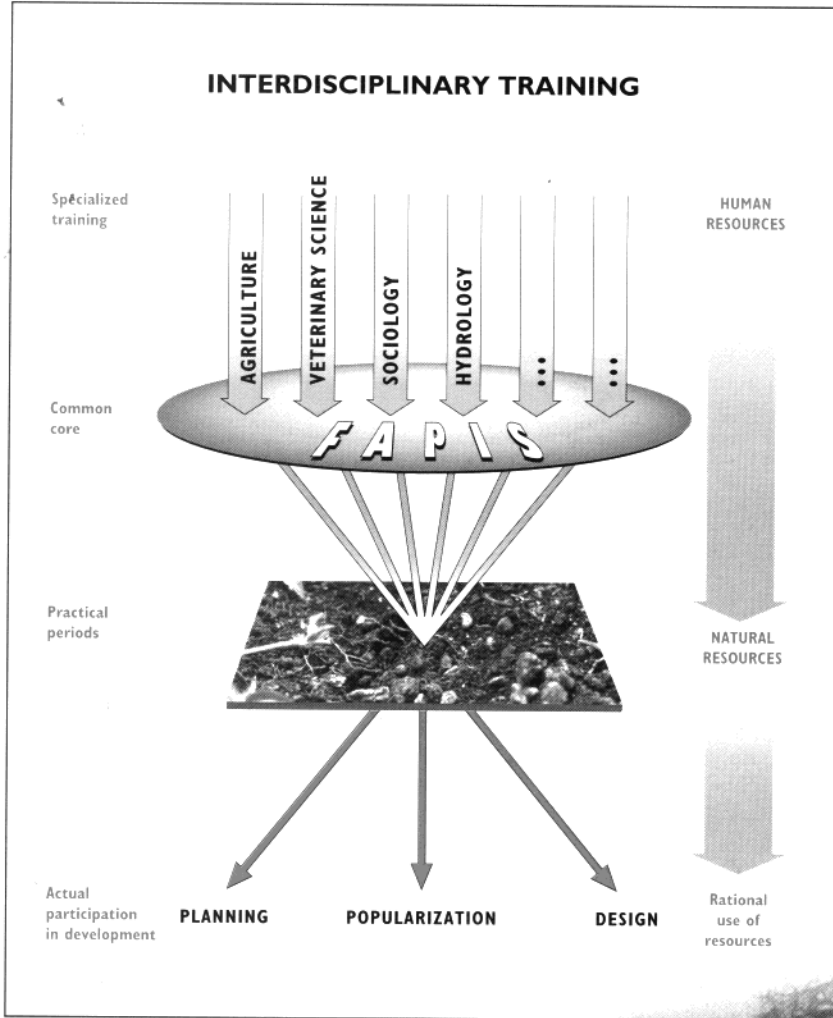
A number of other countries, such as Algeria, Chile, Egypt, Mexico and Pakistan, carried out similar projects as their contribution to the MAB Programme, generally finding the necessary funds themselves.

Such projects were often developed as a part of the application of the principle of biosphere reserves, which are designed to reconcile nature conservation imperatives with socio-economic development objectives. This was the case, in particular, with the projects undertaken in the Mapimi Reserve in Mexico, the El Omayed Experimental Research Area in Egypt, the Repetek Reserve in Turkmenistan in the former USSR, the Big Bend National Park and the Jornada Experimental Range in the United States of America.

The 22 priority projects in the National strategy to combat desertification adopted in 1986 related to the following aspects:

- ▶ inventorying of resources,
- ▶ backup research,
- ▶ training, information, awareness-raising, popularization, rural extension work,
- ▶ integrated rural development and protection of the natural environment,
- ▶ evaluation of the impact of development projects and action taken to protect the environment.

TRAINING AND CAPACITY-BUILDING



The pilot projects mentioned earlier systematically included training activities and therefore contributed largely to scientific and technological capacity-building in the countries concerned. For one thing, they helped to promote their inherently interdisciplinary approach, for another, they provided the teams and organizations involved in their implementation with additional equipment and operating resources. In certain projects, however, special emphasis was laid on training and capacity-building. This was the case with two regional projects in particular: the FAPIS project (Training in Integrated Pastoral Management in the Sahel) and the RCS-Sahel project, a project for scientific capacity-building in the field of agro-sylvo-pastoral development in the Sahel.

Whereas over the present decade efforts have been largely concentrated on the Sahelian region, which is probably the most vulnerable, other regions in Africa and Asia have benefited from UNESCO support in previous decades.

The FAPIS project

The FAPIS project was designed in response to the Sahel countries' lack of specialists in the field of pastoral management. It was realized that pastoral management called for an integrated approach to rural development meeting two basic needs of these countries - self-sufficiency in regard to food and the combating of desertification. So the FAPIS project paid



Permanent pools are important for life in the Sahel.

**From August 1980 to December 1989
the FAPIS project provided:**

- ▶ training (postgraduate) for 112 high-level personnel from 12 Sudano-Sahelian countries,
- ▶ retraining for 151 technologists from 13 countries in the same region.

special attention to training high-level personnel capable of designing, implementing and following up pastoral management programmes and projects and promoting the integrated approach to agro-sylvo-pastoral development.

Launched in August 1980 with the co-operation of the Institut du Sahel and the Inter-State Committee on Drought Control in the Sahel (CILSS) and with the assistance of the United Nations Development Programme (UNDP) and the United Nations Sudano-Sahelian Office (UNSO), this project was continued until the end of 1989.

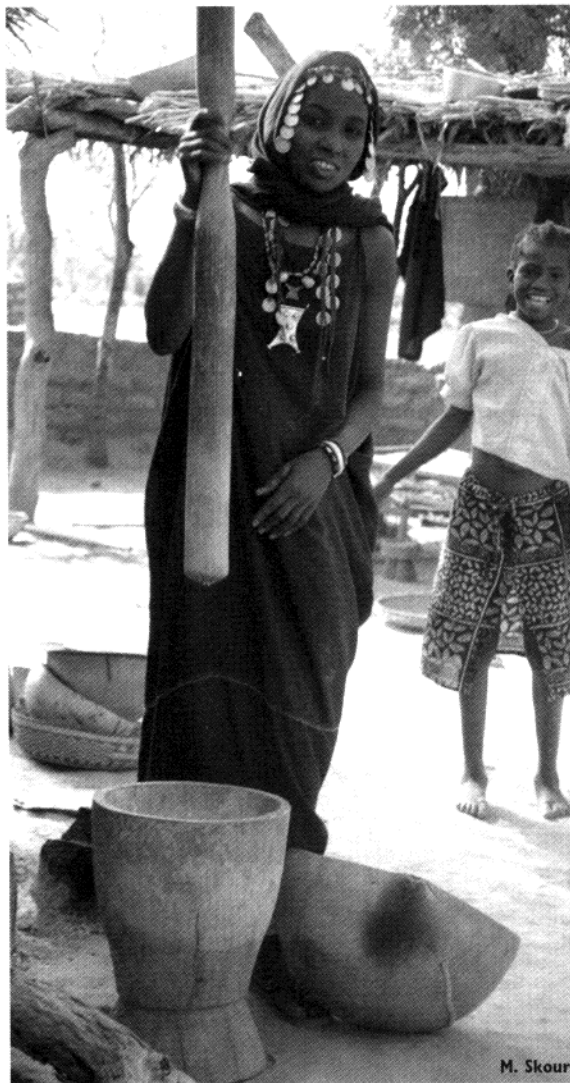
Ten regional seminars were held on various aspects of agro-sylvo-pastoral development and ten study tours were organized in different countries in the Sahel. National seminars and study sessions organized on the occasion of these tours helped to promote the new approaches and techniques and bring them to the notice of the personnel concerned at different levels and, of course, the rural populations.

It should be stressed that the main features of the educational method adopted for this project were inter-disciplinarity and a holistic and integrated approach to the situations and problems of the Sahelian rural world. This approach was designed to meet the development and management needs of the Sahelian lands, in which agriculture, forestry and stockbreeding interact. It takes into account the different parameters of development, and also their interactions - biophysical environment factors, socio-economic and cultural factors, technical factors.

The RCS-SAHEL project

On the basis of the experience gained with the FAPIS project, UNESCO's Division of Ecological Sciences, with the help of the Federal Republic of Germany, launched a new project in 1989 on scientific capacity-building in the Sahel countries in the field of agro-sylvo-pastoral management (RCS-Sahel).

Regional seminars and courses were organized for this purpose, including one in Bamako in December 1994 on the integration of the human and socio-economic sciences in agro-sylvo-pastoral management research programmes. Carried out in close co-operation with the Institut du Sahel/CILSS, these activities helped strengthen the role of that institution and the findings were widely circulated in all its member States so that they could benefit by them.



