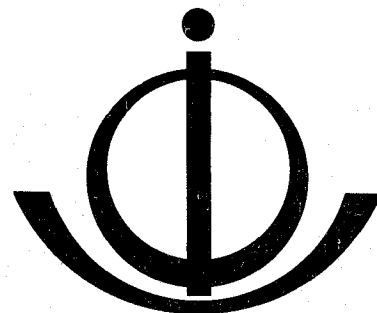




INTERNATIONAL TSUNAMI INFORMATION CENTER

NEWSLETTER

P.O. Box 3830, Honolulu, Hawaii 96812



INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
COMMISSION OCEANOGRAPHIQUE INTERGOUVERNEMENTALE
COMISION OCEANOGRAFICA INTERGUBERNAMENTAL
МЕЖПРАВИТЕЛЬСТВЕННАЯ ОКЕАНОГРАФИЧЕСКАЯ КОМИССИЯ

(Please note new ITIC address above)

VOLUME X, NUMBER 2
JUNE 1977

The ITIC Newsletter bring news and information to tsunami researchers, engineers, educators, community protection agencies and governments in 43 countries. We welcome your news, reports, papers, or abstracts.

International Tsunami Symposium at Ensenada

A tsunami symposium sponsored by the International Union of Geodesy and Geophysics was held at Ensenada, Baja California, March 23-26, 1977. More than 50 participants from 9 countries took part in the proceedings. They were welcomed by Dr. Saul Alvarez Borrego, Director of the Centro de Investigacion Cientifico y de Educacion Superior de Ensenada, the host of the conference. The proceedings were formally inaugurated by Dr. R. Ondarza, on behalf of Dr. E. Flores, Director General, National Council for Science & Technology of Mexico. Dr. K. Iida, first vice-chairman of the IUGG Tsunami Committee began the meeting with the following message from Dr. S. L. Soloviev, chairman of the Committee.

Ladies and gentlemen, dear participants of the Ensenada Tsunami Symposium. The meeting which is opening now seems to be a very important event for the whole scientific tsunami community.

The Tsunami Committee of the International Union of Geodesy and Geophysics was created in 1960 in Helsinki at the 12th General Assembly of the Union, due to the initiative of Dr. Doak Cox and others. Since then, several tsunami symposia have been convened by the Committee, the most representative ones being in Honolulu (twice), Moscow and Wellington, and smaller ones in Berkeley (USA), Tokyo, Bern (Switzerland), Lima (Peru), and Grenoble (France). Several small symposia in different parts of the world were organized by other international bodies.

So now we have the fifth big International Tsunami Symposium and at the same time, the first big symposium in Latin America and this to my mind is significant. Though conditions for scientific investigations are now in Latin America, perhaps not as good as one would desire, the Committee must continue its efforts to involve specialists from Latin American countries in research work on tsunami problems. No less than one quarter of the Pacific coasts vulnerable to tsunami action belongs to Latin America, and we cannot reach our practical goals, which are to create fully effective tsunami warning systems in the Pacific and to estimate reliably tsunami risk for most important sites, without active cooperation of our Latin American colleagues.

During the last three years, since our Wellington meeting, many interesting and important works have been carried out and are under accomplishment. Some of them will

be presented in Ensenada. Progress in numerical calculations of tsunamis and in tsunami description is evident.

Such form of international cooperation as joint US-USSR expedition with measurements of water movements in the open ocean proved to be profitable. The late Dr. Miller contributed extremely to the success of the expedition and in general, to tsunami investigations inside and outside United States, and I fully approve and support the propositions to devote the Ensenada Symposium to the memory of Gaylord.

Notwithstanding of some achievements, we have plenty of problems to solve. Tsunami Warning Systems are not very efficient and reliable and the Hawaiian tsunami of 1975 has confirmed in particular, the necessity of fast working and reliable local services. Progress in systematic measurements of tsunamis in the open ocean is small if not zero. Only very few seismologists are involved in serious analysis of seismic processes in the Pacific, but without appropriate models of seismotectonic movements of the ocean bottom, it is impossible to calculate tsunami effects both deterministically and statistically. New requirements to tsunami risk estimations are offered because of construction of many nuclear power plants in coastal regions of the Pacific as well as other oceans. To answer these requirements, we lack actual data. Meanwhile, we continue to lose these data even for new tsunamis in many corners of the Pacific.

Nevertheless, there are no doubts in the general progress of our investigations and the large number of participants to the Ensenada Symposium also testified to it.

