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This symbol for the Council of Europe's nature conservation activities will also illustrate the Centre's campaign on the conservation of wild flora and fauna and natural habitats.

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Editor responsible: Hayo H. Hoekstra

Editor: Patricia Bugnot

Adviser for this number: Ing. M. F. Broggi (Liechtenstein)

Lay-out and design: Roland Schwoegler

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Front cover: Pieter Bruegel the Elder - Labours of the Months: Haymaking (detail). National Gallery, Prague (Photo Giraudon)

Back cover: Gyps fulvus (Photo Vladimir Pomakov, Bulgaria)

Naturopa

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An important event

This issue of *Naturopa* is entirely devoted to the main theme of the Third European Ministerial Conference on the Environment, which is to be held in Berne, on "the compatibility of agriculture and forestry with conservation of the environment".

For centuries, Europe's landscape has been shaped by these two activities and, especially since the advent of mechanisation, radical changes have often occurred which are incompatible with the needs of wild flora and fauna, or even with a judicious soil conservation policy. At the same time it cannot be denied, especially with the present less than rosy economic outlook, that (as virtually always when nature conservation is concerned) choices have to be made; and these choices, which have to be made by Europeans themselves, entail financial, economic, and hence social, consequences.

Nor is it without relevance that the Council of Europe should, just a few months before this conference, have brought out a major study on natural vegetation in Europe. This *Vegetation Map of Council of Europe Member States* is intended to help make those responsible for nature

conservation more familiar with the places needing protection, especially in connection with farming and forestry.

At the Ministerial Conference, the European Information Centre for Nature Conservation will be launching its fourth campaign. Encouraged by the success of the wetlands conservation campaign, the Centre will be trying to make the European public aware of the need to protect species of European wild flora and fauna, but also their habitats, without which they cannot survive.

It is quite natural, then, that the next issue of *Naturopa* should deal with this theme, and the Centre plans, for the first time, to produce a double issue on the protection of wildlife and natural habitats. The intention is that this issue should serve as a reference work for at least several years to come. H.H.H.



Editorial

(Photo Swiss National Tourist Board)

The Third European Ministerial Conference on the Environment will take place in Switzerland from 19 to 21 September 1979.

The demand for all-embracing and lasting protection of the natural and cultural resources of Europe, inspired above all by the visible and continuing changes in the rural and urban scene over the last three decades, has become impossible to ignore. In the same way, increasing stress is also being laid on the need for more effective protection of air, water and soil and for a reduction in noise nuisance.

In the present period of recession, the harmful influences affecting the environment are, contrary to many expectations, no less obvious than in periods of high economic growth.

Parliaments and governments therefore find themselves faced with the major task — every bit as important as, say, social security — of making adequate provision in economic and technical development for overcoming the many and varied obstacles which stand in the way of improvements in the quality of life.

The Council of Europe has the great merit of having added, inter alia, the protection of natural and cultural resources in Europe to the causes it defends, with as many as twenty-one member states now sharing in its work.

Special impetus for the improved protection of these resources has been gained from projects initiated by the Council of Europe and carried into effect with distinct success, such as European Conservation Year in 1970 and European Architectural Heritage Year in 1975. There have also been the Ministerial Conferences on the Environment in Vienna and Brussels, nature conservation campaigns and seminars on applied ecology. The fifth of these seminars took place in Switzerland in 1977 and was devoted to the subject of "forest and landscape conservation", which has direct relevance to the general theme of the forthcoming Ministerial Conference, "the compatibility of agriculture and forestry with the conservation of the environment".

Why was this particular subject chosen?

Landscape conservation, from its very beginnings, which date from the recognition of the adverse effects of modern technical methods on the landscape, has always been closely linked with activities on the

land. If, therefore, we are set on solving environmental protection problems, we must also take an interest in the development of these two branches of the primary sector, while at the same time ensuring that they take maximum account of environmental protection considerations.

In order to illustrate this purpose with a practical case-study, the programme of the Ministerial Conference includes an excursion to the Reuss valley in the Canton of Argovia.

But conservation is not possible without also promoting environmental education. The extraordinary significance of environmental education for the present and the future no longer needs to be demonstrated. Rather must we endeavour to act now to make up for lost time. Environmental education must become a permanent component in the curricula of all fields and levels of education. Agricultural



and forestry activities offer an almost perfect basis for successful environmental education. The second theme of the Ministerial Conference, "education in relation to the compatibility of agriculture and forestry with the conservation of the environment", is designed to illustrate solutions in these fields.

The protection of wildlife, both fauna and flora, either through preserving biotopes or the actual species themselves, is also intimately bound up with developments in rural areas. It is consequently logical that, in addition to dealing with the above-mentioned themes, it is intended to open the draft Convention on the Conservation

of European Wildlife and Natural Habitats for signature at the Conference, thereby meeting one of the requirements laid down by the Ministers themselves on the occasion of the Brussels Conference (1976). A further step in the right direction will also be made at the Conference by launching the 1979-80 campaign on "the conservation of European wildlife and natural habitats" to be organised by the European Information Centre for Nature Conservation. Great importance should also be attached to the direct personal contacts between Ministers at the Conference, which should enable such subjects as general questions of environmental protection legislation, the organisation and financing of environmental protection and the collaboration of ecological organisations to be broached.

In conclusion, may I make a few proposals for future Council of Europe activities on the protection of natural and cultural resources in Europe. Since its foundation, the Council of Europe has, as already mentioned, been extremely active in this field and a considerable number of recommendations and studies have been produced as a result. The urgency of this task does not, however, prevent the Council of Europe from taking breathing time to compare the recommendations made in the past with the actual results achieved, in order to decide which are the most effective methods for future work. It would be especially desirable not only to circulate the results obtained so far to specialist circles, but above all to make sure they come to the notice of political bodies as well.

In the light of the foregoing remarks, we have high expectations for the success of the Third European Ministerial Conference on the Environment and are sure it will contribute to promoting the efforts undertaken in the field of nature conservation.

Hans Hürlimann

The Reuss Valley scheme (Aargau, Switzerland) – a national success and international evidence that the requirements of regional planning are not incompatible with those of nature conservation (Photo E. Kessler)

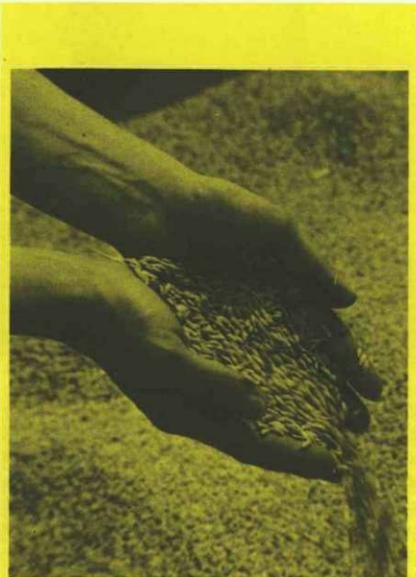


The changing countryside

Francisco Caldeira Cabral

Until fairly recent times, the countryside was where people all over the world lived, found their food, clothing and everything they needed for crafts or industry. Not only does the countryside support life itself, but it is also the reflection of thousands of years of human activity which have shaped the natural environment.

This suggests the richness and complexity of functions and interacting relationships that go to make up the simple, universal reality of landscape. Time was when the countryside was regarded as a natural landscape, as distinct from urban landscapes which were obviously artificial, that is to say man-made. Nowadays, now that the importance of man's influence on all landscapes has been recognised, the term natural landscape is reserved for those very rare cases where man's influence has been non-existent, or



There will probably be 6 000 million of us in the year 2000! (Photo José Dupont – Explorer)

at least only slight. All other landscapes are to a greater or lesser extent man-made.

Ecology teaches us daily that landscape phenomena cannot be considered separately; on the contrary, every landscape is an ecosystem in which every action exerts an influence on the whole.

First priority: food

Not very long ago, the main function of the countryside was to provide food for the country people themselves. Of course, since ancient times unnecessary products have been grown, some of them luxuries, like wine; but since the majority of the population were farmers, their main concern was with feeding themselves, and surplus production was the result of the political organisation of society, its purpose being to provide food for those engaged in secondary and, above all, tertiary activities.

This admittedly led to great stability, with a minimum of risk, but it also made any change very difficult.

In this present day and age, population concentration in the towns and ease of transport have completely changed

things. The activities of the rural community have become angled towards markets and are even tending to be geared to short-term economic fluctuations. This tendency, which is a serious danger to sound resource management, is further favoured by technology and the sale of technology.

It should not be forgotten that agricultural production in the broad sense is the only source of foodstuffs. Mankind's survival depends on it, and this makes it a mandatory and not an optional activity. Food, as a vital necessity, cannot be evaluated in simple terms of economic return. It is most important that this should be realised at all levels and by all sections of the population. Then it will be possible to draw the necessary conclusions, without waiting for disaster to strike!

Now let us look at the countryside that feeds us. How beautiful it can be! Man has always marvelled at the beauty of landscape, because of its peace and tranquillity, its contrasting volumes and colours, its ability to change and yet always remain the same. With the changing seasons, the trees take on fresh hues, wild and cultivated plants flower and bear fruit; yet in this change there is unity, a unity that is not chance, but obeys the laws that govern nature and man himself.

It is almost as if the countryside were unchangeable, as if the old trees had always been there and always would be, unless someone chopped them down. And then, suddenly, nothing is familiar. Without one's realising it, everything is changed. How?

Since the landscape is the result of human action on nature, if man's activity changes, however little, the landscape is bound to change also. An Englishman returning home to Surrey after the Second World War asked his neighbours what had happened to the magnificent grasslands of the Downs, now overrun by wild hazel. The explanation he was given was quite simple: all the young boys went to school until they were 16 — there were no sheep to eat the grass because there were no shepherds to look after them! The simple necessity of sending children to school had transformed a landscape that had been famous since Roman times.

This story illustrates one very important point. Changes in the landscape must be seen not only from the technical and economic point of view, but also from the psychological angle: a familiar landscape gives people a sense of "belonging" — which is just as important to them psychologically as the ecological equilibrium is physically.

Does this mean that we must try to preserve landscapes in their traditional form, as we try to do for monuments? Is this desirable or even possible? After what I have just said, I firmly believe that it is impossible and not even desirable. To do so would mean compelling whole populations not to change, either in the techniques they use or in the way they live, which is clearly impossible and undesirable.

Change without upheaval

Instead of this I would advocate an approach of "conservationist" change. This means changing only what is indispensable and always trying to anticipate the overall effect of proposed changes. In other words, change is not the primary objective, but the outcome of adaptation to prevailing conditions. In any event, allowance will have to be made for ecological as well as economic factors.

Let us take farm mechanisation as an example: the centuries-old Mediterranean practice of growing cereals beneath trees is clearly incompatible with the use of large, modern harvesting machines. On the other hand, it is difficult to do without these machines, not only because of a

The changing countryside

shortage of manpower, but also for reasons of crop yield. So the trees — *all* the trees — are felled, even those in places where the machines cannot operate. A more sensible course, it seems to me, would be to grow more trees in places not suitable for cereals and to clear the arable land. Near Sigüenza, on the Madrid-Saragossa road, both methods can be seen and compared. Similarly, in France it would often have been enough to thin out trees in places where growth had become too dense, rather than destroy them completely, as was done all along the Angoulême-Orléans road in the 1960s.

Fertilisers are another example. With the introduction of chemical fertilisers, which are much easier to handle than the old dung, the latter has come to be regarded as old-fashioned. In turn, there has been an all-out attack on chemical fertilisers, which is equally unreasonable. Chemicals have their place alongside natural fertilisers, but ways must be found of making the organic product more efficient, easier to make and easier to use. I believe it is possible to use forest products without any other application to produce compost, which can be extremely useful in the Mediterranean countries.

Lastly, the use of pesticides in intensive fruit-farming should be more carefully and ecologically controlled: this does not mean that they can be dispensed with altogether, but they should be used only in extreme cases, attempting to restore the balance with natural predators immediately afterwards. This is another case of having to strike a balance between the impossible alternative of doing nothing in an ecosystem which has already lost its natural equilibrium anyway, and total mechanical intervention with complete disregard for nature.

Finally, a few words on watercourses. Rivers and streams are an extremely important part of the landscape, not only aesthetically but also ecologically. Riverbanks, with their very varied vegetation, form a rich and varied ecotope. The vis-

ible watercourse is only a small part of the total movement of water in the whole basin and there must be free exchange between it and the groundwater. Suitable vegetation on the river-banks not only supports but also protects animal life.

However, the countryside is not only biologically and economically valuable to man. Being in most cases partly man-made, it represents, after language, one of the most characteristic features of human civilisation. The rare remaining natural landscapes, on the other hand, are relics of great value for understanding the process of humanisation. Man-made landscapes illustrate the activity of our forebears, their creative spirit and their tenacity, without which the communities they built would not have survived. That they should have been able at the same time to create harmony of form and proportion in their environment is both an example and a challenge to the present day.

A new purpose: recreation

Leisure raises new problems where the landscape is concerned. The countryside has always been a place of recreation and amusement, but in the past mainly for the people who lived there. Fairs and fêtes, the wine-harvest, game-shooting, used to be mainly confined to the local people, but now they attract people in huge numbers from another world, the town, who understand little of their surroundings, of the values and needs of the rural community in which they seek to relax in mind and body.

Growing interest in the countryside is due not only to its beauty, its tranquillity and the sense of freedom it conveys, but also to its size, which can accept large numbers without congestion.

Nevertheless, there are great difficulties: if the rural population is not prepared for receiving visitors and unless plans are made accordingly, there will be problems of trespassing on unfenced private land, with a great deal of difficulty and unpleasantness for the farmers. To someone who has always lived in the town, an unfenced green space is a public space and he is not capable of recognising the outward marks of ownership in a rural setting. Similarly, townspeople do not know what is harmful to crops; one of the commonest examples is camping on a Sunday in a field due to be mown on Monday.

Facilities need to be provided so that visitors can be received either as guests, paying rent for accommodation and other services, or to help with farm work, mainly with livestock and with the harvest, and domestic work.

The latter type of recreation should be encouraged by the authorities, for "active" integration of this kind can be one of the best ways of restoring links between

farmers and the rest of the community and of making everyone realise the very real difficulties facing the countryside which everyone needs.

In Europe, the countryside comprises virtually all the space not built up or occupied by industry; it supports all wildlife, both animal and vegetable. However, the constant spread of built-up areas is an increasing threat to wildlife. So it is understandable that experts the world over should be concerned about preserving wildlife and, accordingly, about preserving the natural environment without which it is doomed. Their concern is quite reasonable — but we must avoid putting the cat among the pigeons. Wildlife reserves must be sited in areas that can be spared from farmland: in woodland, next to grazing land, tracks, hedgerows, etc.

This must be brought home first to landscape planners. Later it will be possible to convince the farmers, whose co-operation is essential. F.C.C.



(Photo David Cabot)

The farmer's view

M. A. Kehoe

Nature, for the Irish farmer, is not something to which he escapes from the pressures of city life, it is part and parcel of his normal day, the whole year round. The conservation of nature is not just a worthy hobby for him, it is essential for his continuing existence and prosperity.

Nature for the farmer and his family is the rivers, lakes and streams of which there are such an abundance in Ireland with its heavy rainfall. Nature is the multiple species of wild plant and animal life, all too few of which are surviving the pressures of modern civilisation. Nature is also the fisheries which provide employment for thousands and enjoyment for tens of thousands but which can so easily be wiped out through the carelessness of man.

The farmer sees nature as an inheritance which has been passed down to him. It is his role not only to preserve that inheritance but to improve it and pass it on to his children and grandchildren.

At the same time there is the apparent conflict with progress. The demands for more food and greater farm productivity, especially in Ireland where agriculture is the most important industry, might seem difficult to harmonise with the basics of nature conservation.

It is of the essence of farming that land, a limited and increasingly valuable resource, be put to the most productive possible use. This involves drainage, use

of herbicides, ploughing, the removal of hedges to increase useful acreage, and so on. Thus an essential ingredient of the habitats of many forms of wildlife can be cut away.

The farmer's responsibilities

The clock cannot be turned back. Modern farm progress cannot be halted. But there must be a realisation of the side-effects of modern farming. Planned measures must be taken to give the ever rarer species of wildlife, some of which we might idly regard as pests, sufficient opportunities to remain with us. Much of this wildlife itself provides essential and not yet fully realised services to farming in preserving the balance of nature.