Young Peul woman holding a pestle to pound millet, in a Sahelian village in Mali.

**The RCS-Sahel project
is designed in particular to:**

- ▶ strengthen existing institutions (IRBET in Burkina Faso, IER in Mali, CNERV in Mauritania, the Faculty of Agronomy in Niger and ISRA in Senegal) by helping to improve the training of young researchers and providing 'limited' additional means,
- ▶ mobilize these researchers on behalf of research topics having priority in their countries,
- ▶ help these institutions make better use of the findings of previous research, either by taking it further or by disseminating those findings which are accessible to the public,
- ▶ facilitate contacts between researchers and extension workers, in particular by encouraging exchanges and joint initiatives,
- ▶ create a synergy of the research teams, by facilitating exchanges of information and expertise and co-ordination of approaches and methods.



The livestock market, a place for people to meet and trade.

M. Skouri

Other initiatives concerning **THE SAHEL COUNTRIES**

Among the initiatives taken with a view to strengthening training and research capacities in the countries of the Sahel, mention should be made of the project for the strengthening of the Katibougou Rural Polytechnical Institute (the IPR), which is being carried out as part of the Priority Africa Programme. The Institute has for a long time played an important role in the training of Africa's key agricultural personnel, so the Malian authorities, supported by a number of other African countries, asked UNESCO to help them strengthen its regional competence in the matter of training and applied research in the field of integrated rural development and the combating of desertification.

The activities undertaken at the end of 1994 or early in 1995 related in particular to:

- ▶ renovation of courses with a view to adapting them more closely to the goals and strategies of the countries of the Sahel,
- ▶ strengthening of one or two of the Institute's teaching and research units which might serve as pilot units, so to speak, in the renovation envisaged,
- ▶ preparation of a file to serve first as a basis for concerted discussion concerning the Institute's stated purpose and later as a platform for fund-raising.

Other **REGIONS**

As well as the Sahelian region, on behalf of which sustained efforts have been made in the past few years, other arid regions have benefited from UNESCO support in earlier periods. Tunisia, in particular, received support under the IPAL-Tunisia project for the strengthening of the Institut des Régions arides set up in Médenine in 1976. Support was also provided earlier for the strengthening of the Desert Institute in El Matariya near Cairo (Egypt) and for the setting up of the Central Arid Zone Research Institute (CAZRI) in Jodhpur, Rajasthan (India) and the Negev Desert Institute in Beersheba (Israel).

Many courses and seminars on different arid and semi-arid zone problems have been organized at these institutes or similar institutions. Among the more recent, mention might be made of the course organized, with the co-operation of the UNEP, at the Matopos Research Station in Bulawayo (Zimbabwe) in June 1994, which was attended by some 30 participants from eight countries in southern and eastern Africa (Botswana, Kenya, Lesotho, Malawi, Namibia, Tanzania, Swaziland and Zimbabwe). This course dealt with the problems involved in combating desertification in the Southern African Development Co-ordination Conference (SADCC) countries.



SURVEYS AND EXCHANGES OF INFORMATION

It is impossible to draw up an exhaustive list of the publications and other forms of exchange of information relating to the different arid zone programmes carried out under UNESCO's auspices. So just a few indications will be given here concerning the most outstanding among them.

The MAJOR PROJECT

and the Arid Zone Research Series

The first arid zone programme, which went on from 1951 to 1964, began with the preparation of a map of the 'World distribution of arid and semi-arid homoclimates' by Peveril Meigs, and led to the publication of some 30 volumes in the Arid Zone Research Series between 1953 and 1969. These volumes consist of reports on the state of the art in various fields such as hydrology, climatology and microclimatology, water/soil/plant relations, climatic changes, solar and wind energy and the history of arid land use. These reports still constitute excellent basic references and have served as a starting point for later studies on various aspects of arid and semi-arid zones.

CASE STUDIES

on desertification

Case studies were carried out in 1976-1977 as part of the preparations for the United Nations Conference on Desertification held in Nairobi (Kenya) in August/September 1977. Their main objectives were to:

- ▶ give a precise idea of the state of desertification in the principal areas affected,
- ▶ analyse the causes and the effects of this phenomenon,
- ▶ identify action and measures to be taken to cope with the resulting ecological and socio-economic problems.

Six different geographical areas were selected so as to include the most typical cases and allow of comparison:

- ▶ Regions with rainfall in the hot season
 - ▶ **Niger:** the Eghazer and Azaouak areas in the centre west of Niger,
 - ▶ **India:** the Luni development sector in the State of Rajasthan,
- ▶ Regions with rainfall in the cold season
 - ▶ **Chile:** the Coquimbo region, Fourth Region of Chile,
 - ▶ **Tunisia:** the Oglat Merteba area in Southern Tunisia, near Gabès,
- ▶ Regions affected by waterlogging and salinization of the land
 - ▶ **Iraq:** the project in the Great Musayyib region, south of Baghdad,
 - ▶ **Pakistan:** the Mona experimental development project in the northern central part of the Chaj Doab.

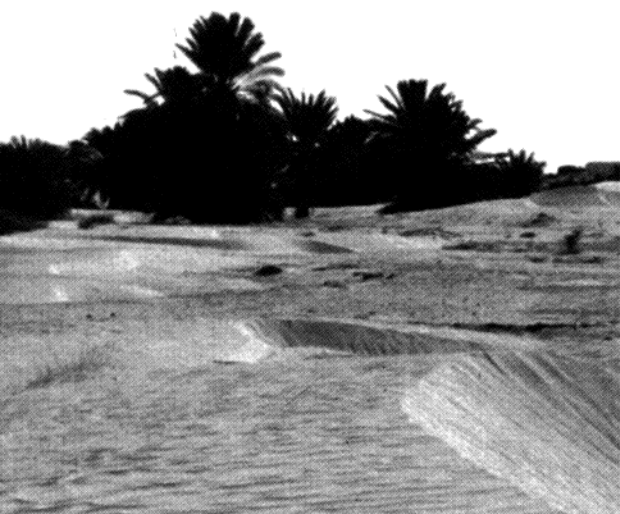
These studies were supplemented by a number of other studies concerning other desert zones of the globe situated in Asia, Australia and North America. This series of studies made it possible to have a global view of the problems of desertification in the world and served as a basis for the preparation of the Plan of Action adopted at the Nairobi Conference and by the various international authorities concerned.

Three of these case studies (Chile, Niger and Tunisia) were updated in 1983 as part of the evaluation of the progress made in the implementation of the Plan of Action to Combat Desertification seven years after its adoption. This updating did not reveal any significant trend in desertification in the three zones studied, but it shed light on different approaches in regard to strategies for combating desertification.

In Niger, the slight increase in rainfall between 1977 and 1983 did not enable the natural vegetation to return to its pre-drought level, although it seemed to retain a fairly considerable potential for regeneration. This potential could be turned to account by adapting the numbers of domestic animals to the grazing capacity of the rangelands and managing the latter in a rational way.

In Chile and Tunisia, on the other hand, human and animal pressure on the natural ecosystems had reached a point where it seemed impossible to restore the balance of these ecosystems, even when rainfalls were favourable. Chile has thus concentrated, as proposed, on developing reforestation programmes, using, in particular, local species adapted to the environment. Tunisia has turned towards an agricultural development of the semi-intensive type, based on judicious use of run-off water obtained, in particular, by the building of a multiplicity of small dams to hold back the water and combat wind and water erosion.

These three examples show that the technical solutions and the strategies to be implemented to combat desertification vary not only with the conditions of the environment, but also, and above all, with the socio-economic conditions prevailing in the area concerned.



MAPS and Technical Notes

It was not by chance that the first arid zone programme inaugurated its publications with the map of the 'World distribution of arid and semi-arid homoclimates' prepared under the direction of Peveril Meigs in 1951 and that the Man and the Biosphere Programme began its series of MAB Technical Notes with an issue on 'The Sahel: ecological approaches to land use', published in 1974. For in the early 1950s it was essential to have an exact idea of the world distribution of arid zones, whereas in the early 1970s the international community was in a state of shock as a result of the great drought that had struck the African Sahel, leading to famine and ecological disasters. The 1951 map was updated in 1976 and published in the MAB Technical Notes series in 1979. About half of the documents published in this series are devoted to arid and semi-arid zone problems. They are listed below:

1. 'The Sahel: ecological approaches to land use'
6. 'Development of arid and semi-arid lands: obstacles and prospects'

7. 'Map of the world distribution of arid lands'
8. 'Environmental effects of arid land irrigation in developing countries'
9. 'Management of natural resources in Africa: traditional strategies and modern decision-making'
10. 'Trends in research and in the application of science and technology for arid zone development'
18. 'Les plantations sylvo-pastorales dans la zone aride de Tunisie' (The planting of trees and forage-shrubs in the arid zone of Tunisia).