May I apologize for not being with you, but some heart troubles, which I hope are of a temporary nature, do not allow me to travel abroad. The same reason hindered me from preparation of my report and from being very accurate in the correspondence. Please excuse me, I suffer strongly to lose this excellent opportunity for meeting old friends and for acquaintance with new ones. Personal contacts are of course necessary for a scientist as much as for other human beings. May I wish you fruitful work and a pleasant stay in Ensenada, Baja California, Mexico.

I would like to note that our choice of Secretary of the Committee in Grenoble was very good. Dr. Murty has done a good job to ensure the success of the Symposium. May I ask the members of the Committee to discuss during their meeting, among other topics also, our strategy to organize the Tsunami Symposium in Australia in 1979 in connection with the forthcoming General Assembly of the IUGG. Our propositions on the desirable duration of the Symposium and on the auditorium needed and so on, must be sent to the General Secretary of the Union. Financial problems also are worthy of discussion because due to the appearance of new branches of knowledge, our share in international funds tends to diminish numerically, and this loss of course is made more severe by the world inflation.

Pocas palabras a nuestras colegas Mexicanas del Centro de Investigación Científica y de Educación Superior de Ensenada, de la Universidad Nacional Autónoma de México y de las otras organizaciones. Muchas gracias por el interés de ustedes, a nuestra reunión, su ayuda para la preparación y su hospitalidad.

Once more successful work and good luck for everybody.

Fifty-one papers were presented during the 4-day symposium, covering many aspects of generation, propagation, and runup of real and simulated tsunamis. Papers were contributed as well both on human response, and on mitigation of the effects of tsunamis. These are subjects that Dr. Soloviev in particular had identified in

previous conferences as needing more investigations. (Papers are listed in this Newsletter, under Abstracts and Resumes).

Dr. T. S. Murty, Secretary of the IUGG Tsunami Committee, who organized and directed the symposium, requested 4-page summaries of the papers from authors. These will be reproduced and bound as a summary of the proceedings.

A tribute to Dr. Gaylord Miller, to whom the conference was dedicated was given by Dr. Walter Munk. Dr. Munk had been Gaylord's professor when he attended Scripps Institute of Oceanography, and it was in his work there that Dr. Miller became involved in long wave research, that led to his outstanding work and contribution in the field of tsunamis.

Dr. Iida, in concluding the Symposium, expressed sincere thanks to the Mexican hosts, especially to Dr. S. A. Borrego and his staff, for not only providing excellent facilities for holding the meetings and contributing to the success of the Symposium, but also for the hospitality and entertainment that had been given.

Speaking of the conference he stressed the need to continue and advance the research on tsunami behavior on the shore, the analysis of tsunami disaster, and the estimation of future tsunami risk.

IUGG Tsunami Committee

An IUGG Tsunami Committee meeting was held on March 26, 1977 at Ensenada, following the Tsunami Symposium.

The following members were present:

Adams, W.M.	(USA)	Murty, T.S.	(Canada)
Alexeev, A.S.	(USSR)	Pararas-Carayannis, G.	(USA)
Heath, R.A.	(New Zealand)	Reid, R.O.	(USA)
Hwang, L.S.	(USA)	Silgado, E.	(Peru)
Kajiura, K.	(Japan)	Voyt, S.S.	(USSR)
Iida, K.	(Japan)		

The following members were absent:

Braddock, R.D.	(Australia)	Sousa-Moreira, V.	(Portugal)
Lomnitz, C.	(Mexico)	Van Dorn, W.G.	(USA)
Pickard, G.L.	(Canada)	Zetler, B.D.	(USA)
Soloviev, S.L.	(USSR)		

Dr. H. G. Loomis, Acting Director of the Joint Tsunami Research Effort was selected to fill the vacancy in the Committee left by the death of Gaylord Miller. It was agreed that Dr. T. S. Murty become 2nd Vice-Chairman, and Dr. Loomis assume the responsibilities of Secretary, subject to concurrence of Dr. Soloviev and the IUGG.

It was agreed that no Tsunami Symposium should be held in connection with the IASPEI meeting in the U.K., scheduled for August 1977, since it follows too closely on the Ensenada meeting. However, depending upon the papers submitted, a one-day (or more) Tsunami Symposium should be held in Sydney, Australia in conjunction with the IUGG General Assembly in September 1979. Arrangements for this should be discussed between Dr. R. D. Braddock and Dr. S. L. Soloviev; also the new Secretary, Dr. H. G. Loomis, should be involved.

Mr. J. Lander of the World Data Center at Boulder, Colorado and Mr. S. O. Wigen of ITIC jointly brought up the question of tsunami data exchange and data requirements for tsunami research.

Dr. D. C. Cox suggested that we seriously look into the concepts of tsunami magnitude and intensity and their relevance for tsunami research.