It is part of the education of farmers, as of other sections of the community, that modern scientific gifts should not be misunderstood nor wasted. Such dangers as the side-effects of fertilisers and pesticides should be realised and controlled. At all times the farmer has to plan the future of his farm and avail himself of the advice available to him through state-organised and other advisory services.

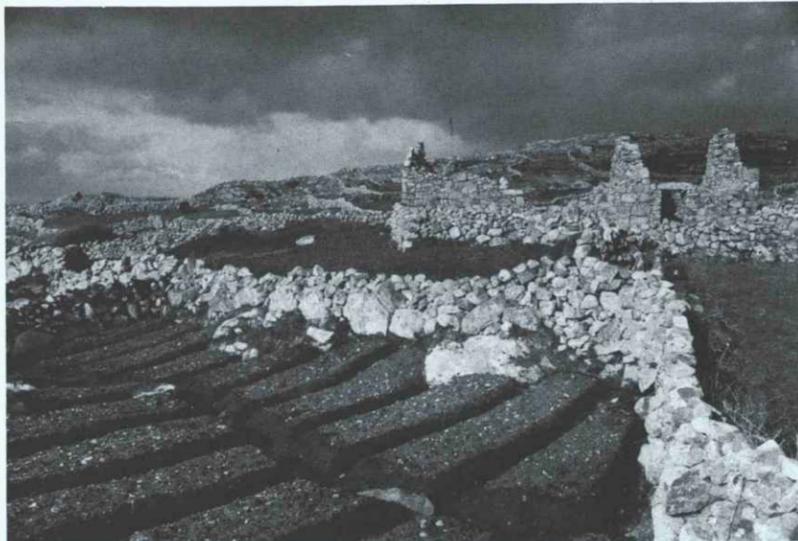
Ireland, with its plentiful rainfall all year round, has an abundance of natural waterways — rivers, streams and lakes. These flow rapidly down the mountainside bringing numerous forms of life with

them. But they can also bring down a variety of organic and inorganic pollutants which can create unwanted vegetation, kill fish and destroy the possibilities of more fish coming to replace them.

The farmer does not want to destroy these waters through his carelessness. He as much as anybody else enjoys the clear stream which passes through his own fields. The answer to farm chemicals damaging rivers is not to stop their use, for without them literally vast areas of the world would starve, but to control their abuse.

It is appropriate here to commend the measures taken by the Irish dairy co-operatives in effluent treatment and pollution control. The modernisation of the Irish dairy industry has led to the emergence of large multi-million-pound processing complexes owned and controlled by farmers. The potential environmental damage from this £2 500 million co-operative industry is immense, but from the start strict controls have been operated over and above the minimum requirements laid down by the local planning authorities. This is a splendid example of Irish farmers caring for their own heritage and environment.

Modern industrialisation has been a feature of Ireland over the past twenty-five years. New factories, both Irish and foreign-owned, have transformed the countryside. Attracted by government tax



Ireland and its potatoes (Photo P. Gleizes - Explorer)

incentives, these new industries have grown up side by side with farming in almost all parts of the country.

The new factories are providing much-needed local employment and enabling farm families to stay together without the emigration on a vast scale which for so many years typified the Irish nation. Smaller holdings, which might otherwise be unviable and could no longer provide full-time employment for the whole family, now give part-time farming which supplements the earnings from the local factory.

Industrialisation, however, brings its own tensions and threats to nature - ugly buildings, and air and water pollution. All, especially local planning authorities, need to be aware of the dangers of this new economic boom. Decisions taken now can be irreversible. Priceless features of our heritage, as priceless as anything treasured in culture, literature or monuments, can be destroyed forever at one meeting of a planning authority. Clear areas of demarcation between land and buildings must be enforced and priorities must at all stages be designated for agriculture and forestry.

When pollution occurs in the city there may be so many separate pollutants that nobody knows who really is to blame at any one time. In the country it is different - the culprit is less easily able to hide behind the anonymity of everybody else's filth. It is clear to everybody which factory or which farm is poisoning the river or the air. The growing community concern over pollution, helped by enlightened civics courses in the schools, is now a strong deterrent to polluters.

Protection of wildlife

From long tradition the forests have been a key feature of the Irish environment. The building of towns and cities and the development of agriculture meant, however, that over many centuries the forests were gradually chipped away with consequent loss of wildlife. Ireland has only half as many species as Britain, and only a quarter of the variety that is found on the continent of Europe.

When Ireland gained its political independence in 1922, there were only 130 hectares of the country under state forest. This grew to 47 500 hectares by 1945, and is now almost 300 000 hectares - a large improvement but still only 3% of the country.

Linked with the policy of not just providing timber for present and future needs but also of preserving the natural environment for wildlife, there has been an ongoing programme of education for the community, with attractively laid out forest walks which bring home the full value of this heritage to city and country people alike.

It is significant that the same Minister in the Irish Government, Mr Brian Lenihan, is responsible for both fisheries and forests. He is also responsible for wildlife, which is now protected by a comprehensive and up-to-date Wild Life Act which the Government passed in 1976. In establishing the Forest and Wildlife Service as the statutory authority with responsibility for the conservation of wildlife, the act has as one of its objectives to provide a base for the unification of existing services dealing with forests, conservation and allied amenity matters.

The new act protects all wild birds and their nests and eggs, except for a few common pests. Protected animals are deer, red squirrel, seal and natterjack toad. Some of these are very rare, while others are common. There is not a complete prohibition on gamekeepers hunting all protected species, but there are specified open seasons for game birds, hares and deer. There are about 120 leaseholdings of the right to hunt over state forest, usually to sporting organisations.

There is a long tradition of game shooting in Ireland, but all sportsmen and the farmers who allow them onto their land realise the dangers of depleting stocks. Voluntary controls have become far more rigid in recent years, for it is fully realised that too much sport in the short term for too many sportsmen would in the long term mean no sport for anybody and the loss of something valuable which might never be recovered.

Ireland has an abundance of wetlands, including bogs, which in one form or another occupy one-seventh of the land space of the country. There are 56 wild-fowl sanctuaries, including the North Slob in Wexford in the south-east of the country. This is where half of the world's total population of 13 000 Greenland white-fronted geese (*Anser albifrons flavirostris*) spend their winter.

Ireland has a significant part to play in European wetland conservation policy. More intensive cultivation is leading to less refuge for wildlife, but there is no conflict between Irish farming and wildlife interests. It is realised that conservation of wildlife is essential for the safeguard of resources which have economic, scientific, educational and aesthetic value.

The smallness of Ireland and its island position means that towns and countryside mingle more closely than in some other countries. It also means that all of the agents for nature conservation and for nature destruction live side by side. Harmony is essential, but all can be assured that policies to protect and develop the very important heritage have the full support of Ireland's 220 000 farmers, who represent more than one-fifth of the total work-force of the country. M.A.K.

Making a choice

Ian Samuel¹

At the core of the problem

In a recent article in *Chemistry and Industry* Professor Rapson of the University of Toronto wrote, "Four specific chemicals have probably added more man-years to human life than all other factors combined". Two of them are agrochemicals, by which we mean, broadly speaking, herbicides, insecticides and fungicides. The two are, in Professor Rapson's words, "DDT, by destruction of insects which propagate malaria, typhus and other diseases; and 2, 4,-D, by destruction of weeds to increase crop yields to feed the expanding world population".

Dr Dieter Bommer, Assistant Director General of the Food and Agriculture Organisation, made a similar point when he welcomed the delegates to an inter-government consultation in Rome in October 1977, by stressing that pest control ranked high on the list of inputs required to achieve the goals of higher food production and freedom from vector-borne diseases. The Council of Europe itself is on record in its booklet *Pesticides* as say-

(Photo H. Roger-Viollet)

ing, "The correct use of pesticides to protect crops before and after harvest and during storage and in animal husbandry, can lead to great improvements in human health and animal nutrition." But the booklet adds the warning, "As with so many things which can be beneficial for man, harm to man himself, his domestic animals and his environment can also occur if their use is not properly controlled."

There are, of course, many people who distrust the judgments of experts, however eminent, and this is a healthy trait in society. But these particular experts have a great many facts on their side: the fact, for instance, that more than a million Irish men, women and children starved to death in the middle of the last century because their potatoes were attacked by a fungal disease that is now easily controlled by a fungicide that is readily available; or the fact that malnutrition and actual starvation threaten millions of people in the Middle East and Africa when, as happened last year, spraying insecticide to control locusts is hampered or made impossible - Mr Edouard Saouma, Director General of the Food and Ag-

riculture Organisation of the United Nations has listed the recent invasion of desert locusts in East Africa as one of the major scourges afflicting the continent. Perhaps when the lovely elm trees of southern England come crashing down, rotted by disease (some 15.5 million of them in the last ten years), even those who most dislike interfering with "the balance of nature" may occasionally wish that some chemical cure were available.

However that may be, it is becoming increasingly accepted by expert and non-expert alike that agrochemicals are now essential to modern agriculture, and that only by modern agricultural methods can we produce enough food for the ever-increasing population of the world. Biological pest control, in which harmful organisms are controlled by predator species, has a role to play, but it is a modest one, for the complexities and difficulties are great and the techniques, still in their infancy, are unreliable. The concept of integrated control, or integrated pest management, in which various cultural methods are combined, is much more promising - indeed it could be said that it is what good farmers do anyway. But one of those cultural methods, and not the least important, is chemical control.

Agrochemicals as agricultural tools

If agrochemicals are here to stay, we must pay attention to the warning in the Council of Europe's booklet and take all reasonable steps to ensure that any risk

¹ Director General of GIFAP (Groupement International des Associations Nationales de Fabricants de Pesticides)



Making a choice

that their use may involve is minimised and that their impact on the environment is not harmful. But before considering how this can be, indeed is being, done, we need to be sure about what we are really discussing. We must be clear that agrochemicals are tools, agricultural implements, in fact, like ploughs or spades, only chemical in form. When agricultural land is built over to provide more houses or more roads or more factories, there is pressure to bring hitherto unproductive land into beneficial use. So the farmer decides to get rid of his patches of stinging-nettles and plant them with cabbages instead. Some farmers will plough the nettles in, others will destroy them with a herbicide. In either case the nettles will disappear. And so will butterflies, the tortoiseshells and the red admirals, for nettles are their host plants. Is it the plough or the herbicide that has had an impact on the environment? Or is it the Ministry of Urban Development?

It is, in truth, society. Different interests inside the community compete and conflict, and in the end a decision is reached and something is done or left undone: a moorland is left as it is, covered with heather and bracken, and full of birds, animals and insects, or it is ploughed up to grow crops or pasture cattle, or it is covered in concrete to make a new airport.

The responsibility of the agrochemical industry

Sometimes — increasingly in these years when the population of the world is growing so fast — society does decide that parts of the environment must be changed, that bracken must be eliminated to enable more food to be produced. The most efficient way of getting rid of bracken is by spraying it with herbicide. At this point, but not until this point, the responsibility of the agrochemical industry is engaged. The manufacturer of any implement is obliged to ensure that it is safe and effective when properly used, that it

will cause no more or no worse side-effects than can be helped. This is all the more serious in the case of the agrochemical manufacturer because he is introducing into the environment materials that are biologically active. Furthermore, they are toxic — they must be if they are to control the insect or the weed at which they are aimed. So they must be, and they are, strictly monitored in use and required to pass stringent tests before they are sold. In this way, the industry and the authorities ensure, so far as is humanly possible, that no harm comes to the user, the consumer of the treated crop, or the environment.

In the developed countries, and increasingly in the developing countries, strict regulations are in force to achieve this goal. It now takes an average of six or seven years for a company to bring a new agrochemical to the market, and the cost is between £5 and £10 million. Anyone who still thinks that these materials are sold without much testing by companies interested only in quick profits would be reassured if he knew the stages through which a new compound passes during its development from the initial synthesis to its use on the farm. It will be noted that the likely impact of the compound on the environment is under scrutiny from an early stage — phytotoxicity, mammalian, avian and fish toxicity are all studied, and at the field trial stage particular attention is paid to the general impact of the material — if any — on the local wildlife.

To weigh the pros and the cons

There is, of course, no such thing as absolute safety. Complete absence of risk is unobtainable. As some people find this difficult to accept, there is a temptation to

demand more and more tests. But sooner or later a judgment has to be made, a value judgment based on the risk/benefit ratio. This involves consideration of the real risk, that is the likelihood or otherwise that the material will cause harm which will be out of proportion to the benefit that it will bring. Dr Kenneth Mellanby, lately Director of the Monks Wood Experimental Station in England, puts the point clearly in his contribution to *Pesticides and Human Welfare* (Oxford University Press, 1976), when he writes, "If millions of citizens in a developing country would die of malaria unless there was a fairly generous use of DDT, it would probably be right to risk some temporary effects on wildlife."

Over the last forty years or so, that is since modern agrochemicals began to be widely used, these risk assessments have been continuously made by the regulatory authorities in many countries, and there have been no human disasters, certainly no disasters like the recurrence of malaria in Sri Lanka after DDT was banned there. There have, of course, been tragic incidents, as when people have been poisoned by treated seed which was never intended for human consumption, or have neglected to take proper precautions when handling toxic materials. But where agrochemicals are concerned the balance between cost (in its widest sense) and benefit lies heavily on the benefit side.

The environmental impact

In the field of environmental impact the record of agrochemicals is at least as good. Again there have been no disasters, no irreversible effects on wildlife or plant life. Some species of birds seemed at one time to be in danger, notably the raptors,

(Photo Imperial Chemical Industries Ltd)



Still fresher, lovelier and more plentiful (Photo Dominique Chibois)

but they have recovered. Wild birds are much more at risk from hard winters, from the destruction by man of their habitats than from agrochemicals. Individuals, both birds and mammals, have been poisoned, sometimes in what might seem like large numbers, but populations have not suffered.

Dr Mellanby deals with this aspect of the matter at some length. "There is a widespread belief", he writes, "particularly among non-scientists concerned with environmental problems, that pesticides, particularly DDT and other organochlorine insecticides, are causing widespread pollution. It is even suggested that the future of our globe itself is in jeopardy, that DDT may interfere with the oxygen supply and, eventually, make life impossible. There is no doubt that there is some pollution, and that pesticides have killed birds and other animals unintentionally." He notes that traces of DDT have been found "in rain, in birds and other animals, in snow, and in fish at sites remote from those where pesticides have been deliberately applied", and he ascribes this to the fact that chemicals are volatilised into the atmosphere and deposited with rain. He calls this contamination but not pollution

because the levels arising in this way "are so low as to cause no detectable effects on living organisms".

Mechanisms to detect the presence of chemicals, most of which have been developed by industry and government scientists working together, are effective and do signal potential dangers. They are, of course, being improved all the time, but already they are capable of detecting the minutest amounts which, although they are there, cannot conceivably be of significance: it has been described as being like the magnification needed for a telescope on Earth through which one can see the footprint of an ant on the moon. The competence of those working in this field, toxicologists, analytical chemists, residue chemists and the like, is very high, and in many countries there is a growing appreciation by industry, government and environmentalists of the importance of each other's role — and of each other's integrity. Scientists who work for commercial companies like to eat uncontaminated food and enjoy an unpolluted landscape as much as the next man; and many a keen conservationist is not above saving his back by spraying a little weed-killer on his flower-beds.

A choice of society

This is a good augury for the future, for the future will be shaped by the wishes and the needs of the men and the women who make up our society. Here is Professor Rapson again: "In any proposal for environmental improvement, the benefits must be weighed against the costs. This must be the central theme of government and of industry in a concerted, aggressive campaign of public education. It will require collaboration for the common good, not confrontation."

We should not forget that the beautiful countryside, like its black spots, has been largely made by man: it is almost everywhere artificial, except in the mountains and moors and those parts of the wetlands that man has not drained. The fields of corn, the orchards, the vineyards, and of course the towns and villages, have been consciously created by man. Much of his creation pleases him and he would like to keep it as it is — to "freeze" the landscape, as it were, in its present state. Perhaps people always want their surroundings to remain as they knew them in their youth: when people talk of keeping the balance of nature, what they really mean is retaining the environment in which they have been brought up and to which they are accustomed.

In theory at least, the trends of modern agriculture could be reversed; spinneys and coverts for pheasants could be planted in the fields, dew ponds for cattle could be reintroduced, along with hedgerows for song-birds and wild flowers. Agricultural yields would drop or prices would rise, or both, but if society willed it, it could be done. Or we could go to the other extreme and set aside large areas for the intensive production of food, and forget all about amenities and pheasants: hundreds of hectares could be put under glass. More likely there will be a combination of both: for many years now tracts of country all over the world have been set aside as nature reserves, wildlife parks and amenity areas; and anyone taking off from Rotterdam airport at dusk could be forgiven for thinking that an important part of Holland was already under glass.