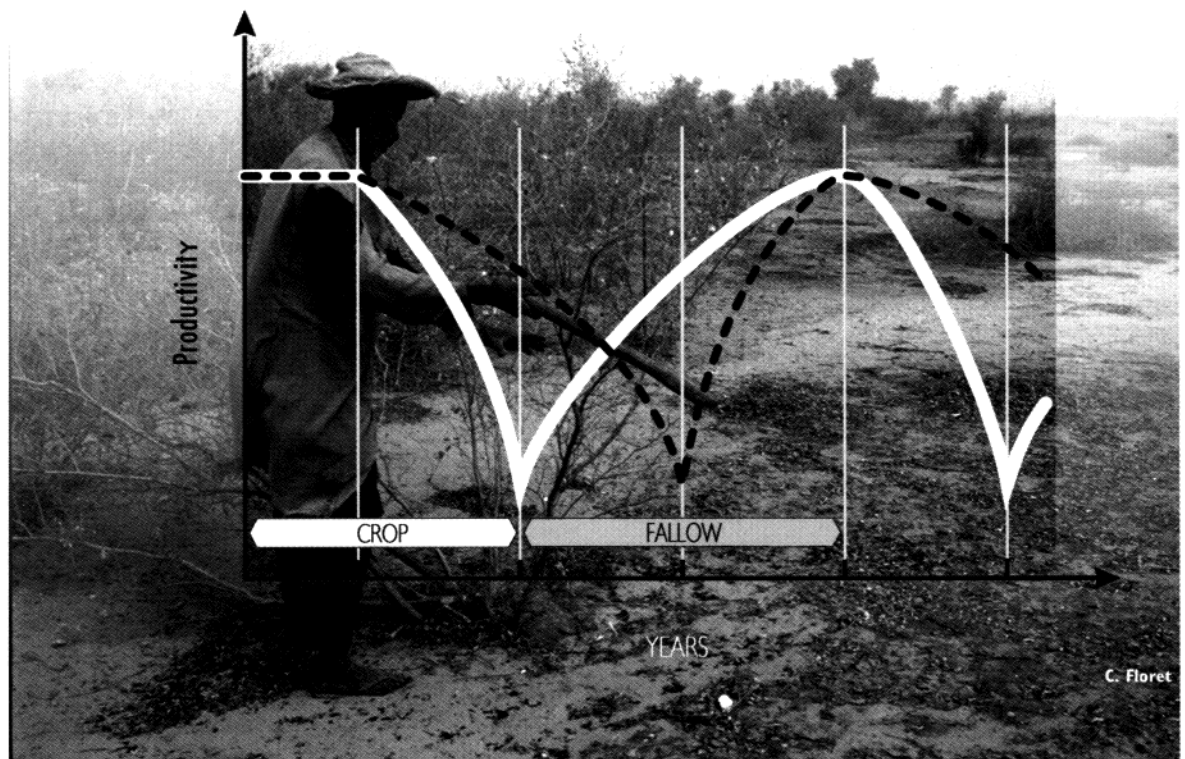
This series of Technical Notes was followed by another series, the MAB Digest, which also included a few issues on arid and semi-arid zone problems, namely:

- ▶ 'Les systèmes agro-sylvo-pastoraux méditerranéens: enjeux et réflexions pour une gestion raisonnée' (Mediterranean agro-sylvo-pastoral systems: the issues and considerations in favour of rational management)
- ▶ 'Savanna management for ecological sustainability, economic profit and social equity',
- ▶ 'La jachère en Afrique tropicale' (Fallowing in tropical Africa).

These documents were widely distributed, not only to draw attention to the problems and threats facing arid zones, but also to offer some suggestions for addressing those problems.

Illustration from MAB Digest 16, *La jachère en Afrique tropicale* (Fallowing in tropical Africa), prepared by Christian Floret, Roger Pontanier and Georges Serpantié. The photo shows fallow land with *Guiera senegalensis* being cut down before the land is put under cultivation. *Guiera senegalensis* is in many cases the only woody species still to be found in sandy fallow lands in the Sahelian zone. This species shoots out easily from the base. Besides stabilizing the soil and

providing organic material (roots), it has become an important wood resource for the inhabitants of these zones. The graph shows the standard Guillemin curve (continuous line) representing the fall and the rise in productivity of a soil after cropping and then fallowing. The idea is to replace this curve by another (dotted line), reflecting a slower fall in productivity, as a result of cultivation under shade trees, and a quicker rise, as a result of improved management of fallow land.



C. Floret

Regional and inter-regional MEETINGS

It is obvious that facilitating and promoting regional and interregional co-operation is one of the essential objectives of intergovernmental programmes such as the Man and the Biosphere (MAB) Programme. Many meetings have been organized for this purpose. Just a few of the more important or the more recent will be mentioned here.

The Coquimbo Workshop

With a view to strengthening interregional co-operation, an intercontinental workshop on the Ecological Basis for Integrated Rural Development and Combating Desertification in the Arid and Semi-arid Zones of Africa and Latin America was held in Coquimbo (Fourth region of Chile) in April 1989. It was attended by some 50 specialists. After examining the findings of a dozen case studies, it drew the appropriate conclusions from research, experimentation, training and demonstration projects relating to the problems of arid and semi-arid zones in Africa and Latin America. These projects constitute a good example of the projects undertaken in accordance with the standpoint and the approach of the MAB Programme, some of which have been presented in the foregoing paragraphs.

The workshop afforded an opportunity of going further into the methodological and conceptual aspects of research relating to these problems. It also made it possible to identify the priorities in respect of research and experimentation to be undertaken, and the means of facilitating the exchange of information in this connection between African and Latin American countries, which have many similarities, ecologically speaking.

Recent meetings

Two important meetings on arid and semi-arid zone problems were organized at the end of 1994. These were, on the one hand, a scientific conference on 'Population and environment in arid regions' and, on the other, an international congress on 'the restoration and rehabilitation of degraded lands in arid and semi-arid zones'.

The first of these meetings, the one on population and environment, which took place in Amman (Jordan) from 24 to 27 October 1994, was organized jointly by the International Union for the Scientific Study of Population (IUSSP), the International Geographical Union (IGU) and UNESCO, in co-operation with the University of Jordan. An original

feature of this meeting was the fact that the interaction of population and environment could be approached at different levels, local and global, and the various ecological and socio-economic aspects could be taken into account. This was possible because the natural sciences (ecology, agronomy, forestry etc.), on the one hand, and the human and social sciences (geography, demography, sociology, etc.), on the other, were fairly evenly represented at the workshop. This balance was largely due to the good co-ordination which took place within UNESCO between the Education Sector (Unit for Population Education) and the Science Sector (Division of Ecological Sciences) when preparations were being made for the meeting.

The other important meeting, the international congress on 'the restoration and rehabilitation of degraded lands', took place in Tunisia from 14 to 19 November 1994. This congress, attended by a fairly large number of participants (about 200), was organized by the Tunisian authorities and ORSTOM (the French institute for scientific research and development through co-operation), with the support of various international organizations, including UNESCO. The particular interest of this congress was its stressing of the findings of actual experiments carried out in different countries. It was for this reason, moreover, that half the time was devoted to field trips to analyse the findings of various

Participants in the Coquimbo workshop (1989).



studies conducted in Tunisia on problems relating to water and soil conservation, the combating of desertification and the restoration of the environment generally.

This shows that we have gone beyond the stage of analysing the various processes of degradation and the problems involved and have reached the stage of implementing practical measures aimed at solving these problems. These measures are still difficult to implement in many cases owing to the physical and biological characteristics of arid environments and the considerable human and animal pressure exerted on them.



ARID zone problems are also tackled under a variety of UNESCO's other scientific programmes.

WATER RESOURCES

Arid and semi-arid zones with their characteristically unfavourable climatological and hydrological conditions are particularly affected by drought and desertification. Low and very irregular rainfall leads to frequent periods of serious drought alternating with sudden and often devastating flash floods, resulting in very considerable soil erosion in particular. Groundwater is also subject to these fluctuations, but the reserves built up in rainy periods make it possible to cushion the effects of these episodic unfavourable influences. Groundwater is therefore an ideal water resource in these climes. In desert regions, water is still to be found underground trapped in the aquifers of large sedimentary basins. These considerable water resources were built up during the more humid periods of the Recent Quaternary when these regions, now desert, received higher rainfalls, which made possible the development of a flora and a fauna amply illustrated in rock carvings and paintings, but of which only a few relicts subsist today.

