CONCLUDING ADDRESS

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Mr Chairman, ladies and gentlemen,

It may be useful to make some general observations and to share some general impressions synthesizing the overall pattern of the talks that have fruitfully filled the last week.

There have been several common denominators of the presentations. The most important one is that numerous reports document that collecting of animals and mapping of their distributions is still proceeding. Furthermore manifold evidence indicates how necessary this is. Almost every speaker referred to one or another, or even to a half dozen, new species. We are very far from the point where we know what is living around us, and the collecting, cataloguing and mapping functions remain basic to our understanding of organismic diversity.

Next we have heard papers explaining and extrapolating from the maps, more specifically discussing the results of zoogeography. We are here dealing with interpretation as much as with fact, and it is not surprising that one hears differences of opinion and arguments. The intensity of the arguments documents not only uncertainty but also the intrinsic interest in these questions. As we begin to map the changes and the climatic and other factors that led to them, we approach the moment where we may predict future change.

Beyond this, there was a spectrum of papers on details of the biology, feeding habits, reproduction and locomotor patterns of specific animals. It is promising to see that some of these analyses are now being taken into the laboratory and we are obtaining detailed studies of the morphology and physiology of these animals and perhaps also of the central mechanisms that produce the behaviour observed in the field.

These studies offer clues regarding aspects of animal adaptation. It is astonishing how often the results have proven to be totally new or to provide documented disagreement with past reports. In several instances, the new data support theory. In other cases they force reformulation; in each case they confirm the element of adaptation.

One set of reports on adaptation is that dealing with the reaction of the local biota to the catastrophes caused by the ever-increasing man-made perturbations of their environment. Experiments such as 'drawing down a dam' by three to six metres, or allowing downstream areas to dry up for months or years before reflooding, must produce effects equivalent to those that preceded us in the history of the earth. Changes in the biota (if any remains) are likely to be more radical and as far-reaching as those in the fossil record. Whether or not one wishes to protect the natural environment or only to manage those items immediately useful, the reports here presented suggest that we do not yet understand enough to gauge the effect of many perturbations of the system. Consequently, it remains essential to argue for reduction of the amplitude of these man-made catastrophes, while we assess the magnitude of biological responses and

methods of enhancing the components of the fauna that are useful to us.

All of these studies lead to an adaptive interpretation of an ongoing process and at least preliminary answers to questions, such as: Why do animals live in particular places? Why do animals behave the way they do? Which resources are they actually utilizing, and how do the sets of resources utilized by different members of the biota fit into each other and interdigitate to fit the energy budget of the habitat? The kinds of information presented provide a new data base from which to re-orient the collection and the mapping process, and with this, the observation of the specific adaptations. Feedback is the key and successive approximations lead to the most rapid advances on all fronts.

Some of the results of our studies bear an important weight on the issue of conservation, conservation not as a slogan with a capital 'C' but conservation with a lower case 'c', an ongoing process that is derived from a biological data base rather than visceral reactions. Few places could provide a more obvious forum for discussing conservation than the Kruger National Park which has existed for such a long time, both as a resource and as documentation of foresight to the benefit of the people of this area and to the people of other countries.

In arguing for the preservation of natural resources, one hears mention of conservation of 'our heritage' without further definition. Rather than repeating such generalities, we might mention some of the specific things that we must conserve, and the reasons they must be protected. Three major aspects need mention: the first is the psychological one about which we may write but which we are not yet able to quantify. While I should not transgress beyond the limits of our science and of my own expertize, it is critical that I do so. The natural places, the wilderness areas, represent a source for a refreshment of our spirit. They appeal to something in our make-up; we yield it at our peril. Cement playgrounds are no substitute for parks. Abstract sculptures are no substitute for living trees nor concrete jungles for wilderness areas. The appeal of wilderness, overlain as it sometimes is by fear of the unknown, remains in most of us. We do not yet know what effects arise from the permanent isolation of man from this part of his real heritage.

The second need for conservation is that it provides a reservoir of objects that may help us understand nature. It forms the basis for an understanding of biology and I hope that it is unnecessary to document this viewpoint.

However, the third reason deserves emphasis; while we know the facts, we tend not to think of them in an economic framework. To be blunt, wilderness and its organismic diversity represent an economic resource of inestimable value. Plants and animals have survived by complex adaptations. We can learn from those that involve physiological or psychological responses, but we can also use those that are based upon biochemical syntheses. Plants have controlled animal predation by inventing cyanides and diverse insecticides, fungicides and bacteriostats, and pheromones and cardiac stimulants. Some such compounds are now recognized, but others are not as yet conceived of.