The choice is ours. We must make up our minds what we want and what we can afford. The tools are there, agrochemicals among them. But the tools are not responsible for what we use them for. I.S.



Burning stubble is highly destructive unless basic precautions are taken (Photo Office National de la Chasse)

Farming without killing Jean-Louis Soye

Ever since Rachel Carson's *Silent Spring* there has been a general feeling of uneasiness at "chemical farming" and its effects on wildlife. This feeling has been kept alive by frequent reminders in the press, because it is a subject that concerns us all and touches a sensitive chord.

At the same time, other processes detrimental to wildlife, such as mechanised farming and recent developments geared to high-yield agriculture are hardly regarded as major factors. This is probably because such factors are far harder to investigate than chemical products.

In this article the various developments and techniques characteristic of modern farming are reviewed, both from the point of view of the agronomist and in terms of game and wildlife conservation.

Regrouping of agricultural land

It would be inconceivable to call into question the value of, or need for, regrouping agricultural holdings, but attention should be paid to the harmful consequences of ill-conceived land consolidation.

In addition to the priority conservation of beauty spots, characteristic natural sites and interesting monuments to be preserved in their traditional setting, land consolidation operations should also take account of the impact of regrouping on the environment. Such impact is unfortunately assessed in the abstract, with all

the unknown factors that this entails, because the various suppositions will not be borne out until after completion of the exercise.

In practice, the following criticisms of agricultural land consolidation may be made in terms of wildlife:

— In agricultural zones, there is a tendency to create plots that are too large, although it is not necessarily any more economic to cultivate one 40-ha plot than 4 x 10 ha plots. This tendency makes for a monotonous environment in which it is hard for birds to find landmarks, and where their food supply will lack variety, or will even be totally non-existent in the case of partridges, if the crops are kept free of weeds. Birkan (*Institut National de la Recherche Agronomique*, INRA) has shown that the number and size of hatchings are directly correlated with the ratio between the length of boundaries and surface of the land holding.

— The same studies have demonstrated that the number of partridge nests found on a given plot of land will depend upon the variety of crops that border it.

— In any case, wherever possible, a band of cover cultivated with cabbages, leguminous plants or maize should be grown along the boundaries of certain plots, and especially those that are largest in area, either along a path or across open country, in order to break up the monoculture. These should form permanent bands, planted with occasional clumps of shrubs bearing berries or edible seeds. Studies

recently published by the Technical Centre for Agricultural Engineering, Water and Forestry (*Centre Technique du Génie Rural et des Eaux et Forêts* CTGREF) have revealed the value of such arrangements in helping numerous perchers, partridges (*Perdix perdix*), red-legged partridges (*Alectoris rufa*) and pheasants to survive the winter. Such an arrangement redresses the trophic capacity of the territory in wintertime, and has, under certain experimental conditions, cut winter mortality by approximately 10% in relation to the estimated population of the territory.

It is thus advisable that operations for the regrouping of agricultural land should be entrusted to multidisciplinary teams, in order to plan the operation in such a way as to bring the expected benefits for farmers, but at the same time to conserve natural structures, landscapes, microclimates and varied habitats for wildlife.

Removal of hedges and banks

The regrouping of farmland in many parts of France, and particularly in Western France and the Paris region, has for forty years been coupled with heedless destruction of hedges and embankments. All too often the farmers themselves have completed the operation, mowing down even those hedges or embankments that the surveyors had originally intended to preserve. If we are to return to a landscape hospitable to wildlife, the farmer

will have to be convinced of the benefits of the hedge, many of which are conferred on the farmer and his produce, as well as on the ecosystem:

A windbreak

Hedges can reduce the negative effects of wind on crops and animals, owing to the following assets:

- reduction in the beating-down of crops by wind;
- reduction in the drying-out of soil when not entirely covered with crops;
- reduction in wind erosion;
- greater ease for watering by sprinkling;
- reduction in the harmful physiological effects of wind;
- reduction in wind-borne distribution of ectoparasites on grassland;
- increased fodder yield in the shelter of hedges;
- reduction in animals' energy expenditure for heat regulation.

Moreover, hedges can improve microclimates owing to:

- reduction in evapo-transpiration;
- preservation of a higher average temperature of air layers;
- retrieval of the sun's rays by the hedge.

As a rule, even after taking into account the ensuing reduction in the area under cultivation, hedges always seem to foster increased yields in cultivated land, although the extent of the increase will vary depending upon biotopes, crops and types of climate. The various factors set out above will have different effects for different crops.

For maximum effectiveness in terms of wind, the typical hedge will be even and unbroken, with alternating larger trees and smaller bushes, deciduous and seed-bearing. The hedge should be properly maintained, and will then have a beneficial effect on farming over a length equivalent to twenty times its height.

Low, broad-based hedges (up to 2 metres in height) are favoured for game, although they do not bring improvements in terms of wind.

Pedo-hydrological function

The hedge will attract precipitation, which it will retain more effectively and return to the soil slowly. It will reduce erosion and compel the depositing of sediments.

Biological function

This is the function that seems at first sight to concern both huntsmen and ecologists, although, on closer inspection, it will be found to concern the farmer as well.

Hedges, especially those planted on embankments, can preserve a stable vegetable and animal ecosystem.

As regards plant life, all the studies conducted have shown that the hedgerow environment is particularly rich in botanical species, whether herbaceous, bushy

or sylvatic. The hedge serves as a small linear wood in an agricultural setting. It is all the richer when the upper stratum is based on deciduous species.

This has some interesting consequences in terms of soil microfauna, such as the presence of highly active earthworms in the reception zone of the dead leaves, because the species found there are dependent on woodland humus.

There is always a greater wealth of fauna — mammals and birds — in farming areas bordered with hedges than in open areas. The rodent population and insectivora live in a state of equilibrium, and hardly ever survive beyond the year, because predators are numerous in this environment and live in the same embankment. Removal of the hedge often leads to a proliferation of small field rodents which are no longer held in check by their natural predators — vanished together with their habitat. The rodents then have to be destroyed by means of various rodenticides, which are all too often lacking in specificity and may affect other species than those for which they were intended (numerous granivorous birds, Lagomorpha and gallinaceous game).

At the same time, perchers are numerous, and their density is still higher at the intersection of two hedges. The population in a given environment increases with the length and breadth of the hedge.

The existence of hedges creates, over a breadth of several metres, a considerable variety of environments favourable to insect populations, some of which constitute vital food for young birds, and particularly gallinaceous game, whilst others are useful as predators or parasites of other insects (such as Syrphidae, Tachina, Carabidae, etc.) or as pollinators (bumble bees).

Certain botanical species, such as the oak and hawthorn, shelter the most abundant and varied insect populations (300 different species have been listed under oaks).

Hunting people have always welcomed hedges, since game is always more abundant there. Finally, the hedge produces and retains humus. It thus plays a unique part in terms of biological conservation.

Crop changes

The problems of labour in a rural environment, together with the demanding nature of stock-farming, have gradually led to a shift towards highly mechanised agriculture, and also to a reduction in land under pasture and in certain feed crops and sown meadows, once particularly hospitable to small game. In addition to this, the increasing tendency of farmers to export within the Common Market framework has led to a reduction in fallow land, at least in cereal-growing areas. For wildlife, fallow land provided cover, reserves and food supplies.

At the same time, the last thirty years have seen an increase in maize-growing far north of the traditional maize-growing areas. Whilst maize-growing areas have a virtually nil trophic potential for small game, maize does provide excellent cover, especially from birds of prey.

Only a very small part of the fallow land is replaced by crops hospitable to game.

Cultivation

Preparation of soil

At the periods of soil preparation, it is hares especially that are in danger of crushing by tractor wheels, crosskills or rollers. In order to obviate this danger, it is a simple matter to chase the hares away, in the early morning, from the area to be ploughed, preferably with the help of trained dogs (after informing the mayor or gamekeeper).

Treatment with chemicals

Whilst the traditional treatment with NPK fertilisers in powder or granulated form does not seem to cause mortality in game, treatment with pesticides is far more dangerous. Even assuming that the farmer, as is almost always possible, uses only those products that present no serious danger to wildlife, the use of pesticides still entails three risks.

Risk of disturbing animals. Doe-hares, which produce several litters a year between February and November, may be frequently disturbed, together with their offspring, by phytosanitary treatment of large-scale crops. Sometimes the wheels of farm machinery crush the young. The period from February to June is particularly critical.

The main disturbance to partridges (*Perdix perdix*) is caused by the one or two fungicide treatments for cereals in May, and grain aphid control treatment in late May or early June.

The food supply problem. Fungicides do not affect the food supply, but insecticides always reduce birds' food supplies, sometimes radically, by destroying the insects available for young birds. This occurs, for instance, in the case of grain aphid control treatment. Such treatment is usually carried out at the time when the newly-hatched partridges have a high protein requirement, which is normally satisfied by means of insects.

Weed-killers produce a direct reduction in the food potential of an area by reducing the quantity of green stuff available for game. They also have an indirect effect, because the selective elimination of certain weeds leads to the disappearance of certain insects dependent on those weeds for food or reproduction. These insects will no longer be available for birds.

Destruction of cover. The chemical arsenal also includes certain selective



An important job for the hunter is to help farmers prevent such massacres (Photo Carl Thiermeyer)



Another way of preventing death in the reaper (Photo Office National de la Chasse)

weed-killers which destroy vegetation within a few days, so that the game has to move on. This is impossible for the very young, which cannot reach new cover quickly, especially when large areas have been treated. This applies particularly in the case of large plots (large-scale cultivation).

Harvesting of fodder

It is common knowledge among farmers that the harvesting of fodder entails high mortality in small game. Studies in Hungary have revealed that 78% of the game losses caused by mechanisation occur in the harvesting of fodder crops, with the destruction of adults, young game and especially eggs.

The extent of such mortality depends on a number of factors. Foolproof remedies are hard to work out, particularly since devices for clearing game, in the form of special bars (*barres d'envol*) cannot be used if the fodder or lucerne is too dense.

There is one simple measure that can be adopted by the tractor-driver in order to cut down the risks that arise in harvesting fodder. This is to start work from the centre of the field, finishing up at the outside (thus gradually chasing the animals into the adjacent cover). This is obviously not very convenient and will unfortunately never be put into practice by farms growing fodder for dehydration, when maximum yield is the primary concern.

Grain harvesting

In a French study, Birkan reports that two sample studies were made in 1969, before 1 August and on about 20 August, before and after harvesting. Between the two studies, there was a 35% drop in the population of young partridges, although no distinction could be drawn between the part played in this reduction by the harvesting proper, and the part played by burning off the stubble.

In the case of partridges, the loss at harvest time will be even greater if the conditions that year have led to re-mating on a considerable scale. Re-mating occurs when nests are destroyed by excessive rainfall or agricultural machinery.

In the event of re-mating, hatching occurs at the beginning of, or during, harvest time for nests in grain crops. The risks can be considerably diminished by means of slow turning and a high cutter-bar, because most clutches are found on the borders of grain crops.

In the case of hares, which have larger litters during the summer, the harvest should be carried out from the centre of the plot outwards in order to drive the game onto neighbouring plots.

Harvesting proper is combined with one or other of the following practices:

- the burning of stubble,
- the crushing of stubble prior to ploughing in.

These operations are carried out because wherever there is no economic use for surplus straw in stock-farming or industry, the only way for farmers to get rid of it is to plough in or burn the stubble.

Burning off stubble

Stubble is burned off in most parts of France, and especially in areas with chalky or heavy soils. Stubble-burning can cause destruction of game (hares, partridges and pheasants, both adult and, especially, young).

A distinction should be drawn between two types of burning:

- If only a small area of the territory is to be burned off, this should preferably be done straight after harvesting. If not, the game will in the meantime have resettled in the stubble and, if the fire spreads rapidly, few animals will escape.

- If an area with a high density of cereals is to be burnt off, as occurs in much of the Paris Basin, it may be a good idea to spread out the burning operation over a period of time in order to enable some cover to be preserved.

In practice, when the conditions of farming are such that the farmer is obliged to continue the practice of burning off stubble, it is advisable to burn in lines and against the wind.

In the United Kingdom, the Game Conservancy suggests that dogs should be sent in before any burning operation. This cannot be done in France unless the gamekeeper or mayor of the commune

has been notified, for such action will otherwise be regarded as hunting.

From the cynegetic viewpoint, the practice of burning off stubble is thus not to be recommended.

Ploughing in stubble

The farmer can restore stubble to the soil by ploughing in. However, ploughing in is not recommended on heavy or chalky soil, or soil deficient in organic matter. In such areas, the ploughing in of stubble will entail comparatively costly treatment with mineral nitrogen. From the cynegetic point of view, it is the preliminary crushing of stubble prior to ploughing in that leads to mortality in game unless precautions are taken. It is important that the crusher should follow directly behind the harvester. Unless this is done, the game will return to the stubble and many animals will be destroyed in the rollers. This little-known mortality factor is a major one, especially when the machinery operates at speed.

In conclusion, the harmful consequences of agricultural improvements and modern cultivation practices are real, even if hard to quantify. Although the competent committees and legislation in France are taking pains to restrict the sale of chemical products, in view of environmental risks, officialdom still seems to be turning a blind eye to the problem of mechanisation. This means that the few available remedies for the present or future will be effective only if the farmer himself gains awareness of the risks that stem from his work, and of the part that he can play, within his own sphere, in cutting down, if not cutting out completely, the deterioration of our environment. J.L.S.

Fallow lands

Emil Surber

Fallow land and its causes

By "fallow land", we mean land which is usable for agriculture but which for one reason or another has not been farmed for a long time, or has ceased to be farmed altogether and cannot be put to any other economic use.

Depending on place and previous use, fallow land below the natural forest edge is gradually colonised by a sequence of plant forms which, if undisturbed by human agency or natural disaster, ultimately become a climax forest community characteristic of that particular place. Fallow land vegetation starts with a grass or leafy plant phase, followed in time by perennial herbaceous plants and later woody shrubs, and finally the tree phase. Different phases can occur side by side and intermingled in fallow land areas; at the higher levels and where the land is no longer grazed, the pure tree phase can take over immediately.

The countries which make up the Alps and the adjoining middle-range mountain regions have developed in the course of the last hundred years from self-sufficient agrarian states into states in which the emphasis is on industry and services.

Food is now imported from the most favourable production areas throughout the world. Trade and supply are no longer

a problem with today's great density and choice of transport facilities. The only obstacles are protectionist measures designed to safeguard national agricultural interests.

At the same time, agricultural productivity in terms of land and manpower has increased many times over through developments in research and organisation in such matters as breeding, fertilisers and improved production techniques (mechanisation). Agricultural production is being more and more restricted to the best soils at the lower levels. Marginal land in mountain regions, which could often be made productive only if specially ameliorated, was once a vital factor in local self-sufficiency; now it has already to some extent been abandoned and cannot be used for any other economic purpose.

There are various reasons why the continued use of agricultural land — even where it is flat — in mountain areas is attended by uncertainty. The vegetation period, and thus productivity, diminishes with increasing altitude. Steep slopes place definite limits on the use of farm machinery. Irregular, unstable or boulder-strewn land is difficult to develop and farm. Extensive subdivision as the result of inheritance laws, or nomadic types of farming with several sets of buildings

which are only used from time to time, place excessive constraints on farming operations.