Desertification has thus wrought havoc since the Recent Quaternary, probably following a climatic change transforming once hospitable regions into deserts. Only the oases and other irrigated areas developed with the resources of groundwater and the run-off accumulated in the rare valley beds make a last stand against the advance of the desert and offer refuge to the sedentary or semi-nomadic populations that live there.

Nowadays a number of Saharan countries, or countries whose territory includes a large part of desert, are endeavouring to develop the use of groundwater so as to increase the areas of palm groves, and irrigated crop land generally, and hence improve the living conditions of the populations.

The management of these rare water resources has evolved from the stage of traditional techniques, adapted to the environment but sufficing only for a necessarily limited population, to a modern stage characterized by recourse to new prospection and exploita-

tion technologies better able to meet the needs of a rapidly increasing population. So there has been a swift transition from the exploitation of natural springs and the collection of rainwater to the drilling of deep artesian wells, the transferring of water from one basin to another and the laying on of drinking water. The corollary to all this is more intensive exploitation of water resources. It sometimes leads very quickly to overexploitation of available resources, which is very dangerous in semi-arid zones where the annual recharge is often scanty, and even more so in hyper-arid zones with but limited fossil, or connate, water.

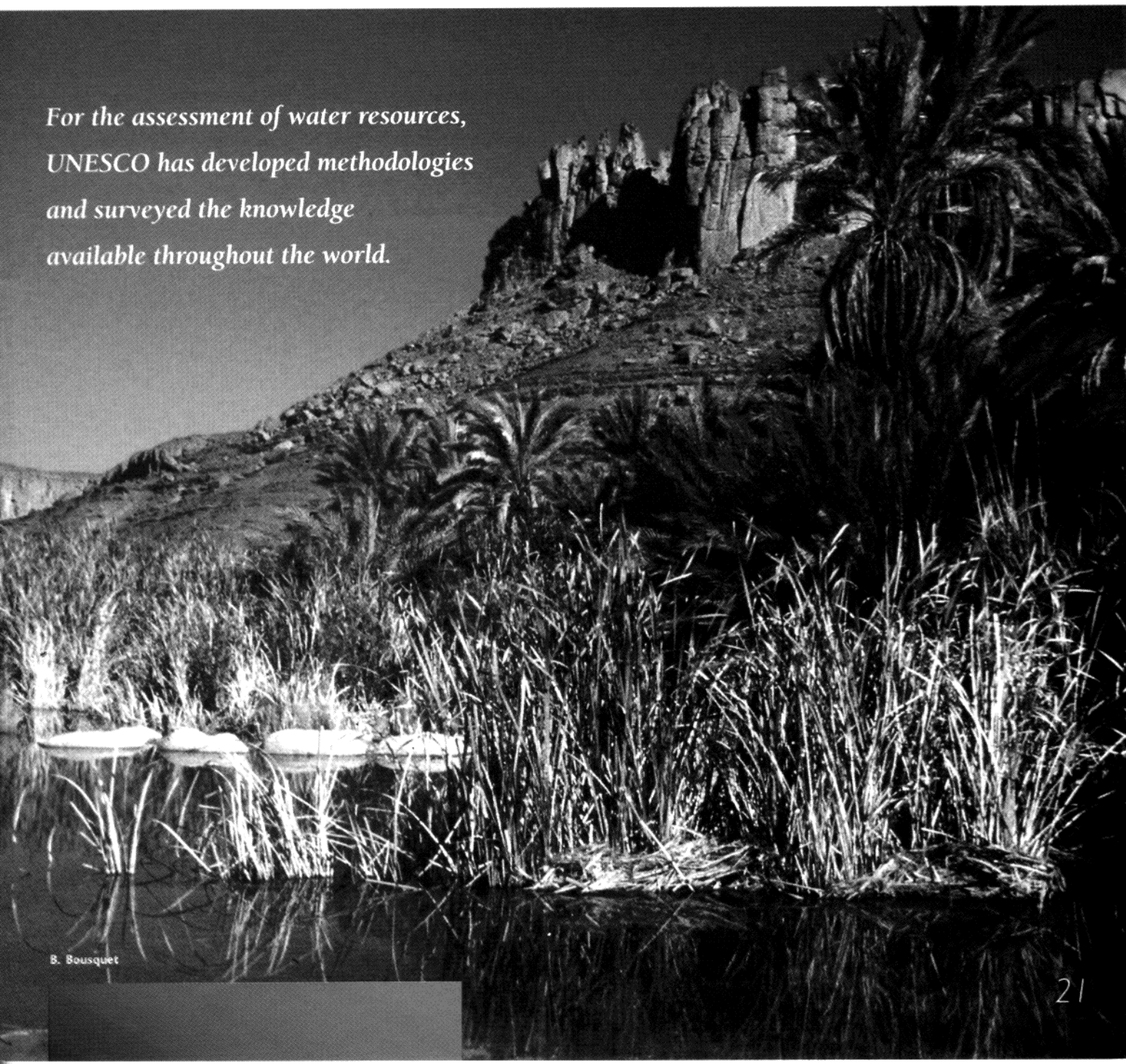
It is therefore of capital importance that the water resources of the arid and semi-arid regions should be managed with the utmost caution to ensure that the balance of these ill-provided lands is maintained as long as possible.

A 'guelta', or small permanent water reserve, in the heart of the Tassili N'Ajjer National Park, surrounded by luxuriant vegetation.



The other
**SCIENTIFIC
PROGRAMMES**

*For the assessment of water resources,
UNESCO has developed methodologies
and surveyed the knowledge
available throughout the world.*



Intergovernmental programmes relating to WATER RESOURCES



UNESCO began its studies on the hydrology of arid regions back in the 1950s. They were continued, first within the framework of the International Hydrological Decade (1965-1974), then, from 1975 onwards, through the successive phases of the International Hydrological Programme.

Under this Programme, efforts have been made to develop knowledge of the physical processes governing both surface run-off and the accretion of groundwater. What is involved, in particular, is the occurrence of run-off and flash floods and the recharging of groundwater.

Special studies have been made of the hydrogeology of calcareous rocks, crystalline and volcanic rocks, the effects of overexploitation of groundwater, etc. These studies have given rise to publications widely distributed in the international scientific community, particularly in the developing countries. A number of post-graduate courses, including some on arid and semi-arid regions (Ain Shams, Egypt), have helped to provide college or university graduates with specialized training in hydrology and the management of water resources in these zones.

For the assessment of water resources, UNESCO has developed methodologies and surveyed the knowledge available throughout the world. Mention might be made in particular of the textbook on the study of groundwater, which deals with all aspects of the exploration and exploitation of aquifers. The production of hydrogeological maps has been encouraged with the

A catchment area developed around a hill lake to provide supplementary irrigation.

The main aspects tackled are as follows:

- ▶ hydrological processes in arid and semi-arid zones,
- ▶ assessment of surface water and groundwater resources,
- ▶ management of water resources, taking into account both traditional techniques and the modern approach.

publication of the 'International Legend for Hydrogeological Maps' and the contributions made to the preparation of regional maps, such as the hydrogeological map of the Arab region, prepared in collaboration with the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD), or the hydrogeological map of Africa, prepared as part of an activity directed by the African Organization of Cartography and Remote Sensing (AOCRS).

UNESCO has encouraged the assessment of water resources at both the national and the regional levels. It contributed, in particular, to the preparation of a document on water resources in the Arab region (1988).

The International Hydrological Decade (IHD) and the International Hydrological Programme (IHP) have also been concerned with promoting rational management of water resources. For this purpose, traditional techniques have been taken into account, but modern methods of planning and simulation have been developed. Traditional techniques of water use and conservation in rural areas in the Arab countries were described in a publication in 1986 as part of the Major Regional Project.



M. Skour

UNESCO has also carried out regional projects financed by the United Nations Development Programme (UNDP), such as the Survey of Groundwater Resources - Northern Sahara (ERESS project - 1972), the object of which was to review knowledge on deep-lying groundwater, to assess water resources and propose scenarios for their rational exploitation.

During the Fifth Phase of the IHP(1996-2001) efforts, will be continued in respect of the assessment and rational management of water resources in arid and semi-arid zones as a means of combating drought and desertification. The integrated management of surface water and groundwater in these zones will be a special theme, indeed the predominant theme, of IHP-V.

EARTH SCIENCES

One of the main contributions of the Earth sciences to the environmental studies relating to the combating of drought and desertification is their broadening of our knowledge concerning the nature and amplitude of the climatic variations of earlier times. For this makes it possible to forecast future climatic and environmental changes. Project 252, 'Past and Future Evolution of Deserts', undertaken within the framework of the International Geological Correlation Programme (IGCP) conducted jointly by UNESCO and the International Union of Geological Sciences (IUGS), is especially dedicated to the study of the evolution of the desert.

