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## CORRESPONDENCE

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### EXCELLENCE IN INDIAN SCIENCE

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#### INTRODUCTION

RECENTLY two papers on the above theme appeared in this Journal<sup>1,2</sup>. As pointed out by the Editor, these were from among those invited by Prof. M. G. K. Menon, Chairman, SACC. Subsequently, a special inter-Academy meeting was convened in Delhi on 12th and 13th September 1983 to discuss the issues raised in these several papers. In this article I shall present a report on this rather unusual meeting, besides offering a few of my own thoughts on the subject.

#### REPORT ON THE DELHI MEETING

A little over forty persons attended the Delhi meeting which included scientists representing the various disciplines, some educationists and a few social scientists. As Prof. Menon pointed out, some of the problems of excellence had sociological overtones which were best commented upon by specialists familiar with those problems. An informal survey showed that the average age of the participants was around fifty, perhaps on the higher side!

The original programme called for presentations from the scientists who had contributed the background papers, to be followed by discussion. However, as it turned out, there were no formal presentations of these papers since the background documents had already been circulated. Instead, the invited speakers were requested to briefly summarize their views, adding amplifications and clarifications as required. Following this, all the others were given a chance, and thus everyone present had roughly equal opportunity to articulate his or her thoughts.

In his opening remarks, Prof. Menon pointed out that there were two categories of excellence, one which may be described as consisting of individual spikes (often of the type leading to the Nobel Prize) and the other which represents very high quality of attainment, knowledge and skills over wide areas of science and technology. Japan, for instance, provides a good illustration of the latter. As far as India was concerned,

compared to the pre-war era, a broad base had been built. True, giants like Raman or Saha are not clearly discernible, and granted that achievements have been somewhat patchy. But nevertheless a base of sorts existed and given the extremely difficult conditions under which Indian scientists work, the building up of this base was a commendable accomplishment. One now had to build further upon this base, and for that what was needed was a critical analysis of our successes as well as our shortcomings. Based on such an introspection one could draw up a blueprint for achieving excellence. The present juncture was a particularly opportune moment for such an exercise since Seventh Plan Proposals were on the anvil. Prof. Menon therefore suggested that before the meeting concluded, the gathering should come up with a set of specific suggestions which could form the basis for further action at various levels, Government, Planning Commission etc.

Following Prof. Menon's remarks, the discussions promptly got underway. Contrary to the usual seminar convention, the seating was around a table which greatly favoured exchange of ideas back and forth. The discussions were completely free and frank. It was obvious that everyone present had pondered deeply on the subject, and since the issues boiled down in essence to a few crucial points, there was a certain amount of repetition. Understandably one witnessed a wide spectrum of moods, ranging from ebullient optimism to pessimism, dismay, and sometimes even anger.

At the end of the first day it was time to take stock, and Prof. C. N. R. Rao was entrusted the onerous task of distilling the concrete suggestions thrown up during an entire day of rambling analysis.

The second day's proceedings consisted essentially of a point by point debate of Prof. Rao's summary, with Prof. Menon giving a 'running' reply to the debate. The proceedings went on nonstop from 9 am to well beyond 2 pm, indicative of the seriousness with which the entire problem was considered. At the end of it all a concrete set of points *had* emerged and to that extent something had been achieved in the Delhi meeting. I shall now briefly mention (in arbitrary order) some of the points made during the discussions. *Need for a large base*: There was a general feeling that our base was not broad enough; and without a wide enough base, spikes also are not possible, except by sheer chance. There was also the practical considera-

tion that the widening process would provide opportunities to young graduates the same way the Departments of Atomic Energy and Space did in the sixties and seventies. In this context, the creation of a new chain of autonomous units on the model of CNRS or Max-Planck Institutes was proposed. Some felt that all new institutes must necessarily be small while others felt that size should not be *a priori* frozen and should be dictated by the scope of activities to be pursued at the Centre concerned.

*Institutional autonomy:* The stranglehold of bureaucracy and the unnecessarily rigid financial control now being witnessed everywhere came in for sharp criticism, and there was an understandable demand for autonomy. It also emerged however, that in some cases, research centres had progressively lost the autonomy they had originally been endowed with by not exercising the autonomy adequately. In a few cases, it was not lack of autonomy but its misuse that was the problem! It was generally agreed that the most desirable institutional structure *in our framework* needs an in-depth study. Such an exercise is in the pipeline.