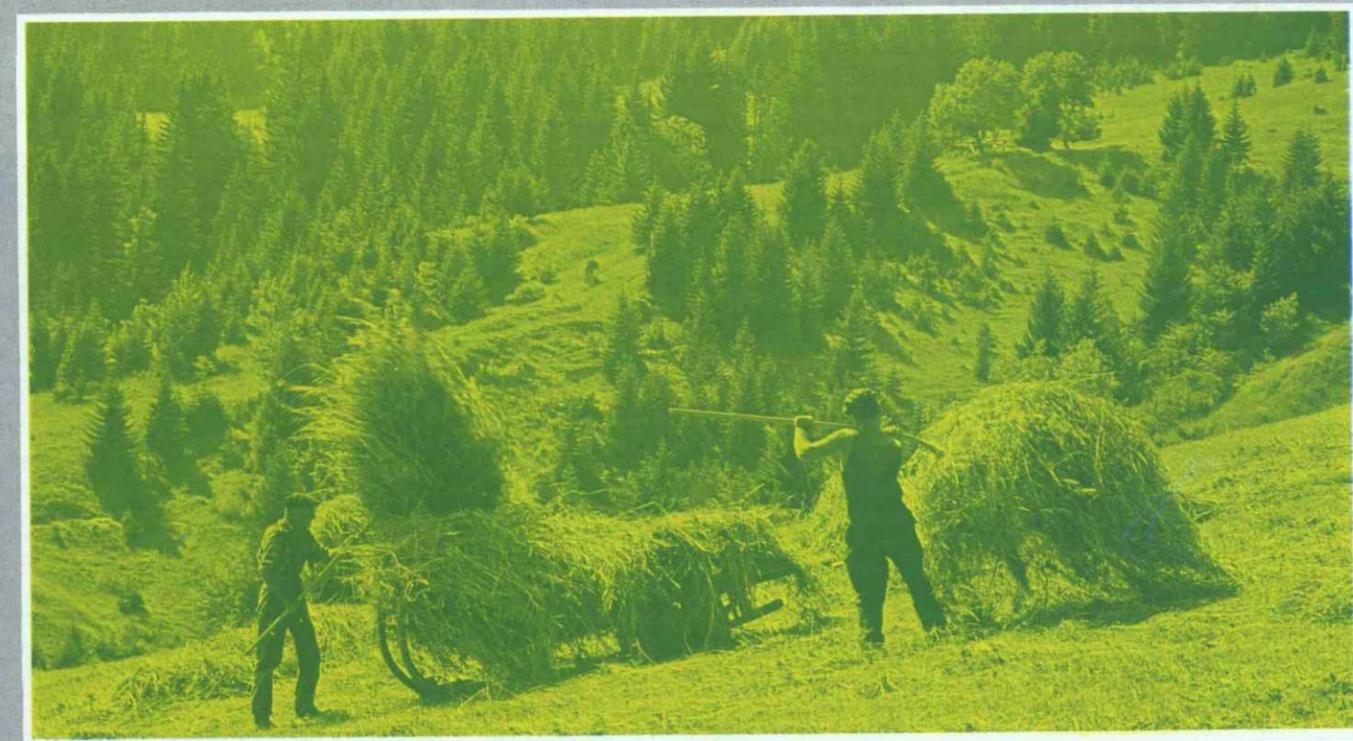
Mountain farming always relied on secondary incomes (from forestry, building work, winter operations, etc.) in order to keep large families alive. Nowadays there are better educational and professional training opportunities for the people who are able to farm the land, and the secondary job is becoming the main occupation. The mountain landscape loses its attractiveness in the process; it is exposed to competition from farms at lower altitudes inside the country, from imported products and from artificial food produced by the chemical industry. In spite of further support measures, therefore, we are likely to see more fallow land developing.

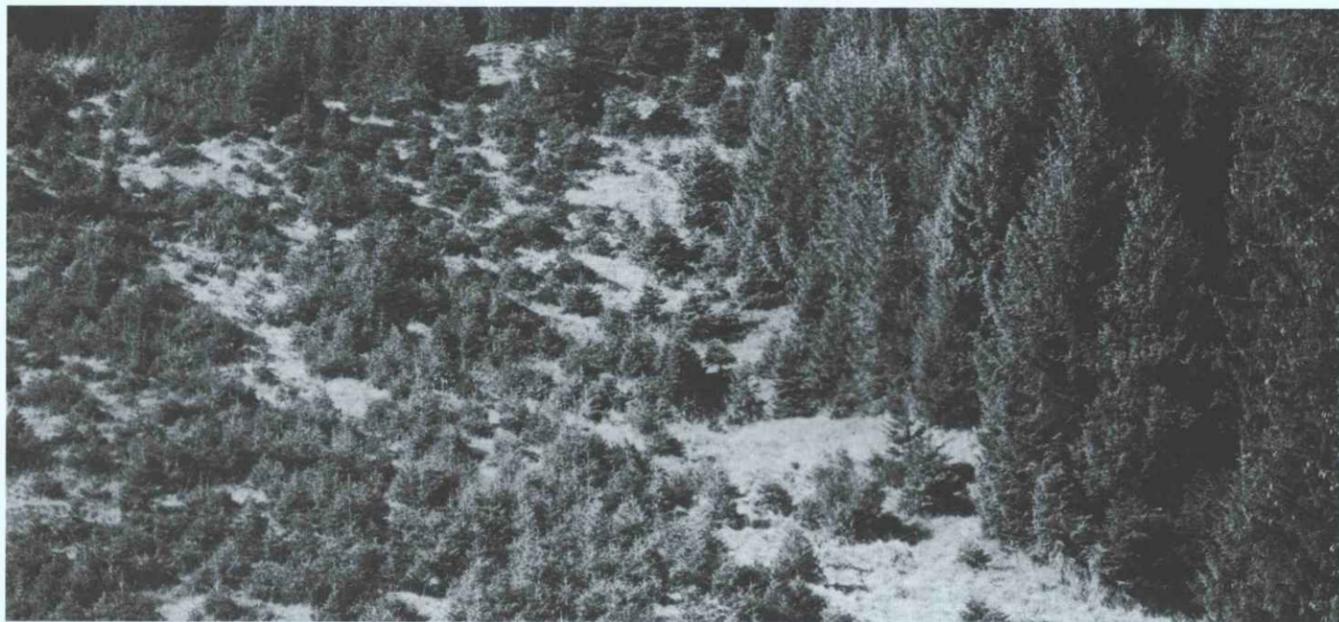
Emergence and spread of fallow land

Fallow land is to be found in every part of the Swiss mountains. There is practically none in the central part of the country where the land is suitable for various kinds of crops. This will continue to be the case in future, since the pressures on agricultural land from urban development, industry and transport are great.

In the Jura and the Lower Alps there are

Gradual disappearance of traditional hill farming is detrimental to the environment (Photo José Dupont — Explorer)





Grass, bushes and trees are characteristic of fallow land which soon takes over once farming ceases and can provide plants and animals with cover for some time (Photo Emil Surber)

clear signs of incipient fallow land — with regional differences — sometimes covering potentially large areas. The process has advanced further in the central Alps, in the cantons of Grisons, Ticino and especially Valais, where in some places 75% of the land used for agriculture until quite recently is now lying fallow in certain lateral valleys.

As yet, there is no statistical survey of fallow land in Switzerland, and its extent must therefore be estimated. The present figure, based on sample surveys, is reckoned to be about 80 000 hectares. It is likely to rise to between 200 000 and 250 000 hectares by the year 2000 if present economic trends continue.

Where Austria is concerned, the 1973 agricultural land use survey mentions fallow land on former arable land in Burgenland, fallow land on mixed arable and pastureland in Styria and Lower Austria, and especially fallow land areas in the Alpine pastures; in the latter alone, more than 70 000 hectares have fallen into disuse. The worst-affected regions are the Vorarlberg, Western and Eastern Tyrol, Carinthia and the limestone Alps of Styria and Lower Austria.

The underlying causes are structural factors (Burgenland), the peripheral situation close to the eastern bloc countries and the resultant isolation (regions to the north of the Danube), the type of terrain, altitude, traffic situation, and alternatives to farming such as industry, tourism and forestry (Tyrol, Vorarlberg, Carinthia).

Another fallow land problem that exists in Austria is referred to by the term "shrub forest". This is former pastureland which has reached the "woody shrub" phase and is now to be converted into forestry

resources. These "shrub forests" generally remain confined to good sites at the lower and intermediate levels.

In the Federal Republic of Germany, fallow land has been considerably on the increase in recent years in the secondary mountain chains (Black Forest, Odenwald, Spessart, Saar, Westerwald) and in the vicinity of major conurbations and in the limited Alpine area of southern Bavaria. The factors at work in the secondary mountain chains are partly ecological, but mainly socio-economic (relinquishment of farming as a secondary activity in industrial regions, serious fragmentation). At the start of the seventies there were already more than 250 000 hectares of fallow land in the Federal Republic (Meisel, 1973).

The situation is similar in the other countries with Alpine or secondary mountain regions in their territory (France, Italy, Slovenia), but little statistical information is available for them.

Environmental effects of fallow land

Little is yet known about the ecology of fallow lands and their effects on the environment; we frequently have to rely on comparisons with other landscape factors (forest, open cultivated land, unproductive land). The picture is further complicated by the predominant pattern of small-scale fragmentation and the varied and constantly changing forms which the phenomenon can take.

Research into fallow land is still in its infancy, and as yet covers little of the extensive range of problems that arise. The first point of interest is the damage which may be caused by landscape neg-

lect when land is left to become fallow, and which may result in the spread of the phenomenon.

Sloping fallow land in the early grass and shrub phase is subject to fire, slippage of snow masses, rapid surface run-off of precipitation and destruction of the plant cover by erosion, with all their attendant consequences. Formerly drained or terraced areas are also at risk. When land ceases to be used, the devices employed to improve it are no longer maintained, and their deterioration can lead to landslips, mud-torrents and avalanche paths for snow masses. Encroachment on to neighbouring or lower-lying land can result in unexpected and legally tricky situations (legal liability).

Adjoining farmland may also be adversely affected by the spread of weed seeds (shrub phase) or the multiplication of pests and plant diseases from fallow land areas.

The development of bushes changes the appearance of the landscape, which takes on an unfamiliar aspect. The simultaneous presence of tall grasses, shrubs and ferns makes the fallow land into a kind of "desert".

Judgments differ on these "desertified" areas. People tend to avoid them as areas for recreation — thorny shrubs can become impassable, and the camper setting up his tent in the long grass must reckon with all kinds of animals, from ants to snakes and small animals of prey.

For as long as they survive, untouched fallow land areas can serve as refuges for animals and plants for which this secondary landscape offers the right biotope and which thus remain for some time viable in the region. Rare species can survive and

multiply in dry or wet conditions if the original extensive pattern of use continues.

The shrub and tree phases constitute stable cover and may have favourable effects on the environment, loose-knit, graduated vegetation affording habitats for birds, small animals and game which are not (or no longer) found in farmed areas and managed forests at the lower levels. In order to enhance the nature protection function of the shrub and tree phases, a minimum degree of management through selective maintenance measures is needed. Such areas are then able to take over functions which previously, as farmed or forested land, they did not have or discharged in a different way. In addition, it is possible to check the short-lived succession of stages by maintenance measures and thus preserve the floristic importance of these areas. Once it becomes possible to control development through intervention to shape secondary natural landscapes, the changes to the visual landscape seem slight, and the visual landscape can become a maintenance objective.

Future use of fallow land

In many cases fallow land is left to its own devices, for economic reasons, and develops from one phase to the next until perhaps one day it is seen as undesirable. Depending on the location, sooner or later the result is an unplanned forest which can, in certain circumstances, be disaster-prone.

The alternative is to keep formerly farmed land open and to conserve a low plant cover by periodic grazing or mowing. In the case of grazing, the grass is kept short by the cattle; in the case of mowing, the hay remains and must be made use of in other ways or else destroyed, unless it can

be turned into silage and taken away subsequently. Experiments along these lines are under way in the Federal Republic of Germany. Keeping the land open requires the co-operation or agreement of the owner of the land, together with organisation, executive bodies and, ultimately, financial resources.

The same applies to keeping land open by extensive grazing of any kind; over-grazing or inexperienced methods can lead to the destruction of the plant cover and thus to damage by erosion. Small livestock are difficult to control and constitute a threat to the nearby forest. It is frequently necessary to mow the pasture a second time because it has been grazed selectively, and this can in the long run produce damaging changes in the plant cover.

The range of support measures in Switzerland has recently been augmented by special grants for the farming of sloping terrain, in an effort to prevent the abandonment of further land and maintain the hill farming economy for as long as possible.

Where the natural process of forest evolution is encouraged, maintenance is still needed in the sense of selecting and thinning young growth in order to create a healthy, stable forest stand. This maintenance and the necessary access, however, entail investment over several decades which may not produce any return until long afterwards, if at all.

Afforestation on fallow land is only justified where the developing forest is obviously required to serve a protective function. In many cases afforestation only achieves viability if it is protected in the critical early stages by structural works. Afforestation in Switzerland costs between 6 000 and 12 000 SF per hectare, and structural work four times as much.

We endeavour to avoid the use of herbicides in dealing with fallow land, in keeping existing forest areas open and in maintenance operations. We regard forest and fallow land alike as conservation and recreation areas and try to keep them free of all interference.

Fallow land is regarded in various quarters as potential building land, especially for second homes. Scattered development leads in most cases to fragmentation of the landscape and the attendant phenomena of inadequate fallow land infrastructure, difficulties of access, and building in danger areas. The construction of buildings on fallow land affords no

"Sloping fallow land in the early grass and shrub phase is subject to fire, slippage of snow masses, rapid surface run-off of precipitation and destruction of the plant cover by erosion, with all their attendant consequences" (Photo Mario Broggi)

solution to the problem: the buildings occupy only a small part of it, while the great remainder continues unused. Piecemeal development of this kind is being countered in Switzerland by existing and planned legislation (water protection and regional planning laws). In many places, speculation over planning permission has prevented the consolidation of agricultural land and encouraged the emergence of fallow land.

Fallow land has seldom been a factor in regional planning hitherto, since the areas in question are of little economic significance and of variable extent.

It must, however, be taken into account in the future as it takes over larger and larger areas, especially in mountain regions, because of its influence on the environment and the shape of the landscape.

Depending on the local situation, a broad range of options is open to the planners. Where the fallow land is not, and is not likely to become, a threat to the environment, there is substantial freedom of action. Where it is likely to be utilised at a later stage, the best course is to preserve it in the early phase, from which it can be converted into positive use at little expense. No immediate decision is called for: depending on the situation, minimum maintenance at intervals of several years is sufficient.

The situation is more critical where the fallow land constitutes a danger to surrounding areas and to inhabitants at lower levels. In such cases the requisite measures should be laid down in planning regulations. As a general rule, fallow land is not simply a source of potential danger, but is linked to other kinds of instability which must be remedied in due course as part of an integral, co-ordinated scheme. E.S.

Captions to colour illustrations

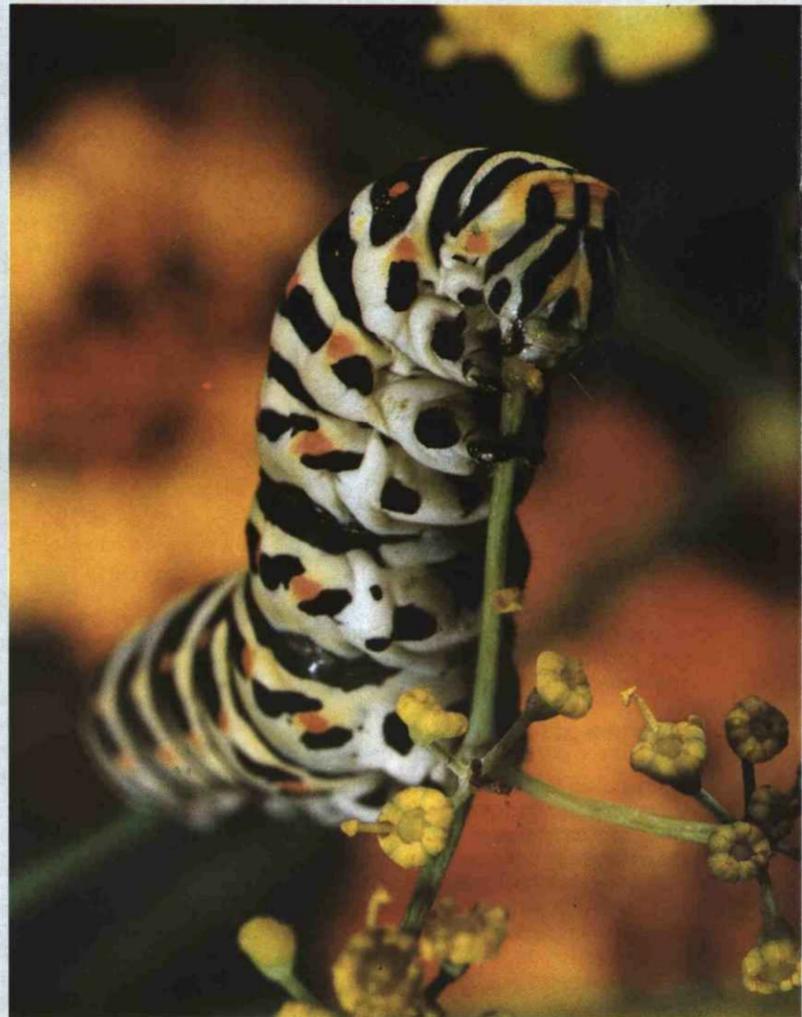
1. *Lymantria dispar*, plant-eating invertebrate (Photo Jacques Six)
2. *Calosoma sycophanta*, entomophage (Photo Jacques Six)
3. *Papilio machaon*, plant-eating invertebrate (Photo C. and M. Moiton - Jacana)
4. *Mantis religiosa*, entomophage (Photo C. and M. Moiton - Jacana)
5. *Gastroidea viridula*, plant-eating invertebrate (Photo Jacques Six)
6. *Leptinotarsa decemlineata*, plant-eating invertebrate (Photo Jacques Six)
7. *Malacosoma neustria*, plant-eating invertebrate (Photo Jacques Six)
8. *Siphonophora rosae* and its predator, larva of syrphidae (Photo Jacques Six)
9. *Coccinella septempunctata*, entomophage (Photo C. and M. Moiton - Jacana)
10. *Syrphus balteatus* (Photo Jacques Six).