Other activities of relevance to arid zones are developed under programmes relating to the mitigation of natural disasters, on the one hand, and the use of remote sensing, on the other.

Project 252

Owing to the diversity of atmospheric circulation patterns and the disparity of geological conditions, the climatic changes linked with these global phenomena are manifold. However, considerable climatic variations may be recorded in vast zones subject to similar atmospheric circulation conditions. This applies to the belt which extends, at a low latitude, from western Africa to eastern China, where the major part of the annual rainfall is supplied during the monsoon, at which season temperatures are less variable.

The accentuation of monsoons during phases of global warming leads one to suppose that similar changes would have been recorded in the past along the present margins of monsoon zones (i.e. the transitional semi-arid zone situated between the humid and sub-humid zones and the southern part of the arid zones). The above-mentioned belt corresponds to the Sahel and the southern part of the Sahara, the Arabian peninsula, the north-west of India and eastern China.

Many geological analyses using isotopic techniques have been effected over the past decade with a view to collecting information on the environmental changes that took place in this vast zone in the course of 130,000 years. The data collected, in large part by participants in the ICGP's Project 252, have made it possible to put forward a conspectus of the palaeoclimatic variations resulting from the global changes that

affected the northern margin of the summer monsoon zone now to be found in Africa and Asia, including India. These findings are based on the analysis of geochronological, palaeolimnological and palaeobotanical data.

Examination of the environmental changes affecting the flora and fauna and the hydrological and anthropological characteristics of the African-Asian arid and semi-arid belt confirms at regional level the conceptual models according to which humid/arid alternations coincided globally with warm/cold temperature variations.

The evolution of the levels of CO₂ (carbon dioxide) and CH₄ (methane) in the atmosphere is probably linked up with these global changes, too.

Has the greenhouse effect helped bring new life to the tropical deserts? Geological indicators of global changes in the past show that in the region under consideration 'cold' scenarios have corresponded to dry periods, whereas 'warm' scenarios have coincided with humid phases.

The natural cooling of the temperature of the Earth (-0.01°C a century) would, over a millennium, gradually lead to the aridity of the transitional zones now subject to highly variable monsoon-type summer rainfall. Human activity has considerably accentuated this trend by adding desertification to the climatic change. However, the increase in the radiative gas contents in the atmosphere, combined with human activity, will probably contribute to an increase in the greenhouse effect and thus lead artificially to global warming. It should be noted that it is the greenhouse effect which maintains the temperature of the Earth's surface at about 18°C. There is no palaeoclimatic equivalent to this situation, for, in the past, such changes were due to the effects of solar radiation alone. However, in the northern hemisphere, a warmer global situation should normally reactivate the monsoon patterns (and favourable changes) in most of the northern regions. If desertification is not controlled, however, it may cancel out the positive effects of this natural development.



The most significant findings of Project 252 are as follows:

- **The last interglacial** is associated everywhere with a humid climate.
- **Since the climatic optimum**, which is situated between 9000 and 6500 B.C., arid zones have advanced from about 400 to 500 km. southwards in north Africa and from about 200 to 250 km. southwards in north-west India and in north-east China.
- **The land area** which changed from arid to semi-arid or from semi-arid to sub-humid in the extreme cold/warm scenarios is estimated at 14 million sq. km. for the regions under consideration.

This pattern is probably valid for other vast tropical zones of the Earth (e.g. Australia).

The use of **REMOTE SENSING**

UNESCO has made a special effort over the past five years to increase the use of modern technologies, such as remote sensing and the Geographical Information Systems (GIS), within the framework of interdisciplinary studies on the environment.

Inexpensive methods using data supplied by space-borne sensors for the monitoring and management of fragile environments in the developing countries, in the arid and semi-arid zones of Africa in particular, have been developed within the framework of integrated research projects.

The studies thus carried out have led to the development of computerized interactive demon-

digital models and maps showing proneness to erosion.

More recently, research has been undertaken on the use of radar images supplied by the European Earth Resources Satellite (ERS) and the Japanese Earth Resources Satellite (JERS). With these images it is possible to distinguish between soils and allothogenous sediments on the basis of their water (humidity) contents and their relations with erosion processes.

In an ultimate phase, it is planned to study the aptitude of microwave signals to penetrate dry sediments, with a view to improving techniques for locating old river-beds covered over with windborne sand in arid terrains. This will facilitate the search for groundwater in such terrains.

The research carried out under the GARS programme will be used for the preparation of distance education materials for researchers in developing countries desirous of familiarizing themselves with the new technologies.

Reduction of **NATURAL DISASTERS**

The vulnerability of arid zones to natural hazards is accentuated by inadequate preparedness to cope with such hazards. Earthquakes, floods, erosion and drought can seriously affect these zones. The resulting disasters have considerable economic and social consequences. Such natural phenomena affect populations and livestock and cause damage to the natural or developed environment, leading to crop losses, the destruction of infrastructure and of people's familiar surroundings. Drought and desertification are among the hazards concerned by the International Decade for Natural Disaster Reduction (IDNDR) launched by the United Nations in 1990.

UNESCO is participating actively in this Decade and in natural disaster prevention - in the study of natural hazards of geological and hydrometeorological origin in the arid zones, in particular. The main objectives pursued by UNESCO in this field are as follows: to promote a better understanding of the distribution of these hazards in space and in time, and of their intensity; to help establish reliable early-warning systems; to recommend rational land management plans; to encourage the adoption of suitable building norms; to protect cultural monuments in the zones at risk; and to facilitate the implementation of restoration and rehabilitation projects.

With these objectives in view, the emphasis has been laid on preventive measures and public awareness campaigns involving education, training, communication and information in particular.

The general outline and examples of UNESCO's action in this field were described in a brochure, 'Standing up to natural disasters', which was brought out for the public in 1991 as part of UNESCO's contribution to the Decade (IDNDR). Particular emphasis was laid on the spatial distribution of hazards and their mitigation, including in arid zones.



SPOT image providing landmarks for the monitoring of desertification (north of the Sahara).

stration packs for decision-makers. A system of this kind enables planners, engineers and industrialists to see the effects of political decisions on the state of the environment. It also enables them to see how to use geographical information systems in the planning of human settlements or transport infrastructure, or in the rational management of water, soil and mineral resources and sources of energy (e.g. firewood).

Under the GARS programme (Geological Applications of Remote Sensing), pilot projects have been launched on the study of erosion processes, the instability of sloping terrains, landslides and the transport of sediment by torrents, by integrating into the geographical information systems data obtained from the observation of the Earth by means of satellites, revealing the true nature of the terrain. The data supplied by satellites with different spatial and spectral revolutions are integrated so as to give

SOLAR ENERGY

It is universally recognized that the overexploitation of wood resources, especially for the meeting of energy needs, is an important factor in desertification. Recourse to any substitute source is likely to help in the combating of desertification. The abundant sunshine from which arid and semi-arid zones benefit can contribute in large measure to the meeting of energy needs in these zones. UNESCO took the initiative of launching a World Solar Programme a few years ago. This programme was undertaken in co-operation with the various organizations concerned in the United Nations system and with non-governmental organizations specializing in science and technology.

The purpose of this initiative is to establish partnerships among the main intergovernmental and non-governmental organizations and industry, and also research and higher education centres, working in the field of energy and its relations with the environment. The programme is designed to promote close international co-operation in the development of technologies and the use of renewable sources of energy. It is carried out on the basis of the recommendations of an expert panel meeting in Paris in July 1993 and the resolutions adopted by the UNESCO General Conference at its twenty-seventh session in November 1993.

A World Solar Summit was planned to take place in September 1996 in Harare, at the invitation of His Excellency Mr Robert Mugabe, President of the Republic of Zimbabwe. It was intended to be a follow-up to the United Nations Conference on New and

The main objectives of this programme are as follows:

- ▶ **improving understanding** of the role that renewable sources of energy can play in the protection of the environment by supplying energy, particularly in rural areas, and contributing to the creation of new jobs,
- ▶ **encouraging** non-governmental organizations to develop partnerships with international and regional intergovernmental organizations, to place their knowledge and experimental findings at the disposal of the latter, and also to launch innovative programmes for the promotion and use of renewable sources of energy,
- ▶ **facilitating** access to knowledge concerning renewable sources of energy and the transfer and pooling of such knowledge, establishing for this purpose a global information system, or network, based on modern communication technologies,
- ▶ **promoting** and harmonizing co-operation in training and research, and the transfer of research findings to industry, at the regional, interregional and international levels,
- ▶ **showing** how the extensive use of renewable sources of energy is economical, being for the developing countries a rapid means of reducing expenditure on energy, and hence saving foreign currency, and of improving their energy supply without having recourse to heavy investments,
- ▶ **obtaining** the approval of high-level governmental authorities for the World Solar Programme (1996-2005).

Renewable Sources of Energy held in 1981 and a practical response to the challenges launched by the Earth Summit (Rio, 1992). ||



The use of firewood is a major cause of desertification.

OPNT/M.F. Maka



Cultural treasures of the Tassili N'Ajjer: the great variety of rock art is evidence of the neolithic revolution in these parts, where the creative genius of humanity is expressed in the fashioning of tools and paintings...

E **DUCATION** and the protection of the world natural and cultural heritage are other spheres of UNESCO's action in which arid zones loom large

E **NVIRONMENTAL AND POPULATION EDUCATION**

The FIRST GENERATION programmes

The International Environmental Education Programme (IEEP) was launched jointly by UNESCO and the United Nations Environment Programme (UNEP) in 1975, in pursuance of a recommendation of the United Nations Conference on the Human Environment held in Stockholm (Sweden) in 1972. The Intergovernmental Conference on Environmental

Education held in Tbilisi (Georgia) in 1977 provided a framework of action, principles and guidelines for the programme, and then the International Congress on Environmental Education and Training held in Moscow in 1987 laid down strategies and an action plan for the next few years. The IEEP contributed largely to the inclusion of environmental components in curricula and the development of various approaches and methods to achieve this end. Various teaching materials and documents were prepared for this purpose.

In so far as desertification is concerned, mention might be made in particular of an educational kit dealing with arid and semi-arid zone problems, with special reference to the African Sahel, and a poster entitled 'Deforestation and Desertification' presenting various facts concerning desertification as it affects the world and its ecological and socio-economic consequences.

An international programme for population education was set up back in the 1970s as a result of

EDUCATION *and* CULTURE



Finding answers to the problems of desertification necessarily implies changes in ways of thinking and acting, attitudes and values. These must be achieved through information, education and training.

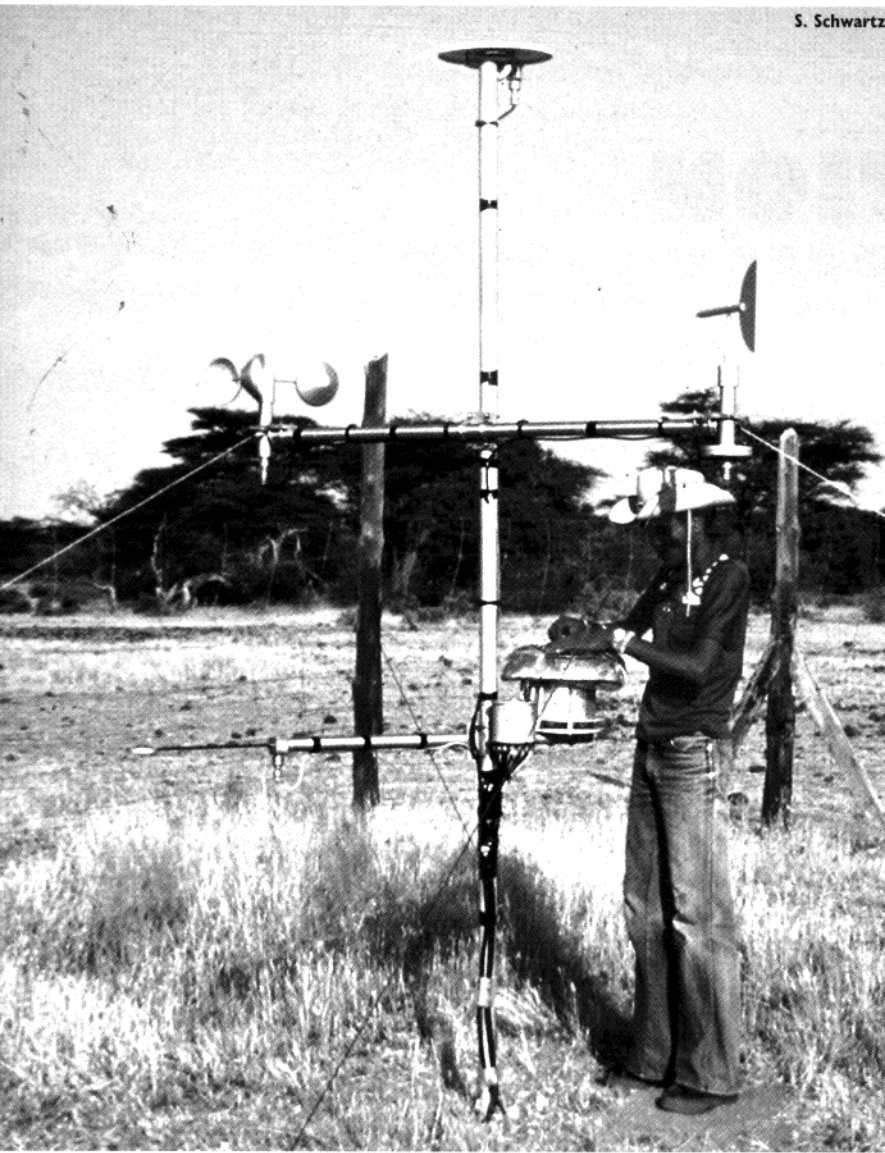
Better informed and better educated populations are better able to cope with the adverse effects of phenomena such as drought and desertification.

co-operation between UNESCO and the United Nations Population Fund (UNFPA). Arid and semi-arid zones occupied an important place in this programme, too, for drought and desertification problems are closely bound up with population dynamics and especially affect disadvantaged populations living in a great many of the least developed countries (LDCs), in Africa in particular. Various field projects have been developed under this programme, in countries such as Chad, Mauritania and Niger, to name but a few.

Even if desertification problems are not entirely due to humankind - even if the causes are not all socio-economic, political or historical - finding answers to these problems necessarily implies changes in ways of thinking and acting, attitudes and values; that is, it implies information, education and training, since better informed and better educated populations are better able to cope with the adverse effects of phenomena such as drought and desertification.

It is important to stress the fact that most of the countries affected by drought and desertification are countries in which the general level of information and training is inadequate and the resulting ecological problems are not isolated phenomena. In fact, they may be both the cause and the consequence of other ills, such as poverty, migrations, conflicts, diseases, malnutrition, etc. Drought and desertification are thus but the visible part of a whole series of phenomena.

S. Schwartz



Station for the measurement of climatic parameters and the training of personnel.

Lines of emphasis of the **NEW PROGRAMME**

It was in order to focus attention on the interaction of environmental factors and demographic and socio-economic factors that in 1993 UNESCO launched an Environment and Population Education and Information for Human Development (EPD) project, turning to account the experience gained in carrying out the two earlier programmes, dealing with environmental education and population education respectively.

This is a programme designed to remove disciplinary, sectoral and institutional barriers and thus contribute to the attainment of the goals of sustainable development through education and information. In so far as combating drought and desertification is concerned, it will address various categories of people, especially in the developing countries, and it will endeavour to strengthen co-operation with other sectors in UNESCO, and with other organizations and institutions, so as to add constantly to its wealth of education and information activities.

The strategy adopted was worked out with various segments of society in mind: decision-makers, planners and educators on the one hand, rural youth and other citizens on the other. It is implemented at local, regional and international levels and mobilizes various

partners and facilities likely to broaden its field of action and increase its effectiveness.

Examples of **INTERSECTORIAL CO-OPERATION**

As an example of intersectoral co-operation within UNESCO, mention might be made of the subregional training workshop organized in the El Kharga Oasis (Egypt) in March 1995, on the basis of research work carried out as part of the Man and the Biosphere (MAB) Programme and the International Hydrological Programme (IHP). This workshop, attended by decision-makers, researchers and educationists, dealt with the problems involved in sustainable development in oasis environments.

Other training activities, intended primarily for trainers – women in particular – are planned to take place in Egypt and in sub-Saharan African countries. They will deal not only with sustainable development, but also with other environmental problems connected with the use of water and wood resources and also public health and nutrition, on the basis of the specific needs of each country.

The EPD Programme and the Man and the Biosphere (MAB) Programme participated in the conference on population and environment in arid regions organized jointly by UNESCO, the International Union for the Scientific Study of Population (IUSSP) and the International Geographical Union (IGU), and held at the University of Jordan, Amman, in October 1994. The work done at this conference, which dealt with themes such as the human causes of desertification, population dynamics and living conditions in arid zones, and strategies for the management of population and environment, is to serve as a basis for the preparation of a teacher's guide.