*Accountability:* It was pleasing to see several voices raised strongly in favour of accountability on the part of scientists. Accountability is sadly missing at present, and has to no small extent been responsible for the rapid ascendancy of mediocrity which perhaps was responsible for people being shaken out of their usual complacent attitudes. Having raised a hue and cry, everyone recognized that accountability is more easily talked about than enforced, especially if it is to be via a peer system. A stiff fight from the endangered species is very much on the cards!

*Working conditions:* Quite naturally, working conditions of our scientists received much attention. Many aspects were raised—salaries, appointment procedures, promotion, perks, telephones, retirement benefits, educational facilities for children, foreign travel etc. The problems of women scientists received special mention but surprisingly, there was barely any reference to the difficulties peculiar to our younger scientists (and I am sure they face many). Perhaps this had something to do with the average age of the participants!

*Instrumentation:* Science today is largely experimental, and experimental science relies more heavily than ever before on sophisticated instruments. Given the near total absence of an instrumentation base in our country, the pursuit of excellence in science poses special problems for us. Some saw the continuance of the OGL and unhindered imports as the only solution

but fortunately, there were not too many supporters for such a philosophy. It was pointed out that Western countries have started imposing restrictions on the sale of sophisticated instruments to the laboratories of DAE, DOS and DRDO; quite possibly the list will increase. Meanwhile, there is a subtle attempt to 'divide and rule'. It was strongly emphasized that the purely academic institutions should not be indifferent to such discriminatory policies on the ground that they were not affected. Indian science is one fabric, and we all float or sink together; no opportunity must be afforded to drive a wedge in our ranks. The only long term solution is to launch an aggressive campaign for a solid instrumentation base.

*Education:* Deep concern was expressed about the state of our educational programmes, both at the school and university levels. All the familiar ills were duly catalogued, but the big question was how to go about tackling the various problems, especially with limited financial resources. Among other things, the question of reservations naturally came up. When all had their chance and the excitement had died down, Prof. Menon with his characteristic calmness pointed out that the educational sector was an anchor not only for the scientific community but for the entire nation and as such its problems needed to be examined in depth separately and with undivided attention. For the present, some useful points had emerged. One related to associating the scientific community with the selection of teachers and another related to 'knowledge camps' (*i.e.* intensive short-term schools on frontier topics for research scholars).

*Catching them young:* An important element in the growth of science is the drawing into its fold of gifted youngsters. Today, the image that most young people have of science is based on their text books (often dreary); that plus the IIT syndrome is keeping many of the talented away from a career in science. It was suggested that community science centres like the Pioneer Palaces in the USSR might be an answer. The success of such a centre in Ahmedabad holds out hope for the entire country. Of course, everywhere the local scientific community must be deeply involved!

*Some stray points:* While the 'big' issues dominated the discussions, several 'small' (but nontrivial) points also got aired. Here is a sampling:

—A plea was heard for permitting students to cross over to other disciplines if they so desired. At present an engineering graduate, for example, cannot do a Ph.D in physics in most of our universities (and I know many engineers who are keen to do so). Interdisciplinary migration was

- considered beneficial for science and therefore strongly favoured.
- The starting stipend for a research scholar is presently around Rs. 750/- whereas the starting salaries in banks etc is well over a thousand rupees. Under the circumstances, many competent research scholars (who often come from lower middle class families) reluctantly give up a career in research in favour of other jobs so that they can provide financial security to their dependents.
  - Attention was drawn to the wide area TV coverage plan, and the scope it offered for the promotion of education in general and science in particular.
  - Professionals in interdisciplinary centres are often treated unequally. Thus, in many laboratories, engineers are treated preferentially compared to scientists as regards promotion, doctors are treated favourably compared to biochemists and so on. Such preferential treatments may serve local ends but is harmful to morale and therefore detrimental to the cause of science as a whole.
  - Scientists often complain that administrators in their respective organizations are obscurantist. Could it be that lack of career advancement opportunities comparable to that available for scientists bred jealousies which finally manifested as obscurantism?

*Sociologists view:* This is perhaps a good point to discuss the views expressed by the sociologists. To start with, they favoured a total overhaul of the administrative and financial structure, replacing financial audit with performance audit. As regards the optimal size of an institution, they were of the opinion that the present cry for a small size was largely inspired by management problems. If these could be solved, then from the organic point of view, bigger, multidisciplinary institutes were to be preferred. Small institutes with intense specialization often decay when the concerned field ceases to be scientifically interesting. A self-contained, mono-field institute often lacks the internal mechanism to readjust and instead tries to perpetuate itself despite ceasing to be on the front line. On the other hand, a multi-disciplinary set up generates its own pressures for rejuvenation, besides offering opportunities for hybridizing and evolving new programmes. As for hiring and firing by contracts, the sociologists felt that the contract system works only in a full-employment scene. Most of the problems witnessed today were a reflection of the turbulent state of our Society as a whole. Given the rural and urban pressures, problems like reservations are bound to be there. In its quest for excellence,

Indian science must understand the external scene and not demand an elite status until Society's pressing problems have received some measure of solution. Even if granted, ivory towers are difficult to sustain. Scientists must learn to ride the tide and come out on top instead of trying to combat it. The Western model for science is not wholly relevant since Western Society is different.

Now comes the big question: After all this, what may we expect? This of course remains to be seen but given the seriousness that prevailed at Delhi, one foresees many steps being taken to obtain better working conditions, to introduce accountability, to ensure greater autonomy, to streamline funding procedures etc. Certainly the voices have been heard, at least to some extent.

### SOME PERSONAL THOUGHTS

One thing I missed at Delhi was a discussion of what the scientific community itself could do to promote excellence, irrespective of whether or not the inputs etc asked for from the Government were available. By way of concluding remarks, I would like to air some thoughts on the subject.

I think our first duty is to establish native roots. In a sense this was already hinted at by the sociologists attending the Delhi Meeting. Let me amplify.

Everyone is agreed that young people must be exposed to the excitements of science. While the Community Science Centres are certainly a way of achieving this, it is also possible to arouse enthusiasm simply by personal contact. At least in the big cities where a sufficiently large number of scientists live and work, the scientific community could suitably organize itself for intensive interaction with the schools. One could for example conduct Astronomy Clubs, Environment Clubs and so on and arouse curiosity in natural phenomena. Similarly, promising college students could be informally associated with research projects. Injecting a personal note, I might add that my own commitment to science was clinched when a Rochester-TIFR Balloon flight team came to our college in the early fifties and wanted volunteers for their flight activities.

Curriculum revision is another activity in which scientific community could engage itself profitably. A few months ago the Department of Electronics organized a Seminar on Excellence in Electronics. Ambitious proposals were unfolded but when the implementation was discussed, it was realised that

trained manpower more than funds was the major stumbling block. Our approach to specialised manpower is via a pyramidal training process and as a result we find we do not have enough trained people in areas like electronics. One way out of this jam would be to restructure many of our M.Sc. Physics courses so that physics is taught via a particular specialization. This is not a wild suggestion. There exists, for example, a book on magnetic resonance which not only teaches the elements of magnetic resonance but in the process also the basics of quantum mechanics and in particular the manipulation of angular momentum operators. A bit of statistical mechanics is also thrown in. Similarly there is a book on Synergetics which gives a painless and elegant introduction to stochastic processes. Indeed Shockley was a pioneer in this art, and his famous book on transistors showed how engineers can be taught quantum mechanics.

Besides drawing up innovative curricula, camps can be organized to train teachers etc. New media like personal computers could be pressed into service and so on. One could thus think of this or similar methods to combat the manpower shortage problem. The basic point is that there are many possibilities for discovering our own solutions to our problems instead of adopting other's models and it is the scientific community which should be concerned about such matters.

Science, it is claimed, is international. While this may be accepted for defining standards, quality etc, we have stretched things a bit.

In the name of internationalism of science, we have (perhaps unwittingly) become excessively addicted to foreign fashions, methodologies, cultures, style of functioning, etc. This has brought a chain of evils. To catalogue some of them:

There is a strong tendency on the part of many to continually seek to travel abroad even to the detriment of local programmes. In many cases students are left high and dry.

Our journals also get neglected in the name of internationalism. (Prof. Kaw too has drawn attention to this in his article.) Nowhere in the world have journals been built up by people from outside the country. Yet in our country our scientists including those who are Fellows of the various Academies expect someone else to elevate the quality of our journals before they are ready to publish.

Recently I came across an announcement for a Winter School organized in this country for which the registration fee was US \$100 or Rs. 1000. This amount may be standard abroad but one fails to understand

how research scholars in this country can afford such exorbitant charges.

The same applies to instrumentation. We want the latest, and we will import if need be. We seldom realize that in other countries there is no import involved. We simply blame our industry and leave it at that. As a community, have we done anything to remedy the situation?

Everyone praises the Chinese, including our own scientists who have visited China. The Chinese are being lauded largely because they have made a great success of self-reliance. Initially of course they were not able to produce products comparable with that of other countries but one gathers that many of their indigenously produced scientific instruments now favourably compare with those available in the Western market. If we toil, we too can cross the barrier but are we willing?

Raman once remarked "There is only one solution for India's economic problems and that is science and more science and still more science". Jawaharlal Nehru also echoed similar sentiments often, although in different words. In the past there has been a tendency on the part of many of us to ignore Society, take refuge in ivory towers, and carry on as we wanted. This has not improved matters. We have also forgotten that to retreat into an ivory tower is a rare privilege that should be earned and is not a right. It is time we changed. I think it is quite possible without compromising either our basic curiosity or our love for science to practice science in such a manner that it also benefits Society. As Prof. Ramaseshan mentioned at Delhi, it is quite conceivable to think of the growth of science through technology and indeed people like Bhabha have shown how this can be done. But for this to happen on a much larger scale, we must all make the commitment. The demands put forth at Delhi are necessary but not sufficient.

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1. Kaw, P. K., *Curr. Sci.*, 1983, 52, 747.
  2. Rao, C. N. R., *Curr. Sci.*, 1983, 52, 751.
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I read with interest the articles "On excellence in Indian Science" and "Excellence in Science" by P. K. Kaw and C. N. R. Rao respectively in Vol. 52 of *Current Science* dated 20 August 1983. While P. K. Kaw has analysed the so called reasons for the non existence of excellence in Indian science, C. N. R. Rao has advanced the fallacious argument that financial support

and institutions of excellence are the magic solution for the poor state of Indian Science.

To do excellent science we need excellent scientists and to produce them we have to train them to be such through our educational systems. I believe this is where we have failed tragically. The existence of numerous school final examinations from S.S.L.C. through Matriculation and H.S.C. to C.B.S.C. all ranging in standards from very good to poor and the resulting non-uniformity in educational standard right from the school level is a glaring index of the unimportance our policy makers have attached to education. Kaw rightly points to the lack of awareness among our students of the achievements of Indian Science. Our total reliance on Western literature permits us to be aware only of Western achievements in Science. As a result, while leading Indian astronomers to cite an example, are aware of Copernicus's and Kepler's works, they are hardly conversant with the signal contributions of ancient and medieval Indian astronomers like Aryabhata, Bhaskara, Brahmagupta, Varahamihira and Jai Singh. The irony of it is that, at the same time, we spurn everything progressive as foreign and unsuitable to our culture. Our defective educational system has resulted therefore in a lack of "science consciousness" among the common folk. The low priority attached to science in our society is also reflected in the total absence or low coverage given to science subjects and features in our daily newspapers. The few science journals are however trying to bridge this gap.

The next level of education, namely in the universities, suffers from lack of resources and from political interference in academics. As Rao points out "funding of universities is pathetic" and constitutes a negligible percentage of national investment in R&D and S&T. Such being the case it is unfair to expect our universities to provide a broad base of science and supply the requisite raw material to higher institutions. To convert our universities into autonomous centrally funded institutions will go a long way towards insulating them from the corrupting influence of local politics.