Dr. L. S. Hwang suggested that support for tsunami research is dwindling and we should invite administrators from various agencies (who might be able to fund tsunami research) to participate in our symposia and visit tsunami research centers.

The question of publication of the revised Pacific Tsunami Catalogue was brought up. Dr. Cox mentioned that there is no point in publishing the catalogue in a hurry without adequately checking the accuracy of all the entries, and that checking is in progress.

It was noted that the sub-committee on numerical modeling of tsunami problems, headed by Dr. W. G. Van Dorn had not reported since its inception after the February 1974 meeting in Wellington.

The following resolutions were adopted:

1. Introduced by Dr. W. M. Adams

Subject to acceptance of the IOC, of the ITIC functions mandate to conduct tsunami surveys for large (2 meters) tsunamis, the IUGG Tsunami Committee recommends that the survey procedure be made as follows:

- (a) the team be chosen well in advance by a sub-committee reporting to the Director of ITIC
- (b) the team membership rotate
- (c) each team be composed of both experimental and theoretical members in order to broaden participation and capability
- (d) standard procedures - following the reports of previous teams be used in the field investigation
- (e) invitation for the tsunami inspection team be obtained in advance of the tsunami event and no team be sent uninvited
- (f) the existence of such a team should not reduce or prevent other investigations of any tsunami phenomena
- (g) the investigation should concentrate on the physical aspects of tsunamis and only extend to social and economic aspects as resources permit
- (h) the Director of ITIC request funding for the inspection team from those organizations likely to benefit directly or indirectly, immediately or ultimately from the findings of the investigation team.

2. Introduced by Dr. K. Iida

In the bathymetric surveys being conducted to provide basic data for possible tsunami studies on the subsidence or elevation, the accuracy should be at least one meter.

3. Introduced by Dr. L. S. Hwang

To outline the needs and establish the priorities in the field of tsunami research, a sub-committee should be appointed. Suggested members: Dr. L. S. Hwang, Dr. W. M. Adams, Dr. K. Kajiura and anyone else who expresses interest in joining.

4. Introduced by Dr. D. C. Cox

The committee recognizes the great importance of the tsunami research role performed by the JTRE since its establishment under the direction of the late Dr. Gaylord Miller, and hopes that the tsunami research effort in the USA should be continued at least at its present level.

5. Introduced by Dr. H. G. Loomis

The Tsunami Committee of the IUGG voted an expression of appreciation for the late Dr. Gaylord Miller's contributions, first as a member, then as a Vice-Chairman of the Committee and wishes to acknowledge also his scientific contributions to the field of tsunami research. The Committee expresses its sympathy to Mrs. Miller and family, on his death.

6. Introduced by Dr. T. S. Murty

The Committee expresses its gratitude on behalf of all the participants, to the Mexican hosts for providing us excellent facilities for holding the Symposium and contributing to its success. We thank especially Dr. S. Alvarez Borrego, General Director, Centro de Investigacion cientifico y educacion Superior de Ensenada, B.C., for providing us with the opportunity of holding the Symposium. We appreciate the various services rendered by the staff of Dr. Alvarez Borrego, and we thank the Mayor of Ensenada for the hospitality.

7. Introduced by Dr. T. S. Murty

All the participants to the Tsunami Symposium thank Dr. Soloviev for his best wishes to the Symposium and wish him a speedy recovery from his temporary illness.

NEWS EVENTS

Solomon Islands' Earthquakes of April 20-21, 1977

Beginning at 2313 UTC April 20, 1977, a series of moderate-to-severe earthquakes occurred in the vicinity of the Solomon Islands. Personnel at the Pacific Tsunami Warning Center in Honolulu, immediately responded to the seismic alarms, triggered by the earthquakes, and issued a tsunami watch following the largest tremor. After-shock activity in the area continued well into Thursday morning, Honolulu time,

according to reports from Mr. Joseph Zebro, one of the four geophysicists at the Pacific Tsunami Warning Center.

The two largest earthquakes in the series occurred at 2312 April 20 and 0424 April 21, UTC and had preliminary magnitudes of 7.1 and 7.5, respectively. The preliminary position of the magnitude 7.5 event, 11.1°S 160.7°E, placed it 60 nautical miles south of Guadalcanal, Solomon Islands. According to newspaper reports, some injuries and damage were reported in Guadalcanal.

Following the first event of 2313 UTC by approximately two hours, the tide gauge at Rabaul recorded a tsunami with a maximum amplitude of 7 cm, according to a report from CAA Operations, Port Moresby, Papua, New Guinea.