Since the launching of the environmental education programme, a newsletter for the general public, *Connect*, is brought out regularly. The leading article of Volume XIX, No. 3, September 1994, was devoted to desertification, following the adoption of the Convention to Combat Desertification. The object of this article was to provide the 200,000 readers of the newsletter with basic information on desertification, to review the measures taken at international level to cope with this phenomenon and to explain the role environmental education can play in this regard.

PROTECTION OF THE WORLD NATURAL AND CULTURAL HERITAGE

Since the early 1970s, UNESCO has also been developing a range of instruments for the protection of the world cultural and natural heritage - in particular, the Convention concerning the Protection of the World Cultural and Natural Heritage, adopted in 1972, and the World Network of Biosphere Reserves, developed under the MAB Programme.

The originality of the Convention resides mainly in the fact that it combines the protection of the cultural heritage with that of the natural heritage (two aspects previously regarded as distinct), stressing the dangers threatening both.

As for the concept of a biosphere reserve, it is not limited to the preservation of biological diversity and the protection of the natural environment as a whole, but also covers the creation of conditions favourable to sustainable development, including its cultural aspects.

Arid and semi-arid zones occupy an important place in such instruments. For palaeoclimatic, ecological, historical and anthropological reasons, they hold precious vestiges of the cultural and natural history of humanity. The African Sahara, for instance, is particularly rich in such vestiges, which are evidence of the evolution of the conditions of the physical environment and the impact of human activity on that environment. This evolution and the concomitant evolution of humankind are well illustrated in the rock paintings and carvings to be found in the Tassili N'Ajjer National Park in Algeria, for instance, and the ancient desert cities of northern Mauritania.

The Tassili N'Ajjer Park has had a place on in the World Heritage List since 1982 and has belonged to the World Network of Biosphere Reserves since 1986. It has benefited, and will continue to benefit, from various forms of support designed to ensure the protection of its natural and cultural wealth and to improve the living conditions of its inhabitants. Various projects



E. Le Floch

have been carried out in this vast region of more than seven million hectares. These projects concern both the protection of outstanding cultural property and natural sites and the rational management of the natural resources still to be found despite the increased human pressure and the harsh climate.

As for the historic towns of Mauritania, seriously threatened by the encroaching sands, a campaign to save them has been continued over the past ten years. It concerns four old towns representative of the civilization of the Moors - Oualata, Chinguetti, Tichitt and Ouadane. It was clear from the beginning of operations that the historic buildings could not be restored, and the cities revived, except within the framework of an integrated plan of action comprising the following aspects: harnessing of water resources, stabilizing of dunes, less isolation for these cities, revival of agriculture, improvement of hygiene, promotion of crafts and tourism and, of course, improvement of education and training - all factors which condition development in the broadest sense of the term.

Similar approaches are developed under other cultural programmes, such as the one on the 'Silk Roads' - those historic roads the most important of which cross the arid lands of Asia.

Sanding up of dwellings and granaries, entailing their abandonment.



Dust raised by horses' hooves during the 'fantasia', a traditional fête of bravura and generosity.



Efforts will have to be continued in the direction of this integrated ecological approach, with due regard for the emergence of new actors and the new mechanisms for co-operation and co-ordination which have been, or will be, set up.

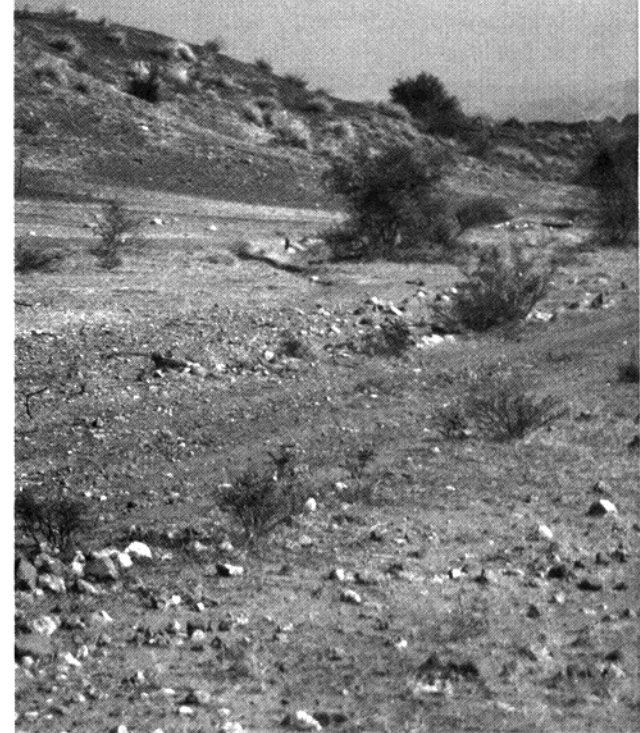
THIS bird's-eye view shows that the programmes carried out under UNESCO's auspices over the past 40 years in response to arid and semi-arid zone problems have gone through different stages and have gradually evolved in keeping with the international community's perception of these problems.

UNESCO has played a trail-blazing role, launching the first international arid zone programme in 1951 and the Man and the Biosphere (MAB) Programme, in which these zones occupy an important place, in 1971. Nor has it failed to associate itself with initiatives on a larger scale taken in regard to the development and protection of these zones, such as the Plan of Action to Combat Desertification adopted at the Nairobi Conference, or various chapters of Agenda 21, adopted at the Rio Conference – the resulting Convention to Combat Desertification in particular.

The integrated ecological approach, developed more especially in pilot projects on research, training and demonstration applied to the integrated development and rational management of natural resources in arid and semi-arid zones, is fully in keeping with the guidelines laid down in that Convention.

So efforts will have to be continued in the same direction, with due regard to the emergence of new intergovernmental and non-governmental actors and the new mechanisms for co-operation and co-ordination which have been, or will be, set up.

While projects and activities confined to one country will not be neglected, the emphasis will be placed on projects of a regional or subregional character to be developed in co-operation with the national, subregional and regional institutions involved. In so far as Saharan Africa is concerned, the Division of Ecological Sciences has, for instance, associated itself with a number of initiatives taken by the Sahara and Sahel Observatory (SSO) and, in particular, the project to set up a Long-term Ecological Monitoring Observatories Network, the ROSELT Programme. The Division plans to take an active part in carrying out various activities connected with the development of this network and in strengthening its manifold functions. Attention should be drawn to the fact that the future network will



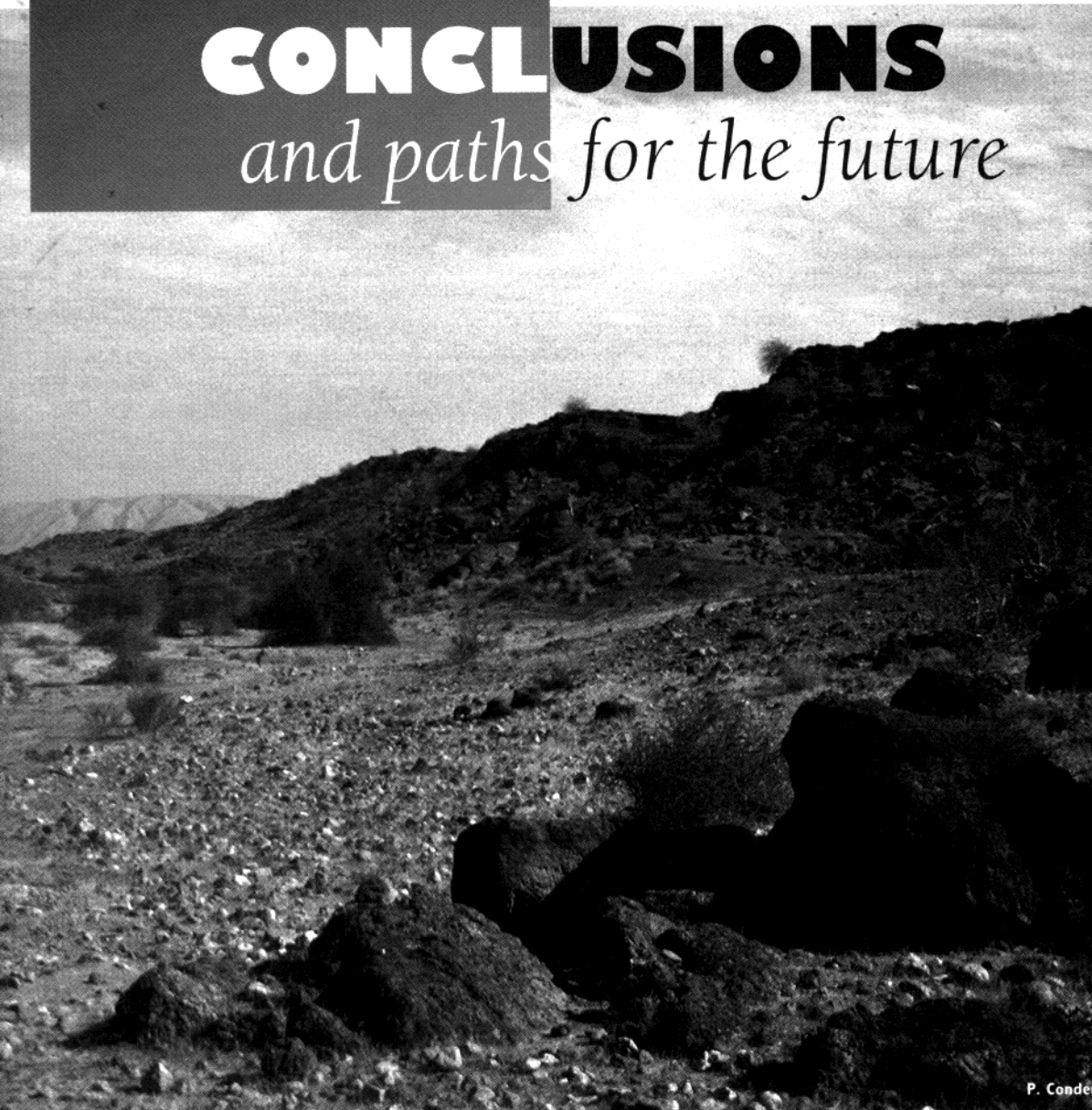
gradually extend to include all of the 20 countries around the Sahara covered by the Sahara and Sahel Observatory (SSO). An arrangement of this kind should be of great help in decision-making in the countries concerned, as well as an effective means of facilitating regional and subregional co-operation in a number of fields covered by the Convention to Combat Desertification.

