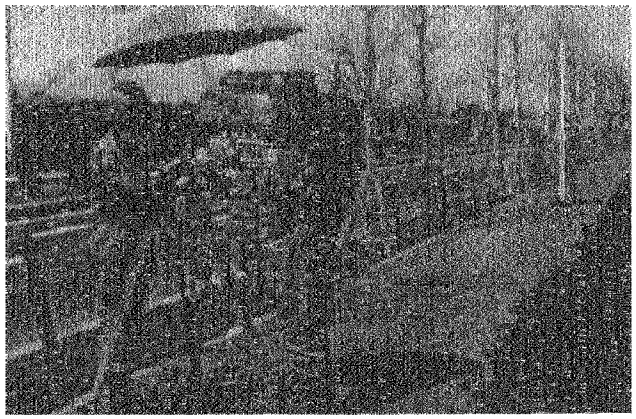
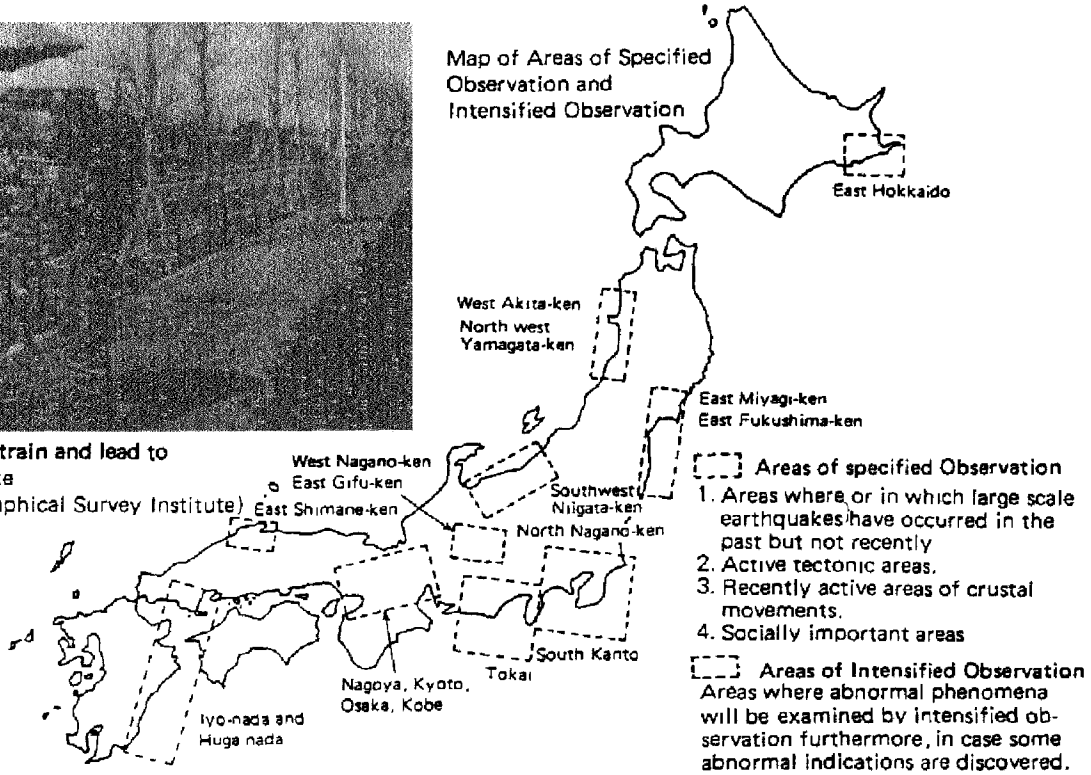
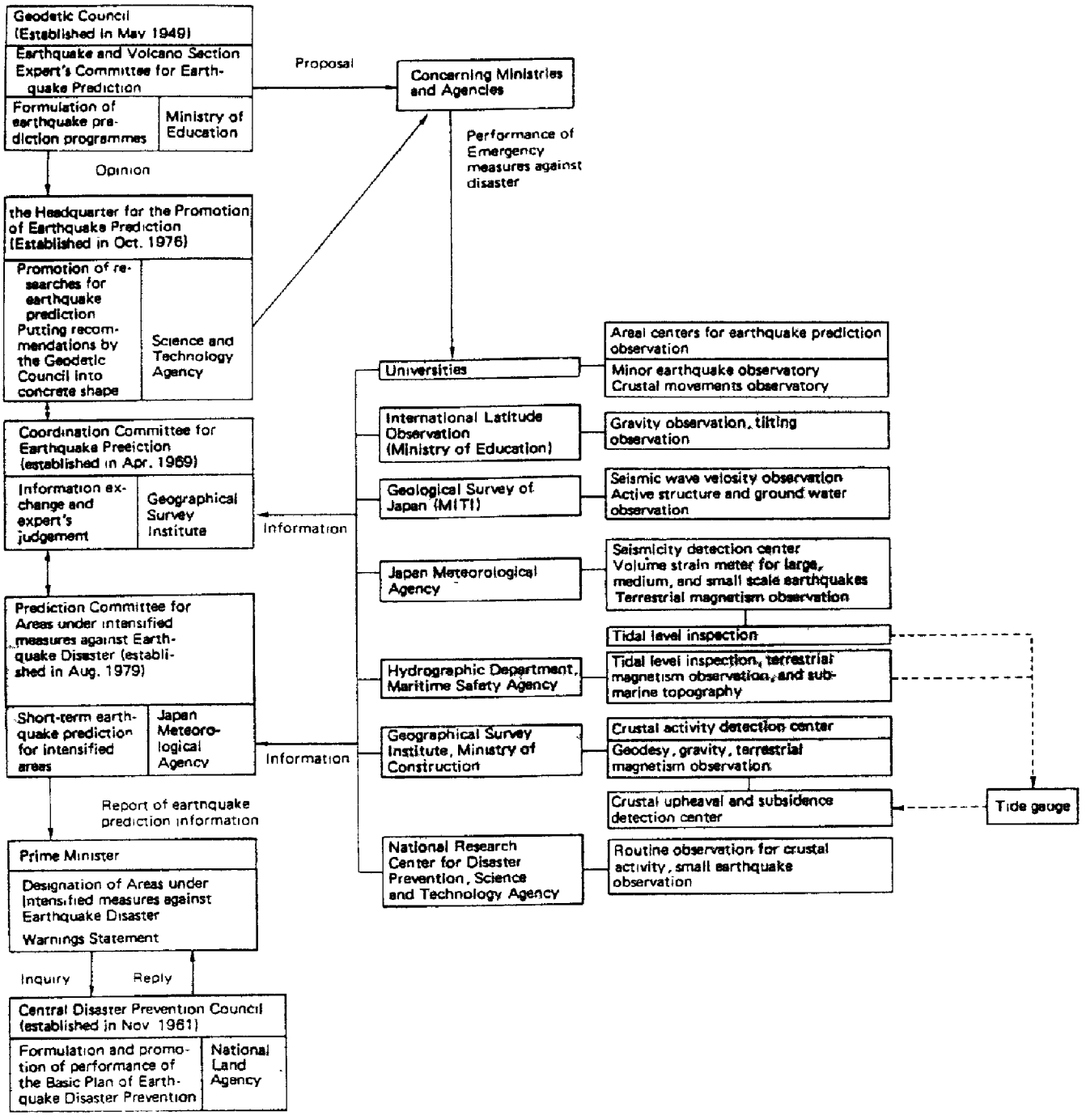
Furthermore, in 1976, the Headquarter for the Promotion of Earthquake Prediction was established in the Cabinet to promote arrangement of integrated and systematic policies as well as to coordinate tight relationship among the relating administrative organs.

The observation researches are undertaken by such concerning organs as shown in the following figure, and requested to be expanded furthermore. Especially, concentrated observations are being conducted for the Tokai area as described in the following chapter and intensification of observations and researches for various types of earthquakes, including right beneath type, in the Southern Kanto area which was designated as Intensified Observation Area, are strongly required.



Survey reveals ground strain and lead to prediction of earthquake
(Supplied by the Geographical Survey Institute)





Earthquake Prediction System

Possibility of occurrence of large-scale earthquakes in Japan

As described in the former chapter prediction of high potential areas for occurrence of earthquakes is becoming possible, judging from its periodic character and state of accumulated strain in the earth crust, based on the interpretation of the mechanism of occurrence of large-scale oceanic type earthquakes as large as Magnitude 8.

The possibility of occurrence of large-scale earthquakes in the major parts of the seismic zone along the trench in the Pacific Ocean side of Japan in the near future, is low, except the Tokai area. States of each area are as follows. (see fig. p. 3)

1. Along the Nankai Trough
As shown in the figure in the page 3 and the table in the page 4, the Tonankai Earthquake occurred in 1944, and the Nankai Earthquake occurred in 1946. Therefore, it is predicted that the next large-scale earthquake will occur in the next century.

2. Along the Suruga Trough
When the Ansei Tokai Earthquake occurred along the Nankai Trough in 1854, it is judged that the destruction on the Tokai Trough zone would have occurred simultaneously. It has past 130 years since then, and the earth crust's strain has been accumulated in the Suruga Bay area. Judging from above mentioned states, the possibility of occurrence of a large-scale earthquake along the Trough in the near future is very high. This postulated earthquake is named as the "Tokai Earthquake".

3. Along the Sagami Trough
The Great Kanto Earthquake occurred in 1923, therefore it is predicted that the possibility of occurrence of a large-scale earthquake in the Trough area (inside of Sagami Bay) is low.

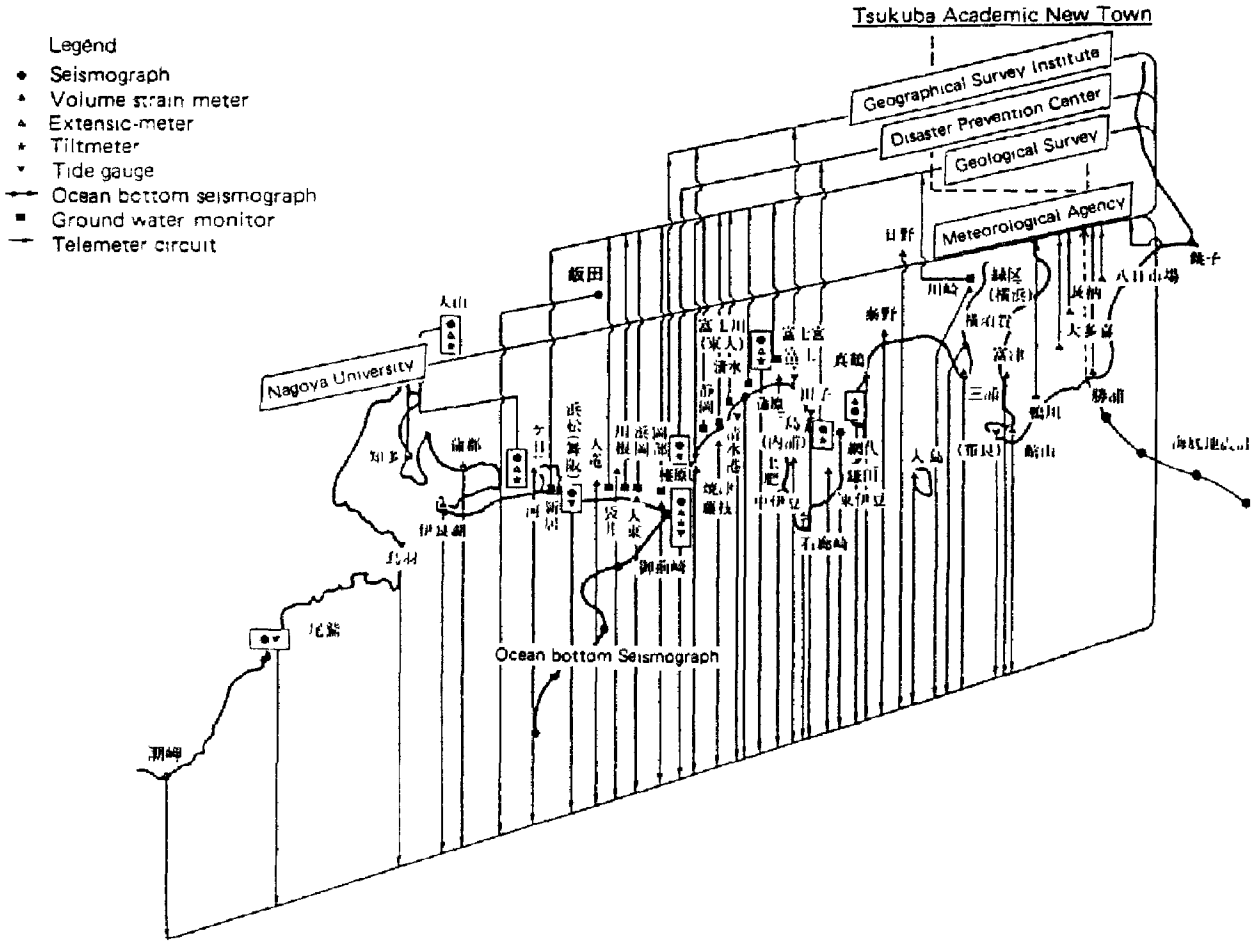
4. The Boso Offshore
This area is of particular feature due to the conjunction of two plates, the Pacific and the Philippine Sea Plates. These are subsiding under the Eurasian Plate, stressing each other. To judge the possibility of occurrence of a large-scale earthquake in this area is difficult due to a lack of information and knowledge of this particular trench, but it is not appraised as negative.

5. Along the Japan Trench
The offshore area from Ibaragi Prefecture to Fukushima Prefecture is judged as a low potential area for a large-scale earthquake based on the past record, despite medium-scale earthquakes have frequently occurred in this area. But, in the north of this area, several large-scale earthquakes, named the Fukushima East Offshore Earthquake in 1938, the Sanriku Oki Earthquakes in 1933, the Tokachi Oki Earthquakes in 1952 and 1968, occurred in this century, and covered about the whole zone of the Trench. Therefore, the possibility of occurrence of a large-scale earthquake in the area in the near future is judged as quite low.

6. Along the Chishima Trench
The area is judged as a low potential area for a large-scale earthquake in the near future due to the filling up all the blanked potential area by large-scale earthquakes in 1950's and 1960's, and finally by the Nemuro Oki Earthquake in 1973. On the other opinion, there still remains earthquake energy, because the scale of the Nemuro Oki Earthquake was smaller than predicted before, and the crustal movements as well.

2.2 Prediction of the Tokai Earthquake

The possibility of occurrence of the Tokai Earthquake in the near future is high. It seems that to predict such earthquakes short time prior to an actual activity is quite possible. For an arrangement of prediction systems, observation and survey programs such as level and detail geographic surveys, have been intensified, conducting micro earthquake observation and routine observation for crustal movements using volume strainmeters and tiltmeters mainly for areas under intensified measures against earthquake disaster. Then, the Coordination Committee for Earthquake Prediction is studying those results. Furthermore, an observation network has been provided for catching some indication phenomena as shown in the following figure. The Japan Meteorological Agency, the National Research Center for Disaster Prevention, the Geographical Survey Institute, the Geological Survey of Japan, the University of Tokyo, and Nagoya University take partial charges of the management of the network and mainly conduct routine observation programs for large, medium, small, and minor scale earthquakes, earth crust tilting, contraction, and volume strain, tidal range, and ground water behavior. The data of these observation programs are sent to the Japan Meteorological Agency by telemeters (remote transmitting), and are under observation of 24 hours a day watching system.



Routine Earthquake Observation Network in the Tokai District

Submarine seismograph developed by the Meteological Research Institute, the Meteorological Agency. The same type meters are settled in the offshore area about 150 km from the Omaezaki Peninsula. (Supplied by the Japan Meteorological Agency)

Knowledge up to date

Opinion of the Coordination Committee for Earthquake Prediction

The Committee expressed its opinion regarding the predicted Tokai Earthquake in 1976, and the situation about this has not changed since then.

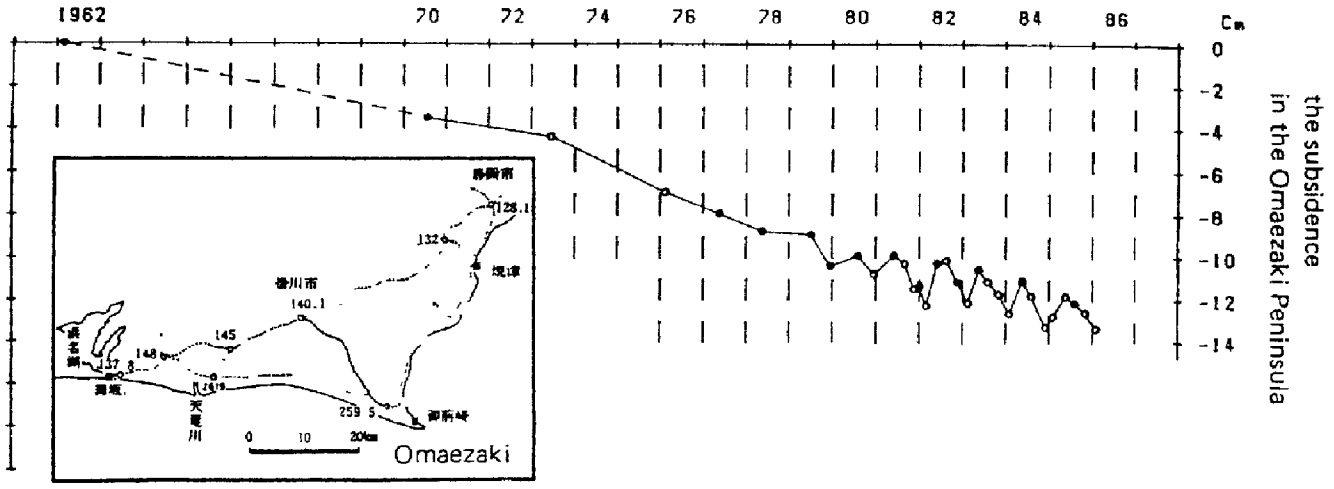
"The facts confirmed by now are that the hypocenter of the Ansei Earthquake was in the area around Enshunada and inside of Suruga Bay, any large-scale earthquake has never occurred in the area from the Omaezaki South Offshore to inside of Suruga Bay since then, and significant subsidence in the west coast area of Suruga Bay and horizontal contraction (west-northwest to east-southeast direction) centering Suruga Bay were observed during recent hundred years, etc. Judging from the results of these observations up to date, any indications for occurrence time of an earthquake has not been recognized".

Since then, the Committee is studying about indications for long-term prediction such as seismic activity, crustal movements, etc.

Long-term prediction

Small-scale earthquakes rarely occur in the area along the Suruga Trough from inside of Suruga Bay to the south, and this tendency will not change while judging from the results of the recent high sensitivity seismicity observations including submarine seismograph surveys. According to the results of the horizontal strain observation in the west coast of Suruga Bay, and the distance change observation between the Izu Peninsula and the west coast of Suruga Bay by the primary fiducial (standard) point survey, the tendency of the west-northwest to east-southeast compaction movement against the Suruga Trough has been continuing.

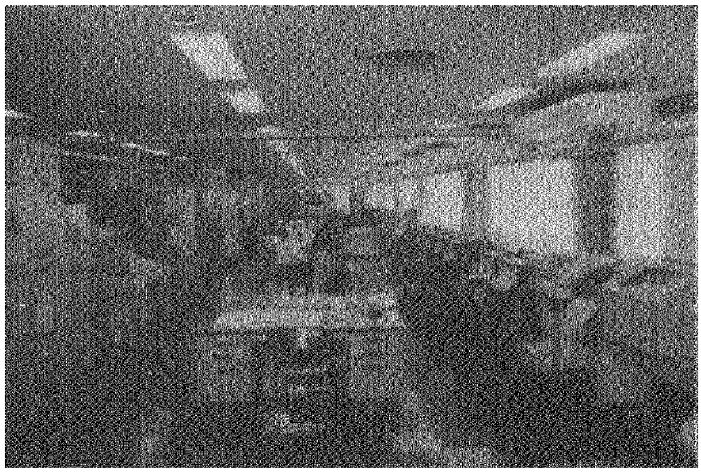
Changes of subsidence speed in the west coast area of Suruga Bay, presumably one of the important long-term indications for a large-scale earthquake, has been observed by the routine ground level survey. Specially, the crustal upheaval and subsidence in the Omaezaki area against the inland stational fiducial point in Kakegawa is significant, subsiding at a speed of about 3 mm per year since 1962, the year set up a level route line, up to 1973, and this speed matches with a postulated speed for the period of recent hundred years. The speed increased up to a rate of 8 mm per year in 1974, but is recently decreasing. To predict future tendency about this movement is difficult at present, and a further careful observation is required. (see the figure below).



The Omaezaki Peninsula is subsiding at a speed of several millimeters a year. In case such tendency of this movement is changed, it is judged as an indication for long-term prediction. The Geographical Survey Institute conducts ground level surveys several times a year because of such important meaning.

Prediction just before activities

As an good indication for prediction just before an earthquake, integrated observations for the crustal upheaval and subsidence movement using tide gauge observation, crustal movements observation by volume strain meters and tiltmeters, density of ground water and others like temperature, radon concentration, terrestrial magnetism, etc., are being conducted at present but any special abnormal phenomena indicating occurrence of an earthquake has not found yet.



Data processing room for earthquake observation in the second floor of the Meteorological Agency's building. All the data regarding earthquake observations in the whole area of Japan, including those of the Tokai district, are under the 24 hours a day observation system.

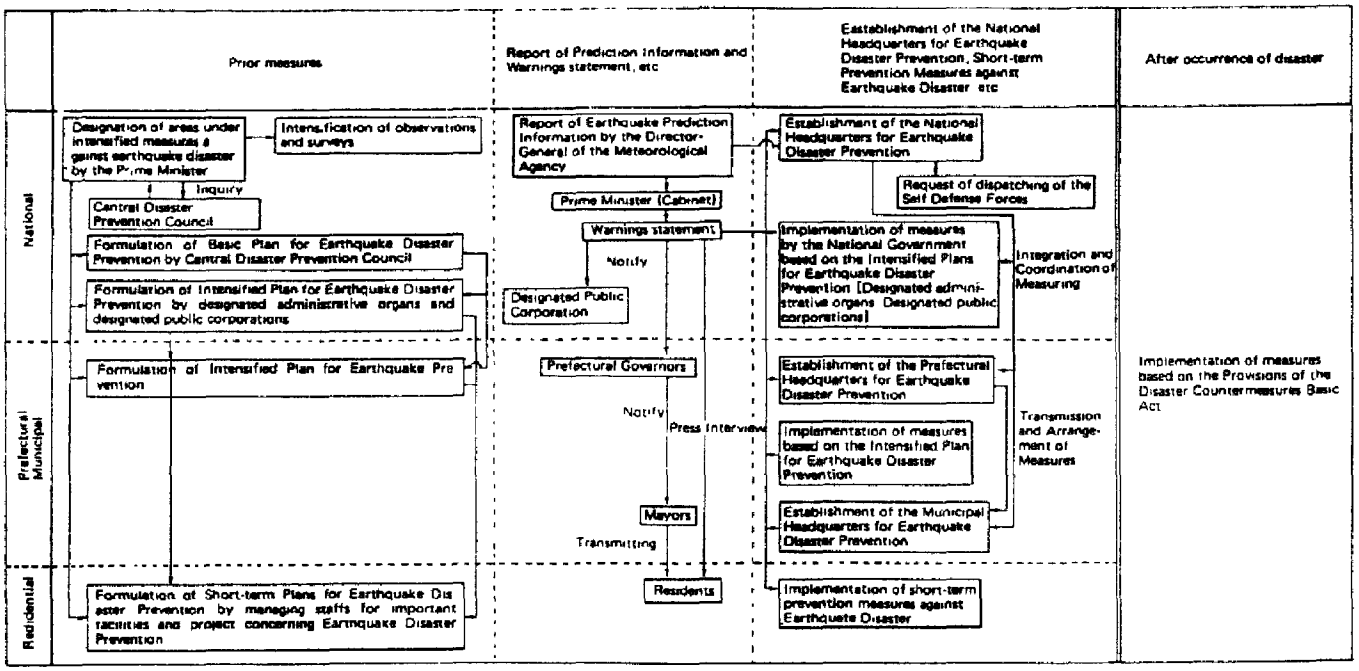
3. THE LARGE-SCALE EARTHQUAKE COUNTERMEASURES ACT

3.1 Outline of the Act

In 1976, an academic paper, said that there is a great possibility of occurrence of a large-scale earthquake in the Suruga Bay area, was present in the fall annual meeting of the Seismological Society of Japan. The paper gave a substantial impact to the people in the Tokai area centering Shizuoka Prefecture, and triggered the settling of the Headquarter for the Promotion of Earthquake Prediction in the Cabinet in October 1976. Then, an improvement of observation systems was planned to intensify such observation for earthquake prediction,and subsequently the Tokai Area Assessment Council was established in the Coordination Committee for Earthquake Prediction in April 1977 (the Council was abolished accordingly after the designation of the Tokai area as an area under intensified measures against earthquake disaster, and the Prediction Committee for designation of areas under intensified measures against earthquake disaster was established in the Meteorological Agency in August 1978). Since then, the Council has studied about transmitting systems of prediction information in case a prediction information just before an earthquake is issued and countermeasures to be taken by various disaster prevention organs, private sectors, and local residents. In consequence of that, the Large-Scale Earthquake Countermeasures Act was concluded in June 1978, and enforced in December 1978, aiming mainly to intensify the system for disaster prevention in case a large-scale earthquake prediction information is issued.

The Large-Scale Earthquake Countermeasures Act was made, on the premise that occurrence of a large-scale earthquake as large as Magnitude 8 class oceanic type will be predicted, to designate areas under intensified measures against earthquake disaster to intensify earthquake observation systems within such intensified areas, to provide prevention systems against earthquake disaster, and to reduce earthquake disasters by effective actions in case an Earthquake Warnings Statement based on a prediction information is issued. The schematic diagram showing the outline of the Act is as follows.

Major Measures by the Large-Scale Countermeasures Act



Progress of the measures against earthquake disaster in Japan after the Second World War

1. Japan had several major earthquake disasters since the Second World War such as the Nankai and the Fukui Earthquakes soon after the War, and the Tokachi-oki Earthquake and the Chile Earthquake Tsunami later on, as well as several bigger disasters from storms and floods, during the same period, but any basic plan of measures against earthquake disasters had never been formulated.

Later on, the Ise Bay Typhoon triggered institution of the Disaster Countermeasures Basic Act, and it was decided that measures against earthquake disasters should have been performed under the Act, as well as other disasters from storms and floods. But, it can be said that the measures had never been planned carefully enough.

2. In 1962, leading scientists published a blue print for earthquake prediction, then in 1964, the Geodesy Council recommended a plan for that. After this, the Niigata Earthquake, the Matsushiro Earthquake Swarm and the Tokachi-oki Earthquake occurred in 1964, 1965, and 1968 respectively. Due to these disasters, the Coordination Committee for Earthquake Prediction was established in April 1969 based on the Secondary Plan for Earthquake Prediction, and the Committee designated the South Kanto area as an area of intensified observation. The system for earthquake prediction has been significantly improved since then.

3. Furthermore, in March 1970, "A report on measures for large-scale earthquakes and fires in the Tokyo Region (Southern Kanto Region), so called "earthquake disaster assumption", was submitted by the Fire Defence Council, then the Central Disaster Prevention Council decided to study measures against large-scale earthquake disasters. During the course of the study, in February 1971, the San Fernando Earthquake occurred in the metropolitan area of the U.S.A. and modern urban facilities, such as tall buildings, highways, and dams, were seriously damaged. This event gave Japan many lessons on measures against earthquake disaster prevention in metropolitan areas. The Japanese Government dispatched a survey team to the area, then upon receipt of the report, decided "Essentials of Earthquake Countermeasures for Larger Cities" which became a basic plan for this field.

The Essentials designated basic items on the basic idea and prior measures on earthquake disaster prevention in larger cities, emergency measures against disasters, and a guideline for rehabilitation of disaster. In case a large-scale earthquake occurs in a larger city area which have many serious problems for disaster prevention such as over-saturated population, heavy and condensed industries, and accumulated dangerous materials, serious disasters including secondary disasters such as fire would occur, so that emergency countermeasures against those disasters are necessary to settle.

Furthermore, the national training programs for measures against earthquake disaster were started in 1971, and performed once every year since then. Training course programs were also started in March 1973 to inform such measures against earthquake disaster to the public, and performed once every year since then.

4. In July 1973, the Central Disaster Council discussed about promotion of measures against disaster prevention, and decided to promote measures against earthquakes, specially concentrated in following points;

(i) Promotion of earthquake prediction research, (ii) promotion of prevented urban areas for disasters, and (iii) intensification of disaster prevention systems.

5. In accordance with the establishment of the National Land Agency in July 1974, the Disaster Measures Division, the Minister's Secretariat, the National Land Agency succeeded the task for coordination of policy formulating for earthquake disaster measures and relating organ's business which was performed by the Prime Minister's Office until then.

After then, the Coordination Committee for earthquake countermeasures for larger cities was established in the Central Disaster Prevention Council's office to promote earthquake countermeasures for larger cities effectively and systematically.

6. In December 1974, the ground upheaval in the down stream area of the Tamagawa River was lightened as a social problem because of so called "Kawasaki right beneath type earthquake theory", and various measures were planned for that. In August 1975, this process was reported to the Central Disaster Prevention Council, and the Council decided to promote programs for the present disaster prevention measures, in which following three important points were specially intensified, (i) promotion of disaster prevention programs in urban areas, (ii) intensification of disaster prevention systems and spiritual uplift for disaster prevention, and (iii) promotion of earthquake prediction.

7. Therefore, in April 1977, the National Land Agency planned to improve the system for the disaster countermeasures, which established Earthquake Disaster Countermeasures Division and performed enactment of the Large-Scale Earthquake Countermeasures Act, designation of Areas under intensified measures against Earthquake Disaster, formulation of the Basic Plan for Earthquake Disaster Prevention, enforcement of the Special Fiscal Measures Act, arrangement of relating taxation systems, etc., responding to the social request for the postulated Tokai Earthquake. Since 1979, for the enforcement of the Act, the Division performed various kinds of surveys regarding establishment of transmitting systems for warnings statements, ways of integrated earthquake disaster prevention trainings, etc.

8. At present, the National Land Agency is performing an investigation for the simulated Southern Kanto Region Earthquake Disaster, an investigation for formation of the construction of the Tachikawa National Disaster Prevention Station (provisional) name, performance of a model project for the Disaster Prevention Station, etc., aiming to promote earthquake countermeasures for larger cities such as Tokyo by improving short-term prevention measures, and intensification of disaster prevention systems for urban areas, other than measures for the Tokai Earthquake.

In May 1983, the Central Disaster Prevention Council decided to promote these measures furthermore, and on July 1st, 1984, the Disaster Prevention Bureau was established in the National Land Agency, and the Earthquake Countermeasures Division, a subdivision of the Agency, is now promoting countermeasures for the Tokai Earthquake.

3.2 Designation of Areas under intensified measures against Earthquake Disaster

Based on Article 3, Paragraph 1 of the Large-Scale Earthquake Countermeasures Act, 170 municipalities in Shizuoka, Kanagawa, Yamanashi, Nagano, Gifu, and Aichi Prefectures were designated as Areas under intensified measures against Earthquake Disaster, (At present 169 municipalities due to the combination of city and town) due to the possibility of suffering significant disaster from the postulated large-scale Tokai Earthquake, and necessity of intensification of measures against earthquake disaster, upon receipt of the recommendations by the Expert's Committee established in the Central Disaster Prevention Council and after the agreement of the related Prefectural Governors, in August 1979.

The summary of the report of the Expert's Committee is as follows.

<u>The report of the Expert's Committee for the Designation of Areas Under intensified measures against Earthquake Disaster</u>

(May 12, 1979 to the Director-General of the Central Disaster Prevention Council from the Expert's Committee for the designation of Areas under intensified measures against Earthquake Disaster).