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Harnessing Nature to control Nature

Pierre Jourdeuil

Agriculture must contend with the onslaughts, sometimes fierce and far-reaching, of plant-eating invertebrates which, by consuming the same plants as humans do, compete with us and force us to resist. Examples of these are the San José scale (*Quadraspidiotus perniciosus*), the mite *Aceria sheldoni* which attacks citrus fruits, or the Colorado potato beetle (*Leptinotarsa decemlineata*).

The entomophages

Alongside these plant-eating invertebrates, however, there is a widely diversified group of insect-eaters or entomophages, which can be a precious boon to agriculture.

By and large, every insect pest belongs to a complex of insect-eating species which attack their prey at various stages of its development. Some of these, the *predators*, are relatively large species which pursue and capture their prey and with which farmers are well acquainted (ladybugs, Hemiptera, hover flies, gall gnats, aphid-lions). Others, the *parasites*, are usually smaller and more discreet in their behaviour; they lay their eggs on or inside the host's body and develop at its expense but without killing it at once.

There are a number of reasons why the insect-eaters are particularly valuable in applied farming:

They have great diversity and so can adapt to every ecological situation, as each insect pest has a numerous and highly diversified group of predators and parasites.

Also, every insect-eater has a highly specialised diet, often preying upon a single family or genera, or even a single species and at a single stage of its existence — egg, larva, pupa or adult. Hence, unlike other agents used to combat plant enemies, and pesticides in particular, their action is highly selective.

Lastly, insect-eaters can adjust the intensity of their activity to the population density of their victim, whose increase creates very favourable conditions for the multiplication of the beneficial insect as-

sociated with it. The latter is then able to eliminate more of the plant-eating insects than are born, reducing the victim's population. The ensuing scarcity of prey means less activity on the part of the insect-eater, and this in turn produces an increase in the plant-eating species, and the gradual creation of a dynamic equilibrium in which alternating rises and falls of the plant-eating and insect-eating populations prevent the unending exponential expansion of the undesirable species. In terms of agronomy, the object is to maintain the pest's population fluctuations as long as possible below the level of economically unacceptable damage. The creation of this ideal equilibrium, however, can be perturbed by more factors than inopportune human intervention: the insect-eater may not be able to reproduce fast enough to inhibit proliferation of the pest: climatic conditions may not be sufficiently propitious for the beneficial species to develop its full potential; or — and this is often the case — it may itself be attacked by a third order of species among which are also found a number of what are called hyperparasites.

Agricultural auxiliaries

The idea of using these auxiliaries is not new: towards the end of the nineteenth century entomologists began to envisage the rational exploitation of insect-eating species. In the state of knowledge of that time, the only feasible strategy was the acclimatisation of exotic species. In 1883, one Coccinellidae, *Rodolia cardinalis*, was successfully introduced to the California orange-groves to combat another introduced Coccinellidae, the cottony cushion scale *Icerya purchasi*. The same ladybug was subsequently introduced to Europe, where it eliminated the mealybug. More recently, the whitefly *Aleurothrixus floccosus*, which was accidentally introduced into France and spread through the citrus fruit-growing regions of the Western Mediterranean (France, Italy, Spain and Morocco), was brought under control remarkably well by the introduction of one of its parasites, *Cales noacki*.

Where the likelihood of success of this strategy is limited, however, another possibility is the periodic release of insect-eaters raised in large quantities in an insectarium — in other words, the substitution of truly biological treatments for chemical ones. One parasite, a Trichogrammatidae, which attacks Lepidoptera eggs, is already being used systematically on several million hectares of cereal, beet and leguminous crops in the USSR and on some hundreds of thousands of hectares of maize and cotton in Mexico. Similarly the use of artificially bred predating Acaridae is an effective means of controlling plant-killing mites.

However, the artificial enrichment of biocenoses by the introduction of useful organisms is only one aspect of a rational policy for the management of biological equilibria, and it must be supplemented by the creation of an environment that will be favourable to the survival and multiplication of existing auxiliaries. At the level of agrobiocenoses one major problem remains, which is the reconciliation of the action of insect-eaters with chemical pest control. The injudicious use of a pesticide against a crop enemy may well cancel out, wholly or in part, the beneficial effects of the insect-eating fauna naturally or artificially associated with that enemy, resulting in a situation which is no better and possibly worse than before.

The survival and effectiveness of insect-eaters in the natural environment do not depend only upon a more rational use of chemicals, however; they are governed by many other ecological interactions, and we can intervene at these levels as well. Botanical diversity, in particular, is obviously an essential factor in the wealth and stability of entomocenoses. In the adult stage, all parasites and many predators need plant nourishment composed of nectar, honeydew, pollen, etc., that are not necessarily provided by the plant being attacked by the enemy with which they are associated. Furthermore, the enemy may be present in large numbers only temporarily, if it is linked to a particular phenological stage in the life of the host plant; many auxiliaries, thus, are periodically forced to move on to other nearby plants to find the food they need in order to survive. A rational policy for the protection of insect-eaters must take into account a botanical environment far more extensive and diversified than the particular plant to be protected.

In broader terms, much scientific research is being done throughout the world on the subject of insects; an example is the systematic study of threatened insects in Europe, starting with Lepidoptera Hymenoptera and Odonata, which is soon to be put in hand by the European Committee for the Conservation of Nature and Natural Resources of the Council of Europe. P.J.



Lagoons in the Cape Circeo nature reserve. The Italian Government has been able to save these last sanctuaries which are of vital importance for wildfowl (Photo L. Bortolotti)

Mediterranean landscapes

Pietro Renato Lauriola

In the Mediterranean region it is not easy to reconcile the maintenance and development of the natural ecosystem with man's industrial, technological and demographic needs, in so far as they are basic to his livelihood.

The problem

It must be remembered at the outset that in the planning of rural areas the balance between agriculture, forestry and pastoral activities is a fundamental factor which must be respected in any ecological approach to the exploitation of ecosystems in a region with such a rich history of civilisation.

Next, account must be taken of the relentless acceleration in man's appropriation of land, which is apt to alter nature, and of the population explosion which, although somewhat abated at present, impinges in-

creasingly on space because it entails fundamental changes in land use.

As a result of this development, a clear trend may be observed towards the concentration of agricultural land, while intensive farming is encouraged by the extraordinary progress of technology (in genetics, chemistry and mechanisation). At the same time, urbanisation in the broad sense, or non-agricultural use, is taking up more and more space, especially as each member of the growing urban population increases his consumption of space at the same rate as his standard of living (the Goldrond effect).

From the point of view of nature protection and conservation, the Mediterranean region has much striking scenery and many areas of great natural beauty, ecosystems that are still more or less intact, valuable reserves of flora and fauna and geological formations of scientific inter-

est which together constitute a heritage common to all the Mediterranean countries and their inhabitants.

Today this heritage is seriously threatened by land speculation, pollution of every kind and the uncontrolled urbanisation of rural areas. We therefore have a real duty to conserve this heritage for future generations and to improve it as far as possible.

Even the planning of coastal areas is a source of continual conflict between lucrative private ownership of land and free access to the coast for the general public. The seaboard is a rare and extremely coveted asset; the more urbanisation and industry spread, the greater is the value of unoccupied land.

Environmental deterioration is growing everywhere: from the Camargue to the Côte d'Azur, in Corsica and Sardinia, below the Apennines and the Maritime Alps,

from Andalusia to Sicily, in the Pyrenees, in Macedonia, and along the Adriatic coast, to mention but a few examples. A reversion to garigue and scrubland is observed all along the coast, and farms are being relinquished in hill and mountain areas.

Every effort must therefore be made to protect the natural ecosystems of these areas, some of which have not yet been seriously disrupted, but the growing needs of a population extremely badly situated in other respects must of course be respected.

Interdependence and compatibility

At first sight it would seem that the question is not one of the compatibility of nature conservation with agriculture, forestry and pastoral activities, but of a very close interdependence between them. The bumble bee is an interesting example in this connection: it is important for the pollination of leguminous plants, but it must find somewhere to hibernate, nidify and feed when these plants are not flowering, and so it needs forests, woodland, hedges, banks and copses. Here, the interaction of factors is obvious, between agricultural use and the need to plant trees on farmland and wasteland in order to preserve the biological process and conserve the species.

Likewise, the systematic destruction of hundreds of thousands of migratory birds certainly raises a problem for the ecological balance, because it entails a constant proliferation of animal parasites on plants. To eradicate these parasites it is necessary to use massive doses of insecticides which harm the natural environment.

A distinction must first be made between the different problems of various kinds of agricultural land. Given the vastness of the subject, the analysis will be confined to examining whether the protection of Mediterranean ecosystems is compatible with agriculture in the plain, hill farming and forestry.

In the plain, the present laws of the market, based on profitability of a strictly quantitative nature, entail the rapid industrialisation of agriculture, leading to the creation of large farms in the plain and to the disappearance of traditional, highly diversified hill farms.

The consequence of this type of economic trend is obvious. The environment is seriously disturbed by the application of modern cultivation methods, the abuse of organo-chlorinated pesticides and organo-mercurial fungicides, the massive use of certain fertilisers and the intensive stock-farming entailed in increased agricultural productivity.

However, it must be borne in mind that farmers are subject to many complex

forms of pressure — economic, technical, cultural and ecological — which are difficult to reconcile; help from competent outside bodies may be necessary. Nevertheless, only the local inhabitants can decide. It is often said that the inequality between farmers and people in business entitles the former to destroy the natural environment in an attempt to preserve their immediate future. To be sure, something needs to be said about solidarity, but this applies to solidarity among farmers themselves as well as between them and the rest of society.

Committees have concluded that ecologists must have a share in regional planning. But an environment imported by technicians is something foreign that the local inhabitants regard with distrust. Ecologists who have observed land consolidation schemes know this well, and recognise that their efficacy depends on the awareness they create, not on studies which are, of necessity, limited.

Some power must therefore still rest with farmers, although the necessary efforts must be made to provide them with as much information as possible.

In hill farming, defence measures do not seem at first sight to conflict so much with nature conservation. But there is still ecological deterioration which must be stopped as a matter of urgency. The drainage and canalisation of streams are neglected everywhere; plantations of resinous trees impoverish the soil through

The Mediterranean area has suffered particularly at the hands of man. Today an attempt is being made to put things right: reafforestation in Spain (Photo H. Roger-Viollet)



too much acidity; forests are not maintained and improved as they should be, and this leads to a deterioration in the water balance. Moreover, there is a tendency to replace pastureland by conifer plantations.

It is nonetheless true that the decline in hill farming is caused by a profound social change, the most obvious characteristics of which are the ageing of the farming population and a shortage of labour and capital for farms. This means that profits are almost nil and the processing industry tends to concentrate in areas with better services or more intensive production. Moreover, owing to a lack of manpower and funds, local authorities are unable to maintain the main types of infrastructure affected (roads, tracks and farm buildings).

This neglect of local infrastructures has accelerated the flight from the land; local authorities tend to follow a wait-and-see policy as far as any conservation plans are concerned, either "passing the buck" to central governments or promoting regional development plans with purely tourist aims.

On the other hand, it is acknowledged that where deforestation and conservation of the natural environment are concerned, the question is entirely one of compatibility, though there are some reservations as regards the reduction in areas of pastureland. Natural forests form terrestrial ecosystems which play an im-



Phoenicopterus ruber: compatibility! This magnificent bird for many years did not nest in the Camargue, France, but is now beginning to cause serious problems for rice crops in the area (Photo Alan R. Johnson)

portant role in maintaining the general ecological balance in rural areas. They represent basic units in the whole terrestrial environment which constitutes the biosphere for human life and work. Woodland is also an effective means of conserving soil and water. It is even the best means we have of combating erosion; moreover, forests have a very clear function in regulating water flows.

Their effect is particularly important in the Mediterranean region, with its characteristic heavy rainfall concentrated in the cold or relatively cold seasons of the year.

A quite remarkable contribution to the conservation of relatively green spaces is still made by two typical Mediterranean plants, the olive and the almond, which should not be looked upon as trees but almost as people. In some areas they represent the only tree that will grow, and they form part of the cultural and social traditions of the whole region. The careful cultivation of olive and almond trees in an archaic agricultural and pastoral landscape used to represent the basic economy of the Mediterranean peoples.

However, an attempt must be made to reconcile the interests of farmers and landowners, who expect income or pleasure from their land, the non-land-owning public, which expects green spaces that will provide them with the opportunity for recreation, contact with nature and knowledge of flora and fauna, and the community as a whole, which requires forest and woodland to supply it with the materials it needs, to regulate the climate, to regenerate the atmosphere and to contribute to the general balance of the biosphere.

Protection through planning

These few facts show that varying aims can be reconciled. Moreover, there are no significant differences in the essential

needs of the Mediterranean regions, however far apart they are. This is sufficient indication of the underlying unity of a way of life which gives these regions a common destiny transcending linguistic and political barriers. They all suffer from the same ills, to which none of the different political systems of European states seems to have found an effective remedy.

The time of uncontrolled growth is past. We are now faced with a complete change in our way of life, in that forecasts predict that by the end of the century the rural population will have fallen to 20%: it is high time that European legislation on the protection and conservation of nature was passed, otherwise it will be impossible to obtain the desired results.

Everyone says that it is necessary to plan in order to preserve. The Mediterranean region needs a comprehensive analysis of its coast, hinterland, islands and peninsulas, and the ecosystem defined by this analysis must be respected and planned. The growth of demand in the recreation sector makes such planning indispensable; however, it must not constitute an end in itself, as is so often the case, but must form part of a conservation programme in which all European countries take part.

Considerable progress could be made with the gradual adoption of zoning: not arbitrary, technocratic zones imposed from above, but zoning by objectives which, as far as biological value was concerned, would concentrate on a few main points, principally the strict protection of zones of great biological and social value (national and regional parks), defence measures taken as soon as possible to prevent further damage in areas of average deterioration, and the declaration of buffer zones and urban zones. One of the first jobs is to delimit the most outstanding or most threatened areas and to study what measures should be taken in each of them to ensure their conservation.

In hilly areas, while respecting the above-mentioned ecosystems, it might be possible to encourage projects aimed at the structural reorganisation of farming in clearly defined micro-economic areas. Local production should also be channelled towards greater diversification of rural activities, to ensure a rich social life. Such areas would become an essential training ground for the continued education of the rural population.

Lastly, it is very comforting to see that afforestation is tending to regain its rightful place in the regional planning of all Mediterranean countries. There is a growing awareness of these problems even in the Southern Mediterranean lands. For example, north of the Sahara there is a transnational project aimed at establishing a green belt running through Morocco, Algeria, Tunisia, Libya and Egypt. This is a regional planning project in a semi-arid zone where forest vegetation is found side by side with cultivated crops and grazing land.

This belt will be established in the strip which receives between 150 and 250 mm of rain annually, and will be about 10 km wide, depending on local conditions. Obviously, in arid Mediterranean areas it would be useless to try to plant trees to protect catchment areas. In such conditions bushes or shrubs can be planted; the evaporation from such cover is moderate, which is an advantage for the water resources of dry regions.

This appraisal (which is of necessity limited) of the various problems related to the compatibility of agricultural and forestry practices with nature conservation in the Mediterranean area highlights the need to adopt comprehensive multinational plans. The European organisations have a very important function in the protection of the heritage and the conservation of biological, geological and historic evidence in this rapidly changing region.

However, this conservation must in no way make a museum or a picture out of nature, for man's survival depends on it. Everything must be done to ensure that nature never becomes a mere memory.

P.R.L.



(Photo Jean Proess)

Europe's forests

Max Scheifele

woodland, which accounts for 29% of the area of the Federal Republic of Germany, has been the subject of critical appraisal. The demand that forests should serve first and foremost as nature reserves in an increasingly unnatural environment appears to be incompatible with efforts to step up timber production to meet the growing shortage looming up at world level. Yet the example of Baden-Württemberg shows that these two demands are in fact by no means incompatible in the context of rational, planned forestry.

The evolution of tree species

In the natural plant communities of the forests of Baden-Württemberg, broad-leaved deciduous trees were once dominant. Beech and oak forests, mixed with fir in the foothills, were the characteristic

feature of the landscape. Stands of fir, spruce and sometimes pine, mixed with beech, were dominant only in the mountain and northern local communities, as in the Black Forest or the Swabian-Frankish forest.

Ever since the inception of traditional forestry, in about 1800, there has been a radical change in tree species. The aim of forestry at that time was to transform into viable forests the over-exploited, devastated grazing woodland, open woodland, mountain pastures, wasteland, etc. It entailed an unequalled exercise in cultivation.

In this way, the former ratio of tree species of one-third conifers to two-thirds broad-leaved deciduous trees was reversed. The transformation was virtually completed by the turn of the century. Since then, there has been little change in the ratio of the different tree species. There were three main periods of afforestation: from 1870 to 1900, the post-First World War period, and the post-Second World War period. Many of today's unmixed stands of spruce and pine date from these periods, and the transformation of these into mixed stands in keeping with the locality is one of the major tasks of present-day and future afforestation.

Present-day forest management

The Baden-Württemberg *Land Forest Act (Landeswaldgesetz)* lays down that the environment, natural equilibrium and natural assets must be preserved and fostered in the management of forests. "Account must be taken of the variety and natural characteristics of the landscape. Special attention must be paid to the planning and care of forest edges planted in keeping with the natural landscape. Adequate biotopes should be preserved for indigenous flora and fauna; account should be taken of the necessary conditions for maintaining a healthy and appropriate stock of game."

Whilst traditional German forestry originally focused on plantation and nurture geared to maximum yield in terms of timber production and economics, forestry today is thus obliged by law to pay attention to the safeguard and fostering of the social and cultural functions of the forest.

Forest plant communities that are especially endangered are classified as protected forests. These are either full-scale reserves in which there is no exploitation for productive purposes, in order that the vegetation of the forest may develop undisturbed in accordance with its own laws, or conservation forests in which management of the forest has to foster, and not endanger, a particular plant community or particular form of afforestation. Factors relating to the protection of species, as well as vegetation, ecological-

sociological, and forest or landscape history aspects are all taken into consideration in the selection of protected areas.

The designation of forest reserves and conservation forests is not to be used as a pretext for neglecting to manage other forests in a manner appropriate to the natural environment.

The foundation for sound afforestation is accurate and intensive reconnaissance and mapping of habitats, to provide information about the natural plant communities of the forest and the possible choice of species. On the basis of this, the *Land's* forest administration has the following long-term aims:

- establishment and nurture of stable mixed stands, in keeping with the natural environment, in which the inclusion of broad-leaved deciduous trees is ensured in the long term;
- breeding of selected species of deciduous trees, especially oaks and valuable deciduous trees, but also beeches, in the *Land's* natural broad-leaved deciduous woodlands;
- conversion of the unmixed conifer stands dating from the different periods of afforestation into mixed stands in keeping with the natural environment.

Achievement of aims

In order to achieve these long-term aims, a whole series of measures has to be observed in everyday forestry work. I will mention as examples only a small number of these, in which the impact on development and variety of flora and fauna can be clearly seen.

(Photo Jean Lavergne)



Wherever different kinds of plant communities coexist within a comparatively small area, there will be a wide range of living conditions, which is a prerequisite for a wide range of fauna.

The establishment and nurture of mixed stands in keeping with the natural environment is of special importance from the afforestation viewpoint. Even the introduction of broad-leaved deciduous trees into conifer woods on a modest scale can lead to the establishment of plant and animal species found in deciduous forests. The nurture of even a few small formations of deciduous trees in otherwise unmixed conifer stands is important, and the planting of deciduous trees in clearings or open woodlands must be carefully planned.

Natural regeneration procedures should be applied wherever practicable and useful. Long regeneration cycles are a necessary condition for coexistence of all stages of forest development, including the associated flora and fauna.

The fact that the change-over from natural to artificial regeneration can entail the danger of extinction for certain animal species may be seen from the case of the wood grouse (*Tetrao urugallus*), which needs a characteristic combination of open woodland with an abundant layer of berry-bearing shrubs, such as occurs only in the case of long-term natural regeneration producing trees of mixed ages.

Improvement of the natural regeneration possibilities depends upon prolongation of the cycle of cultivation. Regeneration periods of thirty to fifty years require correspondingly long cycles of cultivation. In order to avoid impairment of growth or value, a cycle of cultivation of some 130 years must be achieved in fir-spruce-beech woods. Accordingly, in the course of medium-term forestry planning, the cycles of cultivation are constantly extended.

The planning of forest edges is particularly important. As the link between forest and open countryside, these edges influence wildlife in both habitats and also contribute to the beauty of the forest.

The protective edges of forests should therefore be planted in a manner in keeping with nature, to include a variety of species.

The stocks of deer, and especially red and roe deer, must be adapted to local conditions. Excessive game stocks can, as a result of gnawing, rubbing and peeling of bark, be detrimental to the mixing of tree species in our forests. The consequence is a dominance of spruce and loss of fir and broad-leaved deciduous trees. In many places, game exceeds the forest's bearing capacity. This trend is undesirable in terms of forestry and landscape.

Game stocks should therefore be adapted to the local habitat, in order to allow forest management in accordance with local

conditions and the natural environment, without excessive expense on forest protection.

The use of pesticides, especially over extensive areas, can lead to alterations in flora and fauna, and must therefore be limited to the bare minimum. In Baden-Württemberg, integrated plant protection measures, using a combination of physical, chemical, biological and forestry techniques, have led to a substantial reduction in the use of chemical pesticides.

The use of fertilisers in forests is frequently linked in the public mind with use of pesticides, and hence rejected. Yet the use of fertilisers in forestry is predominantly a means of soil enrichment for the improvement of habitats damaged by human intervention. It improves the condition of the soil, and is hence an important prerequisite for creating mixed-species woods. It ultimately serves to improve our environment.

Weighing up economic and ecological factors

At first sight, allowance for environmental factors in forest management seems bound to entail a reduction in economic yield. This may be true in some cases, but should not be regarded as a general rule.

The very measures that have been described above for the preservation and improvement of natural biotopes, for intensifying natural regeneration, extending the cycle of cultivation, and stepping up reliability by selection of species in keeping with the site, offer possibilities for biological rationalisation that would make it possible to step up productivity in the long run.

Woodland has not only productive but also protective and recreational functions to fulfil. In a densely populated country such as the Federal Republic of Germany, the zoning of these different functions is not practicable. All functions have to be simultaneously achieved in the same area. Forestry therefore entails acting not only in technical and economic terms, but also from the ecological and aesthetic viewpoint, and in this task the aesthetic essence of the forest must be preserved.

M.S.

Man's use of the forest

Albert Noirfalise



History

Europe's forests have been manipulated by man for so long that they can only be properly understood through the history of man. When neolithic farmers began to invest them, between 6 000 and 7 000 years ago, they were in the form of the primitive, wild, profound and mysterious forest called virgin or primary forest. Over thousands of years man cut away vast farming and pastoral clearings, but where the forest subsisted at the edges of rural confines he tamed it, exploiting its resources: timber as a material and fuel, litter for improving the soil, humus for temporary crops on burnt land, the ground cover of the soil for stock grazing. When industry developed later on, it was still the forests that provided charcoal for the metal-working and glass industries, and oak bark for tanning. The European forest was for a long time an integral part of the agricultural, forestry and pastoral economy, therefore; it suffered use and misuse, at the cost of secondarisation and indeed degradation. Documents of the times testify to this state of affairs, and the scale of the phenomenon can be judged on the basis of the detailed maps drawn up at the end of the eighteenth century — those of Ferraris for the Austrian Netherlands and those of Cassini for the Kingdom of France.

It was not until the seventeenth century that the common forests timidly emerged from the rural pattern. It was at this time that enlightened "agronomists" replaced the system of fallow land by crop rotation, extended fields of leguminous plants so as to fertilise the land, and that grazing meadows surrounded by quickset hedges were created, on the basis of legislation on enclosures, into which flocks could no longer wander. A farming economy was established and consolidated. Late in the

The forest: it has taken a thousand years to achieve such perfect harmony and balance
(Photo Jim Hall — Farming and Wildlife Advisory Group)

nineteenth century it made decisive progress through the use of fertilisers. It was at this period that common forestland and grazing areas gradually became free of traditional constraints. The forestry regulations already in force in nationally owned forests, in France for instance, following the edicts of Colbert, began to be applied to them at this time. It was the dawn of present-day silviculture.

It performed two basic tasks at the same time. The first was restoration of the hunting and common forestlands, which were changed into production crops. This was the start of our managed forests of native species, a feature of which is regular and planned intervention, such as, depending on circumstances, felling for the purpose of transformation, exploitation or sowing, thinning of seedlings, free thinning, etc. Three systems came to be adopted, in the light of needs: full seedling forest, reserved for the production of timber; coppices still for the purpose of firewood, but where some higher stems are kept; lastly, coppices with standards, where the two objectives are combined. This form of silviculture may be called "natural", because it is founded on the promotion of native species and their spontaneous regeneration. Its objective is to adapt the ligneous capital to the needs of the economy, but at the same time to ensure that it is maintained and its yield remains undiminished, through the indefinite renewal of crops.

The second task was reforestation of grazing land that had been abandoned and was henceforward described as "wasteland". It soon became clear, after abortive attempts using indigenous climax species, that reforestation had to have recourse to more frugal and tolerant species that were well suited to open land and impoverished soils, such as pines, spruce and larches. This was the start of our artificial forests or secondary forests, which made it possible to exploit vast uncultivated zones and revitalise the economies of those regions. This form of forestry, known as "artificial", arose, therefore, out of historical circumstances, but its economic and technical success was such that it acted repeatedly as a model.

"Natural" forestry

What is known as "natural" forestry is perfectly compatible with the conservation of forest biocenoses. It is based on the high forest system of selection by standing trees or groups, and gives the forest a structure which emulates that of virgin forests, of which there are still some examples in Europe. The forest mensuration study of the last few years shows in fact that the perfection of the virgin forest is mainly accounted for by its structural maturity. It includes trees of a great age,

distributed by standing trees or clumps of trees, of unusual height or breadth. The natural mortality of a virgin forest is about 300 years for species whose wood is not very duramenised (beech, spruce, fir), and between about 400 and 600 years for hardwood trees (oak, Arolla pine). In the Rocky Mountains some pines are known to be over 2 000 years old, and the famous Californian redwoods grow to heights of between 80 and 100 metres and live for more than 2 000 years. These spans at the same time indicate the forest's turnover, that is the natural cycle in which it is replaced by its own seedlings. This cycle is on average between two and three times longer than the cultivated cycle or "rotation" which forestry workers apply to forests operated for economic purposes, where timber is cut down when its annual growth begins to slow down because of age.

What is known about virgin forests that have not been disturbed is that they are not a tangle of trees, bushes and vines as are second-growth forests — for example in tropical areas. Even on the Equator a virgin forest is generally dominated by one, two or three principal species, which are the most competitive in the dome and at the level of seedlings. The continuing process of mortality and regeneration also gives the forest what is known as a balanced structure, with a curvilinear distribution of size classes, in which the number of trees declines gradually with age, not without a certain over-population of the oldest and longest-surviving trees.

It would be wrong, however, to think that all virgin forests follow this structural pattern. During a virgin forest's life cycle it may have suffered violent and repeated disturbances due to trees being uprooted by wind, snow or tornadoes, or again lightning, which tends to strike old and decaying trees, or phytopathological accidents to which old trees are the most vulnerable. In other terms, a virgin forest can present a range of structures which only differ from our selection systems in the limitation of age imposed on the latter for economic reasons. The herbaceous and bush flora of the undergrowth is comparable and as diverse in our natural managed forests. Furthermore, the high forest system where regeneration is effected naturally contributes as well as the virgin forest to maintaining competition between and within species, which is favourable to the conservation of dendrological lines of excellent genetic quality.

"Artificial" silviculture

The prospects are quite different in the case of what is termed "artificial" silviculture. It should be remembered first of all that forests operated in this way are mostly secondary forests, i.e. forests reconstituted on non-cultivated or farming





All too often profitable but monotonous plantations replace the natural countryside (Photo SRFB)

land, where previously there were no longer any elements of natural forest biocenosis. Most of such stands are also even-aged, so that the trees reach the limit of their rotation at the same time, which accounts for clear felling. If this cycle is to be broken, it is necessary to transform even-aged forests into varied-age forests either by felling in preparation for seeding — the success of which is uncertain in the case of conifers — or by planting deciduous trees in intercalated cells. This operation is both difficult and costly, and has only been attempted on any scale in certain publicly owned forests with a permanent management structure.

Artificial planting is really a farming ecosystem, and imposes biocenetic constraints on the environment which depend on the dominant species. On the site, however, it creates a forest micro-climate, which is a necessary precondition if a sylvan biocenosis is to succeed in re-establishing itself. The biological succession which starts up in this way is invariably on the slow side, however.

Conditions beneath conifers, for instance, whose litter accumulates on the ground

and mineralises slowly, are not especially favourable to maintenance or restoration of the natural phytocenosis, until the point at which the stand ages and allows more diffused light to filter through. At this stage species of previous vegetation reappear — such as agricultural adventives or heathland plants — and at the same time species of the natural silva, disseminated by wind or birds. Heavy-fruited species, however, take a long time to return, even when they exist in a nearby natural forest. This is the case, for example, with the oak and beech, lily of the valley, daffodil or bluebell in Western Europe. If the conifer forest is exploited on the basis of clear felling and followed by similar replanting, the operation will naturally impose a return of the succession to its starting point.

The secondary forest of indigenous deciduous trees is on principle more favourable to the reconstruction of a natural biocenosis, but here too the succession remains slow. The secondary forests of ash, maple, elm and wild cherry that were established, sometimes spontaneously, on land under cultivation on the plateaux in the region of the Meuse, abandoned by agriculture round about 1880, have not yet recovered either their structure or the composition of a natural forest after a century; their plant cover, certainly highly diversified, includes a majority of easily disseminated commonplace species, but very few species that are really characteristic. The Ardennes beechwoods, replanted over a century ago on freshly cleared or cultivated land, have so far recovered only a very incomplete range of flora, despite the proximity of natural beech plantations in good condition. This shows the time it takes for forestland to re-establish its original characteristics, once its ecosystem has been destroyed. It is for this reason that the reforestation of coppices after mechanical working by means of bulldozers, as sometimes recommended, is an anti-ecological operation, because over a long period of time it shatters the natural soil humification system, the main source of biogenetic elements for the growth of trees.

It is also arguable that artificial silviculture, practised repeatedly and as a monoculture, annihilates the control effected

by the natural forest on pathogenic agents and depredators. In natural forests such control is far from perfect, but such agents are able to effect ravages in monoculture forests, because of the uniformity of crops and local conservation of parasitological complexes. Conifer or poplar monocultures are known, in fact, to be much more vulnerable to accidents of this kind than is the natural managed forest. This is perhaps the main long-term limit of artificial ligniculture, rather than its often hypothetical effect on soil degradation.

Some rules to respect

The compatibility of intensive silviculture with nature conservation also implies that the ecological approach shall be better integrated into forest developments, the principal purpose of which is still and inevitably economic. The rules can be defined briefly. The first is that natural high forests, producing high-quality timber, are to be conserved as forest reserves, because they provide evidence, in its least modified form, of the primary silva. The second is that artificial forests shall be transformed into forests of different ages or mixed forests, with reintroduction of climax species, where feasible. Then, when artificial silviculture is inevitable as an economic system, it is possible for it to be better integrated into the landscape, notably by the arrangement of blocks and the outline of forest edges, in harmony with the relief and landscape.