Honolulu Observatory cancelled their tsunami watch of 0538 UTC April 21, based upon negative wave reports from Suva, Fiji, and Kwajalein Island, indicating no destructive Pacific-wide tsunami was generated.

ITIC is presently investigating this event and has queried various authorities for information documenting this tsunami.

Tonga Trench Earthquakes

Two large earthquakes of magnitudes 7.2 and 7.0 occurred in the vicinity of the Tonga Trench on April 2, and June 22, respectively. Both earthquakes generated small tsunamis that were recorded by Pacific Tsunami Warning System tide monitoring gauges.

Following the magnitude 7.0 earthquake on June 22, reports from Pago Pago, American Samoa; Papeete, Tahiti; and Suva, Fiji; indicated tsunami wave heights of 18 cm, 12 cm, and 40 cm, respectively. ITIC is presently investigating these reports and the final summary will be forthcoming in the ITIC publication, Tsunami Reports.

The Pacific Tsunami Warning Center issued press releases for both events after determining there was no danger of a Pacific-wide tsunami.

Disaster Research

The Disaster Research Unit at University of Bradford, England, has been conducting studies to aid developing countries since 1973, and has published a number of works on predisaster planning and methods of coping with a variety of disasters. Faced with the need for major economies, the University has reluctantly decided not to fund the program beyond autumn of 1977. However, if alternate funding is obtained, the University of Bradford will be pleased to house personnel as members of the University, and give all possible indirect support to this program.

REPORTS FROM UNESCO/IOC UNITED NATIONS AND OTHER INTERNATIONAL ORGANIZATIONS

IOC Plans ITSU-VI Meeting

The Intergovernmental Oceanographic Commission has scheduled the sixth meeting of

the International Co-ordination Group for the Tsunami Warning System in the Pacific, (ITSU-VI) for February 20-25, 1978, to be held in Manila at the invitation of the Philippine Government. The agenda of this meeting will be published in a future newsletter.

ITSU meetings are held every 2 years, and give opportunity for representatives of Member States to be informed on the operation of ITIC, and to provide guidance and recommendations for the operation and improvement of the Tsunami Warning System.

Enquiries regarding participation in ITSU or in the Warning System, may be made to the Director ITIC, P.O. Box 3830, Honolulu, Hawaii 96812, or to the Secretary, IOC, UNESCO, 7 Place de Fontenoy, 75700 Paris, France.

International Council of Scientific Unions Holds XVI Assembly in Washington
(After Natural Resources and Energy, October 1976)

The International Council of Scientific Unions (ICSU) is an international, non-governmental organization of nearly a score of international, nongovernmental scientific groups and adhering national scientific institutions, chiefly academies and research councils, from 67 countries. An international coordinating and service body for science, it is avowedly non-political, but it is not removed from public issues involving science. In mid-October 1976 in Washington, D.C., ICSU's XVI General Assembly took these actions among others: renewed its invitation to scientists of the People's Republic of China to participate in ICSU; reiterated concern that rights of scientists to participate in the world scientific community not be impeded for political reasons; endorsed steps to bring science to bear more effectively in coping with the world's agricultural needs; and moved to establish a Scientific Committee on Genetic Experimentation, primarily to consider questions of possible risk in the conduct of genetic-engineering experiments.

The XVI General Assembly was hosted by ICSU's U.S. adherent, the National Academy of Sciences of the United States of America.

By resolution, the General Assembly expressed "eagerness to welcome into ICSU and the affiliated Unions, National Members representing the great scientific community of the People's Republic of China," and recommended that "the Scientific Unions of ICSU provide for adherence, through appropriate institutions, by scientific communities which effectively represent independent scientific activity in a definite territory provided they can be listed under a name that will avoid any misunderstanding about the territory represented." The General Assembly recommended that the International Union of Geological Sciences, which had excluded Taiwanese scientists from membership, "provide for participation in its work by the community of geologists in Taiwan." Harrison Brown, outgoing president of ICSU, explained that ICSU did not want to keep out one scientific community in order to admit another. The resolution calls upon ICSU unions to "adhere to the principle of the Universality of Science and not exclude from membership any community of scientists which effectively represents the scientific activity in a definite territory."

To succeed Harrison Brown as ICSU president the XVI General Assembly elected Bruno Straub, of the Institute of Biochemistry, Academy of Sciences, Budapest, Hungary. Cornelius de Jager, of the Astronomical Institute, Utrecht, Netherlands, succeeds Straub as ICSU's vice president. Terms are for two years.

REPORTS FROM INTERNATIONAL TSUNAMI INFORMATION CENTER - HONOLULU

Visiting Scientