DISSEMINATION OF PUBLIC INFORMATION

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1. INTRODUCTION

As stated in the accompanying paper on "Procedures for the evaluation predictions", and given today's technical capacity for intensive seismic monitoring in Japan, our practical target is limited to the prediction of major earthquakes in the Tokai region. The purpose of this paper is to illustrate the planned response to abnormal activity in this region.

2. RESPONSE TO ABNORMAL ACTIVITY

If abnormal data are found by the observation networks and these exceed a pre-set threshold, the Director-General of the Japan Meteorological Agency is notified immediately. The Director-General must decide whether these abnormal data are precursors of the threatened "Tokai Earthquake" or not. The making of this decision needs high-level technical advice which the Director-General will request from his private consulting body, namely the Earthquake Assessment Committee consisting of 6 prominent seismologists. If the committee's diagnosis is affirmative, the information should be used to prevent or mitigate the impending earthquake disaster.

To enable the above plan to be implemented, a law called the "Large-scale Earthquake Countermeasures Act" was passed in 1978. In accordance with this law, the mechanism of the "Tokai Earthquake" was studied, and the areas where the expected seismic intensities are 6 or more in JMA scale, have been designated as "areas under intensified surveillance". The seismic intensities of the surrounding area, including Tokyo, will be 5. The effects of seismic intensities 5 and 6 are explained in figure 1. The areas under intensified measures are

Jolt With Intensity of 5		Jolt with Intensity of 6
(Weak)	(Strong)	
People • Almost all people feel like clinging to solid things and try to rush out of doors. • Almost all people asleep are woken up.	• Almost all people are struck with fear or feel dizzy • People may fall out of bed.	• People will be stupefied and feel their lives endangered • Walking will become impossible and one can move only by crawling.
Buildings • Windowpanes are seldom broken. • Loosely-fixed signboards may fall down. • Concrete walls devoid of reinforcing rods or with a weak foundation may fall	• Glazed windows may be knocked out. • A considerable number of loosely-fixed signboards will come down. • Many concrete walls with a limited number of reinforcing rods or with a weak foundation will fall down	• A considerable number of windowpanes will be knocked out. • Pillars and walls will develop cracks and will be damaged considerably • A considerable number of tiles and other decorative materials on walls will fall
In Rooms • Vases and doll cases will fall. • Gas ranges may be moved or fall • Gas heaters and electric heaters may fall • LPG containers not chained will fall down.	• Heavy furniture and electric refrigerators may fall down. • Gas ranges will be considerably moved or will fall. • A considerable number of gas heaters and electric heaters will fall. • Some cylindrical LPG containers, even if chained, may fall along with the walls to which they are fixed.	• Almost all objects will fall or move considerably • Almost all hanging items will drop • Almost all bookshelves and showcases will fall down
Out of Doors • Car drivers will feel the steering wheel move, as if they have a flat tire • Shoulders of raised roads may develop cracks. • Electric wires will swing considerably.	• Cars will become difficult to control as drivers will feel as if the tires of all four wheels have been punctured. • Raised roads will develop large fissures, and shoulders may crumble. • Electric wires may be cut by falling signboards.	• Drivers will lose control of the steering wheel and cars may veer into the opposite lane. • Roads will be cracked, sink or rise • There may be widespread power failure.

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Figure 1. Seismic intensities 5 and 6 on the JMA Scale

shown in figure 2. As previously stated, the only earthquake for which a prediction would be made is the "Tokai Earthquake", and the law is applied only to those areas under intensified surveillance related to the "Tokai Earthquake". The countermeasures including dissemination of necessary information prior to the occurrence of the earthquake will be taken only in the areas under intensified surveillance and the surrounding areas.

If the Earthquake Assessment Committee diagnoses that the discovered abnormal phenomena are precursors of the Tokai Earthquake, the Director-General of JMA will prepare the Earthquake Prediction Information based on the decision of the Earthquake Assessment Committee, and will report this information to the Prime Minister. The Prime Minister will convene a short cabinet session for the sake of formality and will issue the Earthquake Warning Statement. The events in time sequence from the discovery of abnormal phenomena to the issuance of the Earthquake Warning Statement are illustrated in figure 3.

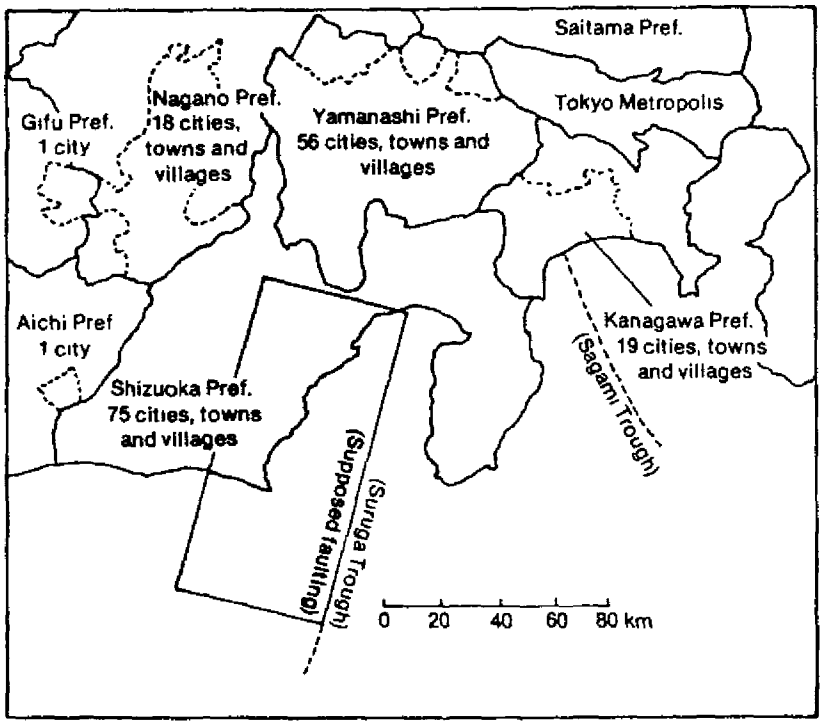
3. CONTENTS, TIME AND MEANS OF DISSEMINATION OF THE PREDICTION INFORMATION

At the time of the discovery of abnormal phenomena, a specified but fairly large number of people will know about it, and the number of people will increase in different organizations as time passes. At this stage, it will not yet be known whether the abnormal phenomena will lead to a Warning Statement. However, it is not realistic to expect these people to keep silence. The mouth-to-mouth diffusion of the information will start. The dissemination of information by this kind of means will certainly distort the contents of the information. False information, which has once spread, is very difficult to replace by the correct information.

The mass media such as radio and television are the best means of dissemination of the information, for they have an ability to disseminate information from the source directly to the people in an extensive area. As to when the information on the discovery of abnormal phenomena and the convening of the Earthquake Assessment Committee should be released, the people in mass media strongly advocate that what is happening should be disseminated to the public as soon as possible through mass media before false information spreads. On the other hand, the governmental antidisaster organizations, especially the police forces, strongly oppose the immediate dissemination to the public, even of the news that the Earthquake Assessment Committee has been convened.

Fig. 2.

Expected Seismic Intensities in the Areas under Intensifies Measures



It is argued that this will cause a strong social reaction and the antidisaster organizations, therefore, should have some time to make preparations before the public is informed. Many meetings have been held between representatives of the mass media and governmental organizations to discuss this matter. The following process was finally agreed upon:

(1) Immediately after the members of the Earthquake Assessment Committee have been summoned to meet, the mass media will be notified by means of the special direct telephone lines between the Japan Meteorological Agency and the media;
(2) the antidisaster organizations will also be notified at this time;
(3) the mass media keeps an embargo of 30 minutes, after which it broadcasts all the facts up to that time by interupting ordinary programmes;
(4) the facts to be broadcast are limited to a description of the abnormal phenomena discovered and a report that the Earthquake Assessment Committee has been summoned to meet. No interpretation of the abnormal phenomena is to be given;
(5) uncertainty of the threat of the "Tokai Earthquake" is repeatedly announced at this stage since no decision has yet been made, and only preparedness for it is requested;
(6) as soon as the Director-General of the Japan Meteorological Agency has reported the earthquake prediction information to the Prime Minister, this fact will be immediately released to the public even before the issuance of the Earthquake Warning Statement. It is expected that the Warning Statement will follow within a few minutes.

On the other hand, the information given to the governmental antidisaster organizations is disseminated through the emergency radio network to the authorities responsible for disaster preparedness in cities and towns in and close to the areas under intensified surveillance.

4. DISSEMINATION OF THE FOLLOW-UP INFORMATION

As shown in figure 3, it will take about 2 hours from the discovery of abnormal phenomena to the issuance of the Earthquake Warning Statement. The Earthquake Warning Statement will identify (1) the nature of the abnormal phenomena, (2) affected areas and expected seismic intensities in the event of the occurrence of the "Tokai Earthquake" and (3) expected time of occurrence. The most important factor is the time of occurrence. This will probably be stated as being "within a few days from the time of the Statement". A

FLOW OF EARTHQUAKE PREDICTION INFORMATION

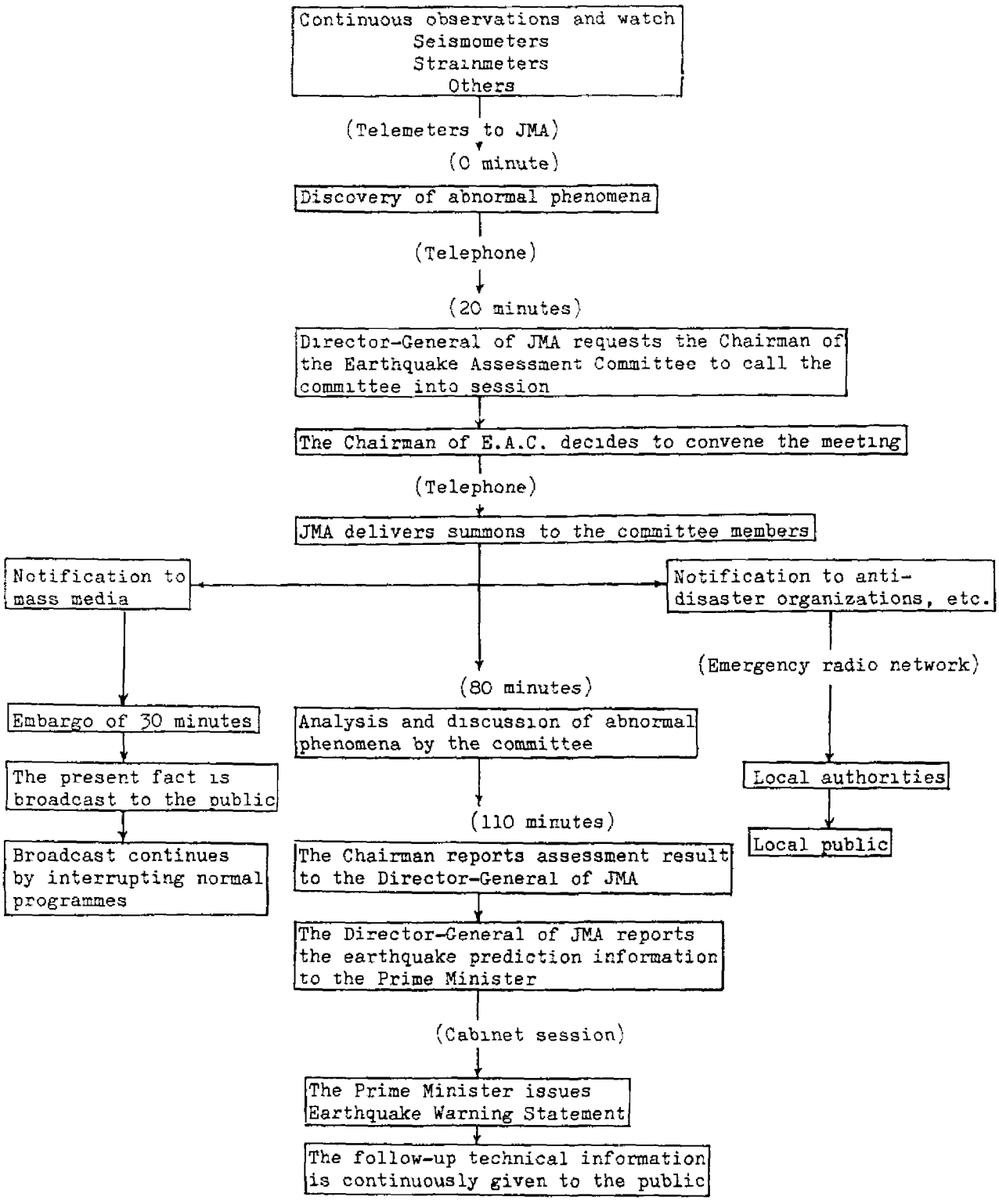


Fig. 3.

technical explanation will be given by the Japan Meteorological Agency. The expression of "within a few days" will sound somewhat vague. However, given the present technological limitations and in view of the variable lead-times of different precursors to past large earthquakes, it would be extremely difficult to determine the time of occurrence more precisely at the moment of issuing the Warning Statement.

After the discovery of abnormal phenomena, however, data of many kinds will continue to be telemetered to the Japan Meteorological Agency. Based on these data, information on subsequent changes in the abnormal phenomena and their interpretation will be reported as frequently as possible. The mass media will continue to broadcast this information to the public. The diagnosis as to whether the possibility of a major earthquake is increasing or (if the abnormal phenomena are fading away) decreasing, will depend on such follow-up information. It is expected that the answer will be given within a few days as to whether the prediction will lead to a major earthquake or not. If the possibility of occurrence diminishes, the Prime Minister will cancel the Warning Statement in accordance with the additional information from the Japan Meteorological Agency. The Assessment Committee will continue to advise the Director-General until the warning is cancelled or the event occurs.

If the Warning Statement is cancelled, the affair will be regarded by the population as a false alarm and its negative impact on society will be considerable. From the scientific point of view, however, it is not a simple false alarm. Once significant abnormal phenomena have taken place, it is considered that the physical state of the earth's crust, where the strain energy has accumulated to a critical level, has approached the final stage of triggering a major earthquake. This situation was experienced at the time of the Haicheng Earthquake in China of February, 1975, for which a prediction was successfully made. In Japan, the public in the areas in question will tolerate a few cases of false alarm, but expects the major earthquake not be missed.

5. CORRECT DISSEMINATION AND INTERPRETATION OF THE PREDICTION INFORMATION

It is of utmost importance that the prediction and related information be correctly disseminated and correctly understood by the population. Most weather forecasts and warnings from the Japan Meteorological Agency are correctly disseminated by the mass media without distortion, and well understood by the

public, because people are familiar with the procedures. For earthquakes, on the other hand, there has been no previous experience in Japan. Even if such information were issued for the "Tokai Earthquake", no assurance can be given that it would be correctly disseminated and understood. To avoid confusion during the dissemination, all the technical information will be broadcast directly from the Japan Meteorological Agency by the scientific staff.

The role of the mass media in making the prediction information useful for disaster prevention is a very important one. Therefore, the mass media are recognized to be an important part of the prediction system. In order to secure (1) accurate and timely information, (2) accurate and quick dissemination and (3) correct understanding and adequate reaction by the public, the Japan Broadcasting Corporation and other commercial radio and television companies are very keen on studying how to achieve the above three objectives, once the Assessment Committee has been convened and this becomes their public duty.

These broadcasting authorities are engaged in campaigns to enhance the public's knowledge of earthquakes in general as well as measures for disaster prevention prior to a major event. Also,in accordance with the Earthquake Law, large scale simulation exercises are carried out at least once a year, as indicated in figure 3 and involving the Japan Meteorological Agency, the National Land Agency, Defence Forces, Police Forces, Prefectural Governments, mass media and local people.

6. PREDICTION INFORMATION FOR OTHER PARTS OF JAPAN

So far our discussion of earthquake prediction has been limited to the "Tokai Earthquake". In fact, almost all parts of Japan are prone to disastrous earthquakes of magnitude 7 or more. However, our present prediction technology has not yet reached such a level as to predict these smaller magnitude but still potentially disastrous earthquakes.

To make prediction-oriented studies on earthquakes of magnitude between 7 and 8, universities and governmental organizations have been co-operating to implement a nationally established strategy. As a co-ordination body at the academic level, a committee named the Co-ordinating Committee for Earthquake Prediction, consisting of about 30 specialists, was established in 1969. All scientific information concerning earthquake prediction is reported to this

committee. The committee meets every 3 months to analyse and discuss the data. If any abnormal changes are found in any part of Japan, the committee reports the facts, together with its scientific comments, to the public. No actual issue of a definite prediction or alarm has yet been made. Some abnormal observations have been reported, however, without causing adverse social effects.

7. CONCLUSION

In the past, many large and disastrous earthquakes have occurred in and near Japan, and experience exists of what to do after the occurrence of such events. However, we have never yet implemented short-term disaster prevention and preparedness measures in response to the prediction of a large earthquake. Nevertheless, we do believe that this kind of prediction would be very useful as a means of preventing or mitigating the potential disaster for a highly industrialized society. For this reason, we have committed ourselves to try to predict the "Tokai Earthquake", and to implement pre-earthquake countermeasures which have been established by a special law. It is also a fact that our lack of previous experience is a serious handicap. We are now studying these problems through extensive co-operation between officials in all of the disciplines concerned. Above all, the rapid dissemination of accurate information related to the earthquake prediction is recognized to be of prime importance.

DISCUSSION

Prof. Rikitake asked whether the Prime Minister of Japan could refrain from issuing an earthquake announcement against the advice of the JMA. Dr. Suyehiro pointed out that the announcement is discretionary but that the Prime Minister would normally issue the announcement immediately. On a question by Dr. Kárník, Dr. Suyehiro briefly touched upon the 30-minute time delay required of the news media between the issue of the announcement and its dissemination.

In the United States, according to Mr. Krimm, the mass media would not observe any self-imposed delay, as in Japan. Prof. Roberts directed a similar question to Miss Rebeyrol of "Le Monde", who felt that responsible press members might co-operate but that no such situation had ever been tested. Dr. Howell suggested that responsible members of the United States press could also be depended upon to comply with a new embargo.

In response to questions by Dr. Fournier d'Albe, Dr. Suyehiro gave details of the wording to be used in a warning. Prof. Rikitake stated that cancellation of an alarm would depend on opinions among members of the Advisory Council; he himself would advocate cancellation if the situation remained static for a few days and no earthquake occurred. Dr. Zhu commented on local and provincial alarms in China. Provincial authorities are more fully informed by scientists and may override the local authorities.

Prof. Nersesov asked how warning would be issued at night. Dr. Suyehiro said that remote-control devices could be supplied to homes, in order to switch on TV sets by the Agency.

Questioned by Dr. Zhu, Dr. Suyehiro explained that no clear-cut threshold exists for deciding the time lapse for a given precursor in terms of an emergency. This would be done on the strength of the data. Dr. Tomblin and Mr. Rouhban intervened to request additional clarification about emergency measures and warnings. Dr. Suyehiro mentioned installations and major stores which will close down, including the high-speed rail services,schools, department stores, etc..

In response to a question by Prof. Roberts, Dr. Suyehiro said that public statements by scientists on possible events in areas other than Tokai have been voluntary withheld; there is no written code of ethics, however, only a general consensus. Dr. Giesecke mentioned that Lima newspapers published work by Japanese scientists on predictions in Japan. In reply to a question by Mr. Rouhban, Dr. Suyehiro clarified that the Commission is only empowered to rule on predictions for the Tokai region and cannot deal with prediction concerning other areas.

Dr. Tazieff, who was not present during the discussion of this paper, sent the following written comment: "In the preliminary report on the above discussion, I read that Miss Rebeyrol, of the French newspaper "Le Monde", asked by Prof. Roberts, answered that responsible press members might co-operate but that no such situation had ever been tested. I know of one exception: the French press, including "Le Monde", did not observe any self-imposed delay (as in Japan), nor did it seek the opinions of the actual experts, during the Guadeloupe 1976 eruption: even though this was not an earthquake prediction, the deontological situation, both for the implied scientists and for the mass media, is of exactly the same nature.

PANEL DISCUSSION:
LESSONS FOR EARTHQUAKE PREDICTION MANAGEMENT

Dr. Karnik introduced the discussion by suggesting a list of topics and problem areas to be considered. He cautioned against a feeling that earthquake prediction is on a level with "palmistry" or similar unscientific methods, and said that professional judgement was required, based on careful evaluation of available data and precedents.

Prof. Nersesov suggested that the seminar split up into groups according to professional affiliations, but Dr. Kárník preferred that the meeting remain together so as to enable all participants to share in the discussion.

Dr. Fournier d'Albe pointed out that many misunderstandings about the state of the art in prediction might be avoidable if scientists always stated precisely what they knew but not more than they knew. Statistical data on precursors are noticeably scarce. In Japan a Committee is required to make decisions on the basis of precursor data, but in most countries the public is not educated to go along with decisions on this level.

Prof. Lomnitz made some comments on the problem of assigning a probability to precursory phenomena, pointing out their ambiguity and the difficulty in quantifying them, especially for observations such as that of animal behaviour. Strain monitoring is not presently feasible, but may well become possible in the future. A discussion developed, with the participation of Messrs. Zhu, Fournier d'Albe, Roberts and Nersesov, on the philosophy of earthquake prediction as is currently practised in different countries.

Prof. Nersesov discussed the Soviet strategy of dividing research into basic studies and field observations. Long series of observations are required for the latter to be used as a basis for probabilistic evaluations. The use of many different types of observation simultaneously is possible for long- and intermediate-term prediction, but difficulties arise in short-term prediction (1 month or less). Imminent prediction is very uncertain and we must find new precursors. It is clear that prediction is possible, but more instrumentation

is required. Prof. Roberts asked whether this meant that a team of specialists would develop first an intuitive experience, then as the date of the earthquake approached, would develop criteria for short-term and imminent prediction in a collective manner. Prof. Nersesov replied in the affirmative. The discussion continued with interventions by Fournier d'Albe, Roberts, Lomnitz, Nersesov, Kárník and Howell.

Prof. Nersesov pointed out that nearly all earthquakes of magnitude greater than 4.5 had been predicted in the USSR during the past 10 years. The precursors varied in each case. In Japan conditions are more difficult because of industrial and natural noise. For M= 4.5 the radius of preparation is only about 30 - 40 km which makes it relatively easier to predict small shocks, because of the relatively smaller area which needs to be instrumented.

In reply to a question by Dr. Tomblin, Dr. Suyehiro and Prof. Rikitake stated that no threshold was set beforehand for the size of the anomaly which would be recognized as a precursor (even though a threshold existed above which, for the Tokai region, the Earthquake Assessment Committee would be convened).

Mr. Rouhban proposed that more attention be paid to failures in prediction. Prof. Rikitake mentioned earthquakes in Sichuan Province and recent predictions in this area of China. Three earthquakes were predicted. Imminent forecasting of the Pinggen earthquake was particularly successful. He described the process of decision-making among the forecasters. Small animals turned out to provide earlier signs of uneasiness than large animals.

Dr. Kárník proposed that the idea should be discussed of a code of ethics for earthquake prediction. Prof. Roberts read the draft of a code of ethics prepared by a Sub-Committee, and circulated on 1 September 1982 to members, of the Seismological Society of America. Dr. Fournier d'Albe wondered whether an international code of ethics would be feasible, in view of the different ways in which science was conducted in different parts of the world. Dr. Kárník suggested that some observations on the proposed code of ethics be formulated on the following day by the Working Groups. Prof. Lomnitz argued that a code of ethics is not useful. Ing. Giesecke pointed out that many scientific activities (e.g. microzonation in urban areas) are forecasts and have economic implications, but should not be dealt with in this way.

Prof. Nersesov believed that no prediction should be published.

Mr. Parakatil commented on the role of the Red Cross Societies in earthquake prediction.

Prof. Lomnitz argued that adoption of a formal code of ethics might tend to inhibit proper scientific activities, while not offering any direct advantage over the mere existence of an ethics committee within a professional society. He pointed out that the Oaxaca prediction was made after proper peer review and circulation of preprints to colleagues in Mexico, and that publication of the paper caused no panic or noticeable public concern. Existence of an ethics committee seemed to be the adequate level of restraint among colleagues, without attempting to legislate in the matter. Further comments on this general matter were made by Drs. Roberts, Fournier d'Albe, Tomblin and Suyehiro.

Dr. Suyehiro suggested that the proper approach was not to promote unenforceable codes but rather to educate journalists and others in the communication of earthquake predictions. A similar proposal was made by Dr. Fournier d'Albe. Prof. Rikitake brought up the question of a prediction made by foreign scientists and suggested that a ruling on this matter might be useful.

At Prof. Rikitake's suggestion, Dr. Tomblin read a letter by Prof. Evison to Prof. Rikitake as Chairman of the IASPEI Commission on Earthquake Prediction, summarizing various resolutions from earlier meetings, with a view to providing guidelines for a code of practice "especially where the crossing of international boundaries is involved", in relation to earthquake predictions.

Prof. Roberts saw no impediment to adopting guidelines on this matter. Prof. Lomnitz concurred, with the suggestion that the designation "code of ethics" be changed to "guidelines" or "code of practice".

Dr. Suyehiro explained the position of the Japanese Committee in connection with irresponsible statements which might cause public unrest. In reply to a question by Dr. Kárník, Dr. Nersesov said that initially predictions in the USSR were issued by several different institutions, but now the responsibility rests with the agency at the Republic level charged with the actual prediction work.

From there the prediction is channelled through the Academy of Sciences.

Dr. Howell explained the work of the Office for Foreign Disaster Assistance in Washington. He felt that as a means of promoting preparedness planning, a prediction is often useful even when it is false. He related his experience with the Brady prediction, and resulting activities in planning for an eventual disaster in Peru. These activities proved beneficial.

Dr. Fournier d'Albe indicated the difference between "prediction", "hazard assessment", and "warning". A prediction is essentially informative while a warning is a call for action.

Dr. Tazieff, who was not present during the discussion of this paper sent the following written comment on the draft proceedings circulated to participants: "As regards the issue of a code of ethics, some people, sometimes because they have been more or less involved in a case history, are not quite favorable to this idea.

Having myself lived three cases of deliberately biased predictions of volcanic eruptions (Pozzuoli 1970, Guadeloupe 1976 and Mount Etna 1979), I am convinced that a code of ethics for geoscience experts is an absolute necessity to prevent the loss of hundreds billions of dollars, as for these two first cases, or the loss of human lives, as on Mount Etna.

I do not agree with the somewhat negative opinion expressed by Dr. Lomnitz that such a code might tend to inhibit proper scientific activities. But I do agree with him that such a code should be designated a code of practice.

I also agree with him about the necessity of having a committee of ethics. The scientific community should be aware that deliberately false predictions are sometimes issued by scientists, either by actual experts, as at Pozzuoli in 1970, or by people totally incompetent in the field involved, as in 1976 for the Guadeloupe eruption and in 1979 for the eruption of Mount Etna. Such false predictions should be actively prevented rather than modestly ignored by the scientific community."

WORKING GROUP DISCUSSION AND RECOMMENDATIONS

The session began in plenary, at which the Chairman, Dr. Fournier d'Albe, identified three proposed topics for discussion, which were as follows:

A. Methodology of evaluation of predictions
B. Response to predictions by public authorities; procedures, constraints, requirements.
C. Code of ethics (or code of practice) for seismologists and others concerned with earthquake prediction.

The participants were then invited to join one of the three working groups formed to discuss each of the above topics and to formulate recommendations for further action by UNDRO and Unesco in the field of earthquake prediction management. Their reports and recommendations are given below.

A. WORKING GROUP ON EVALUATION OF PREDICTIONS

(Fournier d'Albe, Isikara, Nersesov, Rikitake, Zhu, C., and Zhu, F.)

The conclusions to be drawn from the case studies discussed at this Seminar can be summarized under the headings:

1) What constitutes an earthquake prediction?
2) On what basis can scientific predictions be made?
3) How can the validity of predictions be evaluated prior to the occurrence or non-occurrence of the predicted event?

1. What constitutes a prediction?

An earthquake prediction, to qualify as such, must contain a statement regarding the place, time of occurrence and magnitude of a future earthquake; it should also contain an estimate of the expected intensity of ground motion and define the area over which strong ground motion is likely to occur.

What distinguishes an earthquake prediction from an estimate of seismic hazard is the inclusion in the prediction of an estimate of the time of occurrence of the predicted event, within a time scale comparable with that of possible responses to the prediction. For instance, the simple identification of a seismic "gap" or other area of possibly exceptional hazard does not in itself constitute a prediction, nor does seismic zoning or microzoning. Final evaluation of the accuracy of a prediction can only be made after the event has actually occurred or failed to occur.

2. On what basis can scientific predictions be made?

There is at present no valid theoretical model of earthquake generation on which to base deterministic predictions of earthquakes, and predictions based on such models must, for the present, be treated with great reserve.

The successful predictions that have been made so far have all been based on the observation and interpretation of "precursors", that is to say geophysical, geodetic, geochemical or biophysical phenomena, which are not necessarily related to the earthquake generation process but which have been observed to precede earthquakes in the past. Such precursors include abnormal seismic activity, ground deformation and tilt,water level changes and discharge from wells, anomalies in chemical contents of fluids in the earth's crust, geomagnetic and geoelectric anomalies, and abnormal behaviour of animals.

However, no precursor has yet been discovered which is an infallible indicator of the future occurrence of an earthquake; furthermore, it appears that different precursors may appear at different stages in the earthquake generation process, or in different localities in the earthquake preparation region.

In the absence of any one-to-one relationship between the occurrence of such precursory phenomena and the occurrence of earthquakes, one may be led to adopt a "probabilistic" approach to prediction, based on the statistical analysis of seismic and other precursors. However, the volume of observational data has so far proved to be insufficient for valid conclusions to be drawn from such analysis, and predictions, including successful predictions, have in general been based on collective qualitative judgement of the significance

of the observed phenomena. When more observational data become available, it may become possible to base predictions on a quantitative statistical analysis.

3. How can the validity of predictions be evaluated?

In the meantime, it is evident that predictions of various kinds will continue to be made throughout the world and that public authorities in countries subject to earthquakes may be faced with the problem of evaluating such predictions and deciding what action to take in response to them. It is therefore recommended:

(a) that in each country where destructive earthquakes are liable to occur, the government (or an institution designated by the government for this purpose) set up an Earthquake Prediction Evaluation Committee.

(b) that UNDRO and/or Unesco collect information on the methods and procedures for prediction evaluation adopted in these countries (i.e. China, Japan, United States of America, USSR) where such evaluation is already carried out, and disseminate this information to their Member States.

(c) that Unesco and/or UNDRO convene a group of experts to draw up guidelines for the evaluation of earthquake predictions.

B. WORKING GROUP ON RESPONSE TO PREDICTIONS

(Giesecke, Krimm, Nigg, Suyehiro, Tomblin, Vanssay)

Several countries have now experienced earthquake predictions or warnings of various types. These include ambiguous forewarnings from scientific sources, populary rumoured predictions of impending earthquakes, predictions made by amateurs based on scientifically-suspect theories, governmentally-supported warnings, and erroneously-issued warning messages from government sources. Even though these events have taken place in countries with different cultures, different forms of government, and different types of social organization, four components of these events appear to be common to the majority of the earthquake prediction case histories presented at this seminar. Our conclusions and recommendations pertain to these four common "lessons", and are as follows:

1. Prediction evaluation systems

Heightened public concern frequently occurs following the dissemination of an earthquake prediction, regardless of whether the prediction came from a scientific or non-scientific source. Such situations indicate the need for some authoritative body to evaluate the basis for the prediction promptly. The purpose of an expert evaluation of a prediction is to produce a consensus regarding the heightened probability of an event's occurrence. If the expert evaluation upholds the prediction, national or local governments can then implement hazard reduction and emergency response plans with greater confidence that any potential social disruption is justified on the basis of public safety. We therefore recommend:

(a) that for those countries where no local earthquake prediction body has been formed, a roster should be developed of national or regional seismological experts who could be called upon to evaluate predictions;

(b) that national governments should be informed of the existence of such rosters to diminish the time between the public announcement and the evaluation of a prediction;

(d) that if requested by national governments, international organizations such as Unesco and UNDRO should assist in facilitating the convening of these ad-hoc evaluation bodies.

2. Warning messages

While only a few countries have had actual experience with warnings of imminent earthquakes, that experience in conjunction with research on the dissemination of other types of disaster warnings points out the importance of carefully formulated messages that are issued by credible sources. The purpose of the warning message is to motivate adaptive behaviours by the public at large and to minimize the possibility of denial, apathy, or uncertainty about the coming event. We recommend:

(a) that all warning statements should include an explanation of why the warning is being issued as well as a statement on the reliability (is one is available) of the prediction;

(b) that any official warning statement should include specific recommendations for protective actions by individuals and families;

(c) that national, regional or local planning assessments must take place to ensure that proposed protective actions are appropriate for, and within the capability of the majority of people in the threatened area.

3. Portrayal by the media

In several of the case histories which have been studied, it is noted that the media tended to sensationalize or misrepresent some of the components of an earthquake prediction. In some cases, this inaccurate portrayal was the result of honest misunderstanding of scientific concepts by non-specialized news-writers. In other instances, however, the sensationalism was used to attract larger audiences or to embarrass or chastise political authorities. Since the media are the prominent communication channels through which the public hears the prediction and warning, it is important that the information be factual and continually updated. We recommend:

(a) that an information dissemination system should be developed to identify both government and scientific spokes-persons who will be responsible for issuing official statements on the evaluation of the prediction and, when appropriate, the warning;

(b) that as soon after an earthquake prediction (whether officially certified or merely rumoured) becomes public knowledge, these spokes-persons should meet with media representatives to give them current information and to outline future evaluation and preparedness efforts;

(c) that the media should be kept apprised of the situation as it develops to maximize the accuracy of reporting.

4. Public education

Recent case histories illustrate that social disruption, ranging from mild personal agitation to fairly severe economic losses, can result from

earthquake prediction announcements or rumours. One way to reduce this disruption is to educate the public about prediction, from both a scientific and a preparedness standpoint. A second mechanism for forestalling disruption is governmental planning. We therefore recommend:

(a) that governments should produce printed and audio-visual materials explaining, in lay terms, (1) the meaning of "prediction" and "warning", (2) how a prediction will be validated, (3) how the public will be informed of its development, and (4) what appropriate actions should be taken by each member of the public;

(b) that governments should be encouraged to develop both long-range hazard mitigation plans (e.g., building codes and land use practices) to reduce the likelihood of severe disruption if the predicted earthquake occurs, and short-range emergency response plans that could reduce the loss of life.

C. WORKING GROUP ON CODE OF PRACTICE

(Lomnitz, Roberts, Rouhban)

Publication of predictions has on occasion given rise to undesirable consequences for communities in the areas of prediction. It is recommended to Unesco and UNDRO that they consider transmitting to the appropriate bodies recommendations on guidelines to be observed by the scientific community in relation to the communication of earthquake predictions.

Participants at the present seminar have studied the recommendations for a Code of Ethics on Earthquake Prediction recently circulated by the President of the Seismological Society of America, and recommendations by Prof. F.F. Evison of Victoria University of Wellington for a Code of Practice for earthquake predictions. Reference to these documents, and the results of discussions held during the seminar, illustrate the need to strike a balance between the advancement of science and other community interests. On the one hand it is essential to avoid discouragement of vigorous research in the field of earthquake prediction which should be fully supported by responsible national and international agencies. On the other, it is proposed, out of concern for the interest of affected communities, that scientists and officials engaged in

earthquake prediction activities affecting their own or foreign countries should refer to the following guidelines when transmitting information on predictions:

1. If their work seems likely to lead to the development of specific predictions, scientists should advise appropriate official agencies on a confidential basis of their research intentions.

2. When the area of possible prediction is outside their own country, scientists, in addition to advising appropriate official agencies, should seek the co-operation of appropriate scientists in universities or other agencies in the country where the area of prediction is located.

3. Assuming that responsible scientists will accept the obligation to offer their work for review by their scientific peers, in the case of a specific earthquake prediction it should be noted that there is a requirement to ensure conditions of confidentiality during the process of review.

4. In those countries where procedures for the evaluation and transmission of earthquake predictions to administrative and political authorities have been established, it is necessary for the scientists studying phenomena within those countries to make themselves thoroughly familiar with the opportunities and obligations arising from those procedures.

5. Certain case have revealed undesirable consequences arising from the publication of details concerning earthquake predictions by the news media. Scientists or officials should regard the communication of such details to the news media as the sole responsibility of the appropriate public authorities.

6. It is apparent that very difficult problems may be created when specific predictions are made by a scientist for a country other than his own. An obligation exists for scientists working upon earthquake predictions to inform themselves of the conditions existing in the country for which the prediction may be made, and to adapt their procedures in the light of those conditions, after seeking advice from collaborating colleagues and appropriate officials in the country concerned.