As we do not know what questions to ask, it is unlikely that we can yet characterize what is available (and hence what must be protected). The key here is that these properties are locked up not just in the large animals and plants. Everyone can recognize an elephant and a baobab! There are parasites on and in an elephant, there are epiphytes and less obvious parasites on the baobab. As yet we only recognize a few superficial aspects of a multi-faceted, coadapted environ-

ment. In our innocence of the limits of biochemical diversity, we cannot decide which organisms will be critical twenty, fifty or one hundred years from now, for their compounds or for the antidotes they produce, in predator control, or in permitting replenishment of the genetic diversity of food plants. Once a species has disappeared, it will impoverish the reservoir and, to paraphrase William Beebe, 'another heaven and another earth must come to pass before they can be replaced'. These are the points that need to be stressed now because the rate of extinction is accelerating.

Conservation within this framework will, of course, be more than the protection of a few isolated areas that encompass the habitat of one or another showy species. With the increasing discharge of waste products into the atmosphere, with the increasing utilization of fertilizers and pesticides in agriculture, conservation means control of more than isolated parcels and the monitoring of change on a broader level than merely within limited parks. The smog will drift across parks and serve as a selective agent, changing the gene structure and producing differential survival of component organisms; so will pesticides, and so will synthetic fertilizers. The effects of hydro-schemes, changing the availability and the nature of the water, the encroachment of agricultural areas upon the fringing buffer zones will provide severe tests in the years to come.

As severe, in a different way, will be the pressures on those organisms not yet in parks. Commercial collecting, reflecting the demands of pet stores and the thousand-times greater demands of the skin and animal products trade, can suddenly overwhelm limited populations which no one thought to protect because there seemed to be no threat. The scope of this collecting is neither publicized nor recognized. In contrast, it needs to be stated that research collecting, not for teaching but for investigative uses, actually represents an insigificant drain on all but the most limited natural populations. It is most unlikely that there are any populations of reptiles and fishes in Southern Africa today that would be markedly disturbed by a planned programme of sampling, intended to provide adequate and well-preserved series of different sexes, growth stages, and geographical variants for two or four major depositories and to permit limited studies of their biological characteristics. If we do not document the nature of current populations, we will have no way of assaying the changes that are now beginning to accelerate and no way of understanding what is being protected within the borders of parks. We will lack a test to indicate whether the management programme is indeed succeeding in its aim of protection. A white flag pole does not stay white just because it has been enclosed by a fence, or because it is only examined from a distance and at dusk.

At the risk of pontificating a bit, I must finally come to the issue of co-operation. The public is the ultimate arbiter, and will have to provide the resources for parks, management and research. It is critical that the biological community convince the general public that we are working on their behalf, and that they must aid us. We must also recognize that the task of conservation is complex and too important to be relegated to one category of conservationists, in the same way that it has been stated that war is too important to be left to the generals. The issues are too vital to permit any one of us to hide within our personal speciality and defend our particular territory. There are many tasks and we need widespread co-operation and mutual appreciation. Concerned amateurs, museum collectors, museum and university investigators, conservation officials and the wardens of the parks who are on the firing line against continuing encroachment have different tasks, but if one link breaks, the whole chain fails. It is easy to

utilize inadequately understood regulations as tools to exclude colleagues, to argue that regulations apply mainly to other people. It is easy to argue that university professors or park rangers do not understand the problem and should be excluded. Each such act weakens the overall effort.

We can no longer afford to diffuse our efforts, because we really are pitifully few for the great task we face. The resources are limited and conservation will, for better or for worse, have to compete with societal needs and desires. Cost effectiveness is critical. It may not be enough to permit study only by one group, collecting by a second, and observation by a third. Arrangements in which a specialist on the spot helps to provide material and becomes part of an investigating team will have to become the rule rather than the exception. Towards this end, groups in which ideas can be exchanged and problems as well as methods of observation refined become necessary. Whenever possible, we must continue to involve interested amateurs as these can be a key to involving and interesting the general public, without whose support all conservation methods are doomed to failure.

Let me then close by expressing hope that when this group meets for a second time it will not only still have the same living fauna to study, but that knowledge of its facies will be improved and that there will be continuing co-operation among us toward an improved understanding of our wild heritage.