The sites to become a part of the ROSELT network are selected with a view to their fulfilling the following diverse functions:

- monitoring the state of the environment (ecological and socio-economic aspects) in zones already affected or threatened by desertification,
- studying the effects of development activities and combating desertification,
- long-term ecological research aimed at a better analysis of the dynamics of ecosystems and the factors which enter into this,

CONCLUSIONS

and paths for the future



P. Conder

Sparse vegetation on a much eroded sloping terrain (Pakistan).

- ▶ testing methods and techniques for the rehabilitation of the environment and the rational management of natural resources,
- ▶ other activities in support of development – training and demonstration.

The idea of long-term ecological monitoring observatories might be applied in other regions and combined with that of biosphere reserves, one of the main focuses of the Man and the Biosphere (MAB) Programme. These observatories are like biosphere reserves in that they constitute permanent representative sites for research, training, ecological follow-up, conservation of biological diversity and support to development. Here we have a series of tasks and functions which contributes directly to the implementation of the Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa.

As for the International Hydrological Programme (IHP), its efforts are focused on the concept of integrated management of surface water and groundwater, for the purpose of turning to better account the interactions of these two types of resource, with the idea that water, being a rare resource, should be used sparingly so that it will last.

In geology, and the Earth sciences generally, besides the palaeoclimatic and geomorphological aspects already taken into consideration, special emphasis will be laid on modern methods of analysing and monitoring the environment, such as remote sensing and Geographical Information Systems (GIS), the use of which will be shared with other programmes concerning various aspects of the development and management of natural resources.

In the engineering sciences, special attention will be paid to the development and use of renewable sources of energy in general, and solar energy in particular.

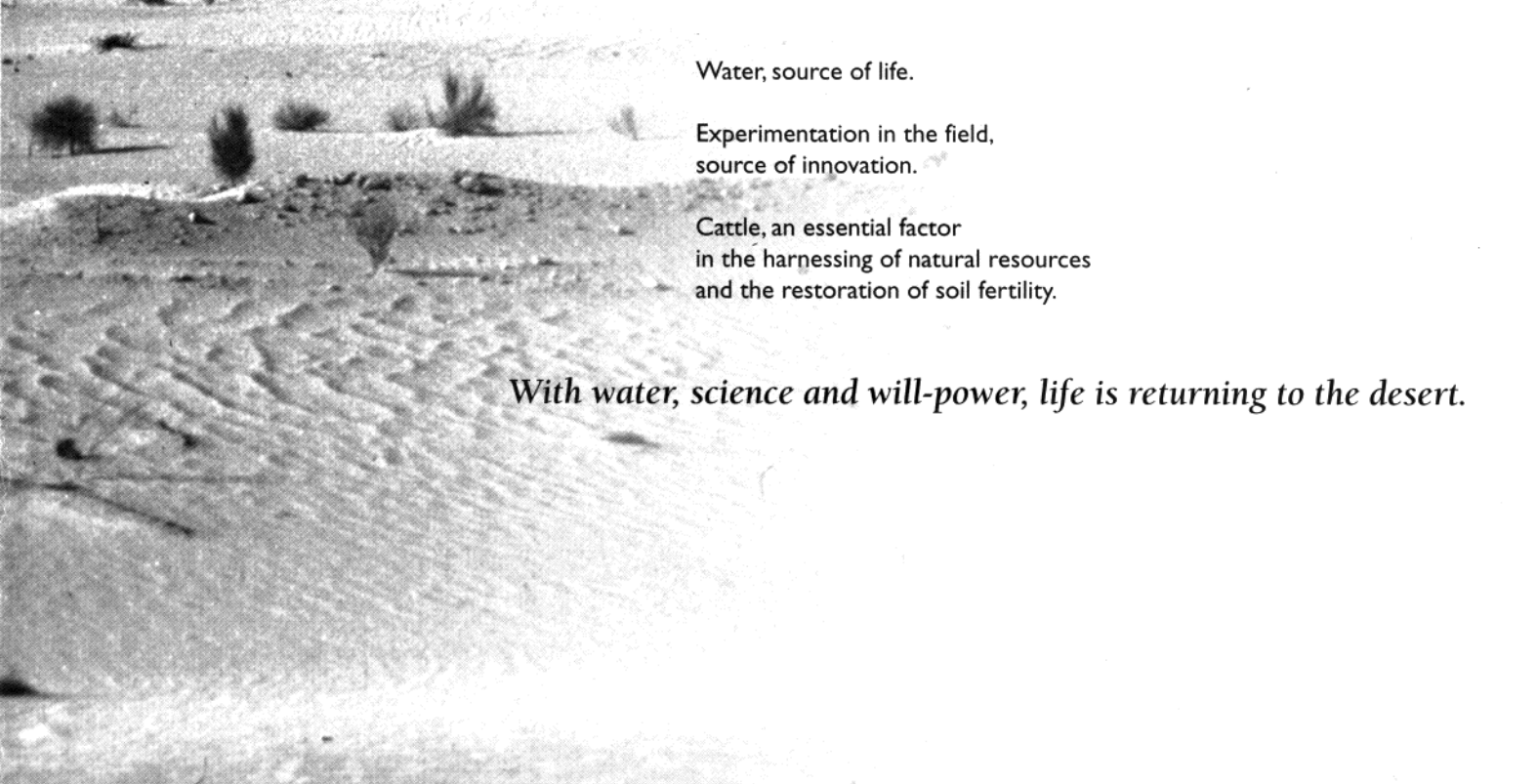
At the interface of the engineering sciences, biotechnology and ecology, mention should be made of another programme, the International Programme for Arid Land Crops (IPALC), which was launched in 1994 by the Ben Gurion University in the Negev (Israel), with the support of UNESCO. This programme is aimed at developing co-operation among different research institutions working on the plants cultivated in arid lands.

While stressing the circulation of the scientific and technological information they generate, these programmes will be called on to co-operate more closely with the new Environment and Population Education and Information for Human Development (EPD) Programme, so that all this information is better adapted to the needs of different categories of users, especially in the education sector, which is the ideal sphere of UNESCO's action.

It is obvious that educational programmes must be regularly supplied, not only with the findings of the various scientific programmes, including those of the social sciences, developed under UNESCO's auspices, but also with the results of its manifold activities in the cultural sphere.

It is probably in desert lands that the cultural dimension of development assumes its full significance, for there the Man/Nature relationship is strongly marked by ecological constraints and the weight of history. Indeed, these constraints have a considerable influence on lifestyles, ethical values and the organization of society generally. ||





Water, source of life.

Experimentation in the field,
source of innovation.

Cattle, an essential factor
in the harnessing of natural resources
and the restoration of soil fertility.

With water, science and will-power, life is returning to the desert.