One important question raised by these two essays is the role of science from a socio-economic standpoint. The Science Policy Resolution adopted by the Indian parliament on 4th March 1958 indicated the government's intention to support science and technology in order to "secure for the people of the country all the benefits that can accrue from the acquisition and application of scientific knowledge". (Appendix 3). Nehru's strategy for developing science and technology included creating social consciousness among

scientists by posing social problems before them. In other words, science and technology were meant to serve as tools to bring about socio-economic progress. But Rao has reduced science from this sublime status to a mere sport—a race for medals. The internal contradiction in his essay in this regard is striking. He says to begin, "I have known extraordinary men of science who have not received the Nobel Prize". Later he pronounces "In science, like in sports there is no medal for a loser". Are we to conclude then that these extraordinary men of science were all losers? Or did they mount the victory stand to receive some other medals?

The predominant part of the scientific endeavour in our country as in many others is funded by government grants which are dispersed through its various agencies. These funds being the tax payers' contribution to the national exchequer, makes the scientist directly responsible to the common man for his bread and butter. It is therefore only fair that in a poor country like India a large part of the funding for scientific research should be directed towards applied sciences. Kaw and Rao project totally opposing views in this regard. Rao sees no merit in doing science which does not measure up to international standards. This view reflects the proven folly of our policy planners and scientists to seek recognition for their endeavours outside *i.e.* in the West.

Setting up institutions of excellence and affording support and protection to our scientists will not solve the problem of our science. We must develop a healthy and honest scientific community alive and responsive to the needs of our people. Kaw points to the lack of a critical mass in any field, the absence of peer groups, lack of mutual respect among scientists and a hesitation or even refusal to discuss the limitations of each other's work. In other words, we lack a scientific community. One has only to scrutinise the leading articles published from several western countries to note that not only are they often authored by as many as a dozen scientists, but who, in addition hail from laboratories, as much as thousands of miles apart and sometimes separated by oceans. But in our country, in a leading institution like Indian Institute of Science, one rarely finds a publication coming jointly from two adjacent laboratories within a single department, with only a wall to separate them.

Most of our leading scientists labour under the illusion that given unlimited funds, we can carry out excellent scientific work. A few crores of rupees cannot bring about a transformation which needs essentially a solid infrastructure and scientists with the right bent of

mind. Isolating scientists in institutions like our I.I.Ts and IISc will at the most create a few oases in the vast desert of mediocrity and turn these institutes into ivory towers. Given such a situation, our IITs will continue to mass produce brilliant engineers who after the additional acquisition of a management degree will end up as glorified salesmen of the multinational corporations. Our science cannot flourish in isolation of the socio-economic and political forces which must after all shape our science. Also, the state of our science can only reflect the political climate and the moral fabric of our people.

Both Kaw and Rao seem to believe that pampering our scientists and lavishing on them material comforts will motivate them towards excellence in their professions. This attitude is also evident in the latest move of the UGC to appoint "Professors of Eminence" in our universities with a fat pay packet. It is not monetary benefits that our scientists lack, it is the right atmosphere conducive to uninterrupted application to science, free of administrative headaches, and availability of essential chemicals and equipment. Kaw even states that we must make our science as attractive and lucrative as management and administrative services. If our society has cultivated and thrives on wrong value systems, the least that scientists can do is to refrain from perpetuating the same. Instead they must boldly establish a fair and just value system and inculcate it among the younger generation. Here, our few leading scientists have a crucial responsibility to discharge—that of breeding excellence. It is their task to spot out and promote promising young scientists. Instead what we now see is a deliberate attempt to breed mediocrity and indulge in empire building by our influential scientists/science managers, with a view to eliminating all challenge to their supremacy. Housing, medical benefits, gas, scooter and telephone—none of which is being denied to our scientists in any case—cannot contribute to dedicated science. In my own experience a telephone is the greatest impediment to excellent science for it draws away an often willing scientist from many an enlightening seminar or scientific discussion.

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Science. In my opinion the fundamental issues have been left completely untouched and I disagree with prognosis of the two eminent scientists. I may submit the following remarks for considerations of powers that be and of my colleagues.

1. Why the best students should be attracted to a scientific/university career when the age of settlement of a scientist/university teacher (thanks to U.G.C.'s brainwave of an M.Phil degree prior to Ph.D.) is generally 30 years. Other classmates of a "Scientist" are by then well-settled and raising a family while he is not sure of a decent job. Not only that, if he does not fall in line he may end up (at least in the Universities) at the very step at which he entered. It does not need my stating the present criteria for selection of lecturers, readers and professors in the universities. At any time it is not academic merit alone.

2. It is a completely wrong notion that facilities in terms of equipment and library are the only inputs for excellent research by good scientists. It is belied by the fact that institutions so well-endowed in India (TIFR, BARC, IIS, IIT, RRL, IARI, etc) have not produced world-class science. What is needed more is the intellectual atmosphere, where scientists have ample opportunities to discuss their work with competent colleagues in the same field. Unfortunately in India area groups are rarely formed because every one wants to have a separate field to create an identity for oneself.

3. The entire funding system is topsy-turvy. It produces and encourages "sales-managers" in science and not "production and quality-control managers". The so called scientists are not busy in their laboratories doing research but are busy writing grant applications, appeasing granting authorities, entertaining influential individuals, administering grants and going round the country by air. The remedy is to identify persons for a period of 5 years and give a block grant through the institutional base.

4. Dr Rao says that "one always knows who the outstanding people" are and goes on to comment that "choosing the right research problem is half job done". The simple solution then is to involve the outstanding scientists and get a good job done. But looking at the national scene one can only surmise that either the outstanding scientists do not have a say in the matter (no reason for that!) or the scientists being labelled as "outstanding scientists" are pretenders.

5. Every agency as well as Dr Kaw argues for bringing back Indian scientists settled abroad but without giving a single valid argument; the assumption perhaps is that who have done well abroad will do so in

I have read with interest the two articles on excellence in Indian science in August 20 1983, issue as also the comments in November 5 1983 issue of *Current*

India. I feel it will be nothing short of a calamity to put this idea in practice because, till recently very few talented scientists went abroad; the second raters were the ones who went in majority and will come back. No first rate scientist will come back because he knows what scientific research is. We must build our scientific cities by our India-based scientists only.

More pertinently where are our bright students going and why? The malady is deeper and I have tried to deal with it in broad terms in clauses 1 and 3 above.

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## ANNOUNCEMENTS

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### 54TH TEXTILE RESEARCH INSTITUTE RESEARCH AND TECHNOLOGY CONFERENCE

The 54th TRI Research and Technology Conference is scheduled for April 11 and 12, 1984, at the Sheraton Centre Hotel in Charlotte, North Carolina. The Conference will focus on important new developments in fibre and textile technology and is expected to provide an industry-wide forum for discussion of key

technical issues. The theme and program will be announced early in the year.

Further particulars may be had from: Textile Research Institute, P.O. Box 625, Princeton, New Jersey 08542, USA.

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### FIFTH ASEAN ORCHID CONGRESS

Fifth ASEAN Orchid Congress will be held in Singapore from 1-7 August 1984. An Orchid Show will be held concurrently.

There will be a three day Seminar to discuss the following aspects:

“Orchid Research, Co-operation and Co-ordination; Ecology and Conservation; Breeding and Quality Improvement Towards Export;

Commercial Orchid Production and Orchid Improvement in ASEAN Countries.”

Those interested to participate may write to: The Organising Secretary, Fifth Asean Orchid Congress, c/o Parks & Recreation Department, Botanic Gardens, Cluny Road, Singapore 1025 OR Professor A N Rao, Botany Department, National University of Singapore, Lower Kent Ridge Road, Singapore 0511.

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### ALL INDIA SYMPOSIUM ON ANIMAL BEHAVIOUR & 13TH ANNUAL CONFERENCE OF THE ETHOLOGICAL SOCIETY OF INDIA, TRIVANDRUM, 20-23 JUNE 1984

An All India Symposium on Animal Behaviour is scheduled to be held in connection with the 13th Annual Conference of the Ethological Society of India at the Department of Zoology, University of Kerala from 20-23 June 1984. The Symposium shall have a few major scientific sessions and invited lectures on the important themes. Papers in any branch of Ethology/Animal Behaviour are welcome. It is also proposed to publish the abstracts of all contributions

and the full text of the presented papers.

For further details, please contact The Organising Secretary, All India Symposium on Animal Behaviour & 13th Annual Conference of the Ethological Society of India, Department of Zoology, University of Kerala, Kariyavattam 695 581, Trivandrum. Last date for receipt of abstracts (not exceeding 250 words) is 15 March 1984.