The last rule is that when reforestation work is being carried out it is important to prevent the accidental destruction of biotopes that are remarkable for their flora, vegetation and fauna; this applies to wasteland of marginal value, such as peatland, marshes and designated wetlands, waste areas of heathland or semi-natural grass. Such last wildlife refuges often find more favourable conditions for their survival in wooded areas than in rural regions; all the same, foresters themselves must take care not to destroy or mutilate such refuges, in their endeavours to protect what remains of them at any price. The location and conditions of such sites often tend to be mediocre and in need of investments which may well prove uneconomic. A.N.



Small forest bogs swarm with life

Changing the farmer's mentality

Jim Hall

Farmers accused

Where conservation is concerned, the attention of public and governments is largely focused on such obvious issues as the effect of pollution from oil spills, the need for internationally secure areas for wildfowl, the nature reserves of high scientific interest, etc. Now coming to the fore is the pressing need to consider the impact of progress on the whole environment, not least that of agriculture on the countryside.

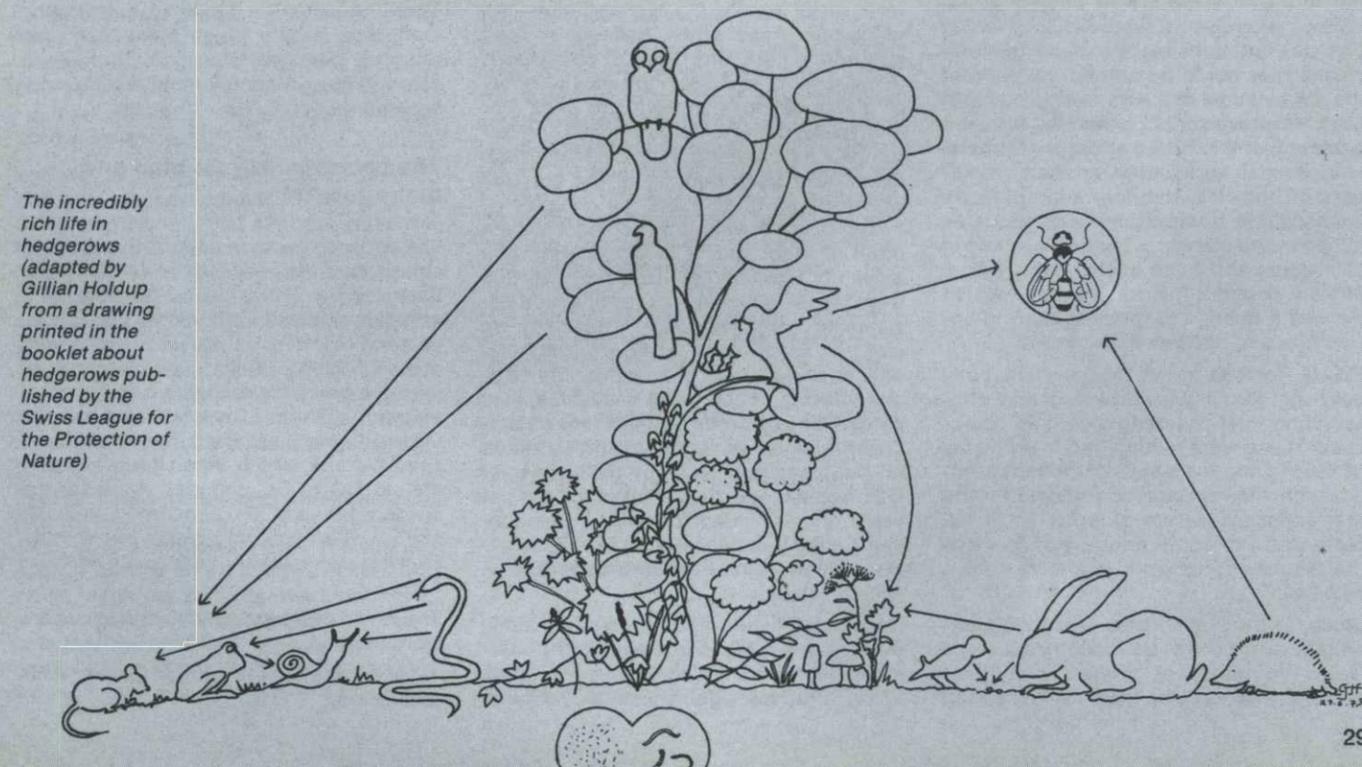
Nine years as Adviser to the Farming and Wildlife Advisory Group have taught me that whilst much is possible where the conservation of wildlife and landscape are concerned, much still remains to be done before the need to conserve is universally understood and accepted. Before explaining what experience has shown me to be possible in land use planning, a few broad brush-strokes of background will help.

History tells us that man has always manipulated his surroundings to meet his needs; that was the first requirement for survival, followed steadily by a desire for improvement, so that man emerging from nature has become dominant over nature. Of course one understands the pressures for change that have come with increases in population, but in the last forty years there has been such an upsurge in scientific research and development that we have the technical ability to supplant all things natural with our own crops and stock and to do so instantaneously. There is no longer a time scale to change which allows nature (wildlife) to adapt.

It was an awareness of this capacity for instant change that prompted me some years ago to use the phrase "new agricul-

tural landscape". It was not to coin a neat phrase but to state a need, the need to come to a decision on what must be done where the conservation of wildlife and landscape is concerned, how that is to be decided, and who is to put it into effect.

The choice of the term "landscape" was perhaps more instinct than design. To most people it has a meaning, whereas the term wildlife requires a wider appreciation of the biological world in which we operate, something more fundamental than just the protection of endangered species, commendable as that must be, and more essential to the survival of mankind. The "British Countryside" Act of 1949 made the link between the two when it defined landscape as "natural beauty" and stated that its protection was to include the protection of flora and fauna, the scientific term for wildlife.



The incredibly rich life in hedgerows (adapted by Gillian Holdup from a drawing printed in the booklet about hedgerows published by the Swiss League for the Protection of Nature)

To understand why I have any competence to write as I do, one has to know firstly that I describe myself as a countryman. I was born and raised on a farm, both beautiful in its surroundings and a haven for wildlife. In a sense the agricultural depression of the 1930s kept it that way, there was little capital for reclamation, man and wildlife lived in some state of equilibrium. I left my farming background for industry, served in the Second World War and when I returned to farming I had broadened my outlook. This was to prove important when in the 1960s I heard farmers accused of destroying the countryside because they were creating larger fields, and of poisoning the land through their use of chemicals. Whilst in common with many farmers I resented the accusations, unlike most I looked for the reasons behind them and found many of them to be thought-provoking.

FWAG

At about the same time the early discussions of a small body of farming and conservation interests took place, which were to result in the formation of the Farming and Wildlife Advisory Group (FWAG). No one body, they discovered, was charged with evaluating agricultural change. No one to consider whether anything needed to be done about it, or, if something had to be done, to carry out the necessary work. Their first step was to test the effects of change in a practical farm study. For the first time ever, the wildlife was surveyed beforehand — trees, shrubs, plants, birds, insects, etc. This information was included in planning the future of a farm. Now known as the "Silsoe exercise" it showed that whilst changes had to be made to make the farm viable, they could be carried out without the devastation that was taking place in farm "improvements" generally. A mixed company of a hundred strong — farmers, landowners, agricultural advisers, members of both the statutory and voluntary conservation bodies, people of status — joined in the planning. They also joined in discussion and in an exchange of points of view. It was a historic occasion which marked a change in thinking both in agriculture and conservation circles.

FWAG, formed as an independent body covering farming, landowning and conservation interests, then stated its objectives. These were to identify the problems of reconciling the needs of modern farming with the conservation of nature and the landscape which supports it; to explore areas of compromise, and to make the results of this work as widely known as possible.

Since, in the British Isles, land use planning of over 80% of the country's surface is in the hands of farmers and landowners, whereas less than 1% is planned

with conservation specifically in mind, farmers' attitudes and their belief or not in the value of conservation is all-important, in fact crucial. It is my belief that unless we can arrive at an accepted consensus of "what it is best to do" on this 80% of land, the special areas, such as nature reserves and sites of special scientific interest, will become museum islands in a sea of indifference. Our countryside will deteriorate into a monotony of crops, and the pests and diseases which prey on them. What was once described as a "disequilibrium in nature" will prevail.

However, I am not despondent. It has always been FWAG's belief that our objective must be to bring us closer and closer to the men who make the final decisions, the farmers and landowners. In spite of economic deterrents such as the price-cost squeeze (as I write there is a move to freeze farm prices whilst costs move inexorably upwards), and psychological deterrents such as the feeling that the community does not care, the number of individuals who are managing their farms and estates with wildlife and landscape in mind continually grows, and requests for advice from our thirty county groups with it. What does this mean in practice?

Let me start by saying that wildlife and landscape conservation — care for the countryside — need not be complicated or expensive. A great deal can be done using one's powers of observation, common sense and an awareness of a few basic facts.

Nature reserves

Countryside care can be looked at in three main ways. Firstly, the highest values are placed on areas which, because of their age and a particular form of continuous management, still retain the widest variety of plants, animals, insects and birds. For one reason or another, intensive agriculture will have passed them by. Many such areas have been bought for the purpose of managing them as nature reserves by the statutory or voluntary bodies. They are often of high landscape value. Many still exist on farmland managed by farmers themselves, sometimes with financial assistance, sometimes not. They may be large or small areas. They are irreplaceable because, once changed by drainage or fertilising, or by using pesticides, they cannot be restored to their former state. These elementary facts should be made crystal clear to farmers by the conservation bodies, and the reasons for special value and the need for special management clearly stated. It should not be assumed that everyone knows about the issues involved.

Unfortunately it is not always possible, even where there is goodwill and understanding, for the finances of an enterprise to stand the management costs and lower



returns of such special areas, so they are under constant threat. On the one hand a nation may have to decide that national interests must override personal ones, but on the other hand such decisions must not be confiscatory.

In such areas, whilst common sense still has a part to play, management advice is needed and should be freely given.

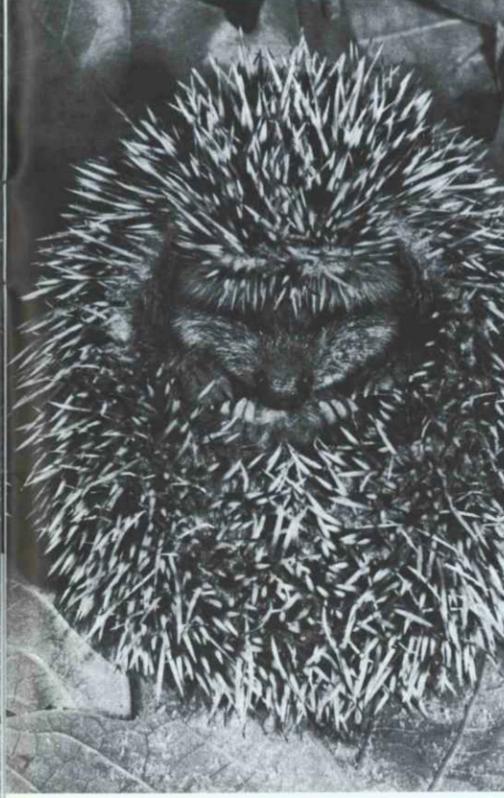
There will also be areas of outstanding landscape beauty which merit their own brand of care and attention. Their interests will always complement wildlife conservation.

The countryside planning and management

The second way of looking at the countryside covers the vast bulk of farmed land. Every farm will have its own range of landscape and wildlife. There will be special pockets of interest, there will be rarities to protect, there will be other degrees of importance all the way down to the common and plentiful. There will also be wildlife, for which cropping has provided a special niche, which, when it reaches pest status, has to be managed. Care for the countryside will be concerned with viability, with managing pests, but without causing unnecessary change or destruction.

The areas on farms which concern us are worth listing:

- field boundaries, hedges, banks, walls and fences;



(Photo Y. and M. Vial - Jacana)

- shelter-belts, windbreaks, copses and woodland;
- scrub, heaths and moorland;
- access areas, roads, tracks, bridleways, footpaths and their verges;
- areas around farm buildings, stockyards, machinery storage grounds;
- odd rough grassy areas, embankments and steep slopes, small paddocks;
- wet areas, bogs, marshes, ponds, lakes, reservoirs, slurry pits;
- running water, streams, brooks, ditches;
- marl pits, old chalk pits, quarries, disused railway lines.

Without knowing exactly what plant or bird or insect or mammal lives therein you can safely assume that all these areas will have their own forms of wildlife. This is easier to realise if you remember that the term "wildlife" covers all living things that are not cultivated or domesticated, so the plants in the hedge or the trees in the wood are a form of wildlife as well as the yellowhammers (*Emberiza citrinella*), partridges, or red admiral butterflies that live there; it also includes soil micro-organisms.

In most cases these areas will either form part of the farm's necessary functions, such as the roadway verge, the ditches and the stream, or they will be of marginal value, such as wet hollows difficult to drain, steep banks and ponds. Whatever category they fall into, management now means a plan. For a start there has to be a balance between productive and unpro-

ductive areas: the farm or estate must pay, that is common sense. Having put first things first, it should still be possible to leave enough wildlife and landscape features to form an acceptable countryside. It will be different from the countryside of even thirty years ago, but it should be such that it can be maintained alongside progress in agriculture for the foreseeable future. It should also be such that the income from the farm rests on competent farming.

Some would see this approach as paring the countryside to the very bone, whereas we know there is a large element of choice. A reasonable maximum field size may well be fifty acres. Some such decision should be made and adhered to, otherwise hedges will ultimately disappear, but there are still 20 or 30-acre fields aplenty. There are farmers who pursue maximum profitability as though driven by some irresistible force even though they may pay the tax-man most of it. Others will farm just as well but enjoy their woods and their sport, their primroses, their owls or sparrow-hawks. Others again will have so little vision as to dump tins and tyres in their ponds, yet others will keep them clean and take pride in everything that grows and moves there.

All of this can be worked out in the general planning sense. Men working the estate should know the plan. They will no longer out of ignorance or carelessness cut down the trees that have been planted in the corners of fields or saplings left to grow in the remaining hedgerows. When the sprayer is out, drift will be avoided that might affect the natural areas. Spray left over will go onto another crop, never onto the area of wild plants. There should never be spray left over, good economics make for good conservation.

The countryside planning and management now involves the day-to-day operations on the farm. It will even, and this may be news to some, involve the choice of chemicals to use, and certainly indicate a very careful assessment of when to spray and not to spray. Apart from spending money unnecessarily, pests become resistant, predators on pests are reduced and pests proliferate as a result. Nor should it ever be forgotten that we are now using some highly poisonous chemicals, dangerous to man and forms of wildlife alike.

In Great Britain much of the information needed for careful choice and use is on the product label.

As a bonus all this is good for game.

"Rehabilitation"

The third way of caring for the countryside comes under the heading of "rehabilitation". Sometimes it may be motivated by a twinge of conscience for past

actions, sometimes to improve working surroundings, at other times to improve sporting prospects. It may be linked to new works, such as making the irrigation reservoir into an attractive and interesting area through proper profiling of the bottom and introducing water vegetation. It may be planting trees, even the planting of hedges, believe it or not. Ponds have been created just to have a pond, useful too as a fire-fighting reserve of water. Nesting boxes have been fixed to trees. My beliefs have recently been supported by a joint statement issued by the National Farmers Union and County Landowners Association in which they declare that their members should accept a responsibility for caring for the countryside. I believe too that society must accept that it has its part to play and that priorities will have to be established.

The above gives us a starting point. For the detailed plan, for specific information about the best trees or shrubs to plant or the best management of a copse or wood, advice may be needed. FWAG now has a network of thirty voluntary branches which set out to offer farmers and landowners a comprehensive advisory service using existing resources to best advantage and creating new resources where funds can be found to support the cost. It must be said, however, that society is niggardly in its support of conservation. If its financial contribution were indicative of the need, and the goodwill of farmers and landowners were to be lost, the outlook would be bleak indeed.

Nevertheless, I sum up with the words of the NFU/CLA statement: "Take stock, plan ahead, take positive action." Everyone should remember that the choice at issue is care for the countryside — or its destruction. J.H.



Apple production in the Netherlands where integrated pest control is increasingly widespread (Photo ANWB)

There is another way

Rudy Rabbinge and R. S. Loomis

Agriculture may be defined as a human activity that uses the sun's energy to convert plants and animals into useful organic materials. Few resources are necessary: a suitable crop, a piece of land, some sun and rain and human labour. Man tries to manage the crops and soils so as to achieve a reasonable return on his input of capital, labour and energy.

During the past fifty years, agriculture has been strongly influenced by industrialisation and by advances in biological and environmental science. For example, new information about plant nutrition and plant breeding has led to marked improvements in crop yields. The vagaries of human nature, climate, and individual skill and knowledge have meant that farming systems seldom operate at an optimum in economic, social or, for that matter, biological terms. Increasingly, however, knowledge of production methods and plant biology means that, theoretically, maximum yield is no longer governed by human whim and fallibility.

The last ten years have seen an increasing interest in nature conservation, the demand for landscaping on amenity grounds has grown, more and more land has been required for urbanisation and recreation. Compromises therefore have had to be reached. This article describes some policies for land use and emphasises one direction for selective development. So far as agriculture itself is concerned, its principal aim should be regarded as the production of food and other organic products in such a way that their prices are reasonably low and the use of energy and other resources is optimal. Agriculture must be economical also

in its use of land. Within the agricultural landscape there must still be space for other human activities, and agricultural operations should not be to the total detriment of nature and landscape conservation. The agricultural work-force should be maintained at optimal level and its income should be comparable with that of skilled industrial workers.

Present-day, modern agriculture

Modern high-technology agriculture is a heavy consumer of energy and chemicals derived from fossil sources. Fossil energy is used to power labour-replacing machinery and fossil chemicals are the source of fertilisers which may increase production levels. At present, the use of fossil energy in Dutch agriculture amounts to 420 g. Joule per agricultural labourer per year, which compares with manufacturing industry and, incidentally, equals the energy use of fifteen average Dutch families. Agriculture is thus among the more energy-intensive human activities. The very large increase in agricultural production during recent decades is mainly due to the growth of technological knowledge and the input of additional fossil energy.

The following figures illustrate these changes: in 1950 the average yield of wheat amounted to 3 500 kg/ha; in 1970 that average had increased to 5 000 kg/ha; in 1978 the average yield was 6 700 kg/ha, and yields of 7 000 to 8 000 kg/ha were no exception. Similar trends can be observed for sugar-beet, potatoes and grass.

The fossil energy used per kg of wheat produced has stayed the same since 1950, but labour has been halved. These data characterise the increased efficiency in production. If this trend continues one must wonder what its effects will be on nature conservation, ecology and environmental pollution. The answer to these questions must be sought within the relationship between increased production and input of labour and fossil energy.

The law of diminishing returns

When other production factors are kept constant, an increased application of nitrogen results in an increase in yield; each additional amount of nitrogen, however, gives a smaller additional yield. This is an illustration of the law of diminishing returns. However, no farmer will apply only nitrogen; rather he will adapt the input of different production factors so that more nitrogen is applied only when the amount of phosphorus is correct and the water availability etc. is sufficient. A good farmer takes care that his husbandry is such that all growth factors are considered and controlled as effectively as possible. One may ask if the law of diminishing returns is also valid when a combination of growth factors and agricultural engineering is considered. Then the contrary is true. Without external inputs, factors such as low natural nitrogen and disease limit yield to a low level. Small inputs of fossil energy (such as fertilisers) can greatly increase that efficiency. If we then consider the total response curve on an energy basis we can have an increasing

output per unit of input. This unexpected response is due to the nature of the production process. A soil with a pH of 6 is necessary for normal production levels, say 5 000 kg/ha of wheat, but may also yield at a much higher level (10 000 kg/ha). An increase of the production factor lime is then not needed. Very important prerequisites for high yield, however, are protection against pests and diseases and the availability of water. However, protection against pests and diseases does not require so much energy but rather the skill and experience to apply appropriate chemical and biological controls. Pest and disease control must be carried out at the right time; so too must the various stages of crop husbandry, especially harvesting, since poor timing sometimes causes serious reductions in yields. With grass production, it has become increasingly clear that a potential yield of 20 tons dry matter per ha can be reached in North-West Europe. However, mowing and grazing losses are very high, so that in practice the yields are not very much more than 7 to 8 tons dry matter/ha. Bad timing and lack of attention to the crop are the principal causes for these big differences between potential and actual yield. The techniques to limit these considerable losses are known, but lack of labour at the right time affects efficiency. In fact, the input of fossil energy to increase yields is only fully effective when backed by the knowledge, skill and expertise of the farmer. As a result of our expanding knowledge of water use and water management, of soil structure and texture, and as a result of the increased use of nutrients and the considerably increased knowledge of pests and diseases, these factors, which are all subject to the farmer's control, are no longer so limiting for agricultural production. Solar radiation, temperature and the physiological characteristics of the crop are now frequently found to be the principal limiting factors.

This conclusion is in accordance with the historical development of agricultural production. Increasing yields may enhance labour productivity and may promote a more efficient use of fossil energy, but one should realise that the keystone for these benefits is the management skill it takes to apply productivity-increasing measures at the right time and in the right manner.

In the Champagne district, vines are also treated with natural products: spraying with a growth substance containing plant extracts (Photo R. Zimmermann - Nature et Progrès)

Aspects of nature conservation

At first glance a description of the developments in high-technology agriculture may seem strange in a journal about nature conservation, and about conservation of wildlife and its habitat. However, high-technology agriculture is with us, and it is essential to ensure adequate food supplies in heavily populated countries. Policies for nature conservation must take into account this need for a viable agriculture.

Productivity per ha may increase considerably when fossil energy is introduced as nutrients or soil additives and when the availability of skilled labour is guaranteed. This rise in productivity per ha may actually release surplus land for alternative uses such as forestry, urbanisation, recreation and nature reserves, and also for less intensive agriculture. This last possibility is of particular importance in Western Europe, where much of the landscape has been shaped by the agriculture of the past. Because less arable land is needed *per capita* for food supply in high-technology agriculture, the opportunities to put such a concept into practice will arise. Nature conservation, extensive agriculture and intensive agriculture may be integrated in the majority of our farming areas. The systems that provide both a good economic return from an agriculture of low intensity and improved values for wildlife are still to come. Within the next few decades a clearer idea of the options will emerge.

To see how such a technology might work one could look more closely at pastures used for beef rearing.

These extensive agricultural systems must be retained, not so much for their products, but more to retain rural employment opportunities and to maintain historical landscapes.



In these low-yielding agricultural areas the number of farm workers per ha should be low and the input of fossil energy need not rise too much. In this way pastures rich in number of species of herbs and plants may stand a better chance of survival. Because this system is primarily aimed at landscape/amenity preservation, stock levels are lower than they would be for maximum productivity. A high proportion of land could therefore be reforested or used for nature conservation.

Thus three different management systems emerge: labour and fossil energy intensive production on a limited land area; a less intensive agriculture that aims at landscaping goals and wildlife conservation and, finally, an area that is used solely for forestry, nature conservation and so on.

Selective development

The suggested alternative agricultural system may cause complications in terms of current agricultural policy.

One must be careful not to imply that high yielding and labour and fossil energy intensive agriculture is totally incompatible with wildlife. The cropped areas may be barren of wildlife; this need not apply, however, to boundaries, field divisions and uncropped corners. We can also make improvements, especially in advanced pest and disease control measures. In many cases production of 6 tons wheat/ha requires no more fossil energy input than a production of 8 to 10 tons/ha. Use of pesticides might be reduced if we could improve biological control measures. An example of this is apple production in the Netherlands, where integrated pest and disease control is becoming an accepted practice. This requires much skill and experience but has sharply reduced the amounts of pesticides required for crop protection.

There is another way

Starting in the mid-1960s, the normal practice was to spray apples some twenty-five times a season against disease and pests. Most of these sprayings were preventatively applied according to a set schedule. The problems caused by this system were manifold. Resistance against pesticides developed so that the number of sprayings had to be increased and the range of compounds had to be adapted. To break this vicious circle, and to diminish the negative effects of pest control, integrated control was developed.

Integrated control in this example now involves both the classical methods of biological control, including host plant resistance, and the more advanced new techniques of pest control involving cultivation methods, genetic manipulation of pests and selective use of pheromones and insect hormones, as well as the usual selective pesticides. Considerable progress has been made through research in this field. In apples, the number of sprayings has decreased considerably and the use of the more selective compounds is becoming more and more normal. Biological control is used against many of the secondary species, which became pests after spraying and treatment against primary pests because those sprays also eliminated the secondary species' natural enemies. For example, fruit-tree red spider mite and apple leaf roller, the most severe animal pests on apples, can be kept under control by their natural enemies. Fruit-tree red spider mite is controlled by predatory mites, and apple leaf roller by a combination of parasites and bacteria. Against these secondary pests, sophisticated techniques are being developed which should result in a satisfactory control system.

It has not been easy or inexpensive, since a well-equipped research team was required, working in combination with a skilled management team.

Other alternatives

We have attempted to present a concept of agriculture which is compatible with the aims formulated in the introduction and does not exclude nature conservation, but even paves the way for it. The development of this concept requires fundamental changes in existing practice, since the safeguarding of historic small-scale landscapes requires a low-intensity agriculture running in parallel with an

agriculture dependent on high technology.

An alternative could be the division of the land between nature conservation and high-technology agriculture, but this seems incompatible with the objective of landscape conservation and the maintenance of an agricultural work-force. Much historical agricultural land would then be taken out of production and used for probably poor, natural forests. A third direction for future agricultural development is promoted by those who maintain that agriculture should use less fossil energy and more "biologically" sound methods.

These alternative technologists also wish to remove artificial fertilisers and biocides from the production system. Farms should become more labour-intensive and the number of tractors and other energy-consuming machines should be decreased. Clearly that approach is based on an ideology which ignores the presence of the real world as it now exists. While we might decrease fossil energy input somewhat, the input of labour would be increased considerably. Moreover, all land would then be required for agricultural production, since productivity would be much lower (2 000 to 3 000 kg wheat/ha instead of 7 000 to 8 000 kg/ha in high-technology agriculture). At some point dietary adequacy could be placed in jeopardy. The high number of people in the production process would have either to live at a very low wage or prices would have to increase considerably. The prospect for society would not be very hopeful, nor would that for nature conservation, since too much land would be required for agricultural production.

Selective development is necessary with a high-technology agriculture centred on the best lands. This means an agriculture that is labour- as well as capital-intensive and needing highly skilled and well-equipped farm-workers with sufficient time to apply their knowledge. To limit the use of biocides, more attention should be paid to the development of integrated pest control and early warning systems. More research should be directed into the development of new management techniques for those extensive areas of low-intensity agriculture. These management systems can still apply much modern technology, but in such a way that labour and energy input per unit of land are both kept low. Landscape, wildlife and some nature conservation will be very important in these areas and revenue from them should be sufficient to cover the farmer's expenses.

In this system of selective development a considerable part of all land is available for other activities, such as forestry, nature conservation and urbanisation.

Hopefully, policy makers will start discussion on these options in the near future. R.R. and R.S.L.

Contributors to this issue

Mr Hans Hürlimann
Conseiller fédéral
Président de la Confédération
Chef du Département de l'Intérieur
CH 3003 Berne

Prof. Dr Francisco Caldeira Cabral
Av. Da Liberdade 211-2° DTO
P 1200 Lisbon

Mr M.A. Kehoe
Chief Executive
Irish Farmers' Union
Irish Farm Centre
IRL Dublin

Mr Ian Samuel
Director General
GIFAP
Avenue Hamoir 12
B 1180 Brussels

Mr Jean-Louis Soyez
Office National de la Chasse
85 bis, avenue Wagram
F 75017 Paris

Mr Pierre Jourdeuil
Directeur
Station de Zoologie et de Lutte Biologique
Centre de Recherches Agronomiques
37, boulevard du Cap
F 06602 Antibes

Dr Emil Surber
Institut Fédéral de Recherches Forestières
CH 8903 Birmensdorf ZH

Mr Pietro Renato Lauriola
International Centre For Advanced
Mediterranean Agronomic Studies
11, rue Newton
F 75116 Paris

Dr Max Scheifele
Landesforstpräsident
Ministerium für Ernährung,
Landwirtschaft und Umwelt
Postfach 491
D 7000 Stuttgart 1

Prof. Albert Noirfalise
Faculté des Sciences Agronomiques de
l'Etat
Laboratoire d'écologie végétale
59, avenue de la Faculté
B 5800 Gembloux

Mr Jim Hall
Adviser
Farming and Wildlife Advisory Group
The Lodge
Sandy
GB Bedfordshire SG19 2DL

Dr Rudy Rabbinge
Agricultural University
Bornsesteeg 65
NL 6708 PD Wageningen

Mr R.S. Loomis
Department of Agronomy
University of California
USA Davis

National Agencies of the Centre

AUSTRIA
Mag. Dr Stefan PLANK
Österreichische Akademie
der Wissenschaften
Institut für Umweltwissen-
schaften und Naturschutz
Heinrichstraße 5/III
A 8010 GRAZ

BELGIUM
M. Marc SEGERS
Ministère de l'Agriculture
Administration des Eaux et Forêts
29-31, Chaussée d'Ixelles
5^e étage
B 1050 BRUSSELS

CYPRUS
Nature Conservation Service
Ministry of Agriculture and
Natural Resources
Forest Department
CY NICOSIA

DENMARK
Mr Claus Helweg OVESEN
National Agency for the
Protection of Nature,
Monuments and Sites
Ministry of the Environment
13 Amaliegade
DK 1256 COPENHAGEN K

FRANCE
Mrs A. M. KRUG-BASSE
Ministère de l'Environnement
et du Cadre de Vie
Service de l'Information, des Relations
et de l'Action éducative
14, boulevard du Général-Leclerc
F 92521 NEUILLY-SUR-SEINE

**FEDERAL REPUBLIC
OF GERMANY**
Deutscher
Naturschutzring e. V.
Bundesverband für
Umweltschutz
Generalsekretariat
D 5300 BONN-OBERKASSEL 3
Kalkuhlstraße 24
Postfach 320 210

GREECE
M. Byron ANTIPAS
Secrétaire Général
Société hellénique pour la
protection de la nature
9, rue Kydathineon
GR ATHENS 119

ICELAND
Mr Arni REYNISSON
Director
Nature Conservation Council
Laugavegi 13
ISL REYKJAVIK

IRELAND
Mr Patrick DUGGAN
Department of Fisheries and Forestry
Forest and Wildlife Service
22, Upper Merrion Street
IRL DUBLIN 2

ITALY
Dr ssa E. MAMMONE
Ministero dell'Agricoltura
Ufficio delle Relazioni
internazionali
9, via XX settembre
I 00187 ROME

LIECHTENSTEIN
Mr. M. F. BROGGI
ETH/SIA
Liechtensteinische Gesellschaft
für Umweltschutz
Helligkreuz 52
FL 9490 VADUZ

LUXEMBOURG
M. F. Ch. MULLER
Conseil supérieur de la Nature
Direction des Eaux et Forêts
34, avenue de la Porte-Neuve
B. P. 411
L LUXEMBOURG-VILLE

MALTA
Dr Louis J. SALIBA
Department of Agriculture
and Fisheries
14, Scots Street
M VALLETTA

THE NETHERLANDS
Drs H. J. C. KOSTER
Department of Conservation of
Nature and Landscapes
Ministerie van C R & M
370 Steenvoordelaan
NL RIJSWIJK (ZH)

NORWAY
Mr Thorstein DREYER
Ministry of the Environment
Myntgaten 2
N OSLO DEP OSLO 1

PORTUGAL
Dr José de ALMEIDA FERNANDES
Presidente da Direcção
Liga para a Protecção
da Natureza
Faculdade de Ciências
58 rua Escola Politécnica
P LISBON 2

SPAIN
Mr Pedro de MIGUEL GARCIA
Subdirector General de Política Ambiental
Ministerio obras Publicas y Urbanismo
Direccion General del Medio Ambiente
Avda. Generalísimo s/n
E MADRID 3

SWEDEN
Mr S. LUNDSTRÖM
National Swedish Environment
Protection Board
Smidesvägen 5
Fack
S 171 20 SOLNA 1

SWITZERLAND
Dr J. ROHNER
Ligue suisse
pour la protection de la nature
Wartenbergstraße 22
case Postale 73
CH 4020 BASLE

TURKEY
Orman BAKANLIGI
Avçilik ve Milli Parklar
Genel Müdürlüğü
TR ANKARA

UNITED KINGDOM
Miss S. PENNY
Librarian
Nature Conservancy Council
Calthorpe House
Calthorpe Street
GB BANBURY, Oxon, OX16 8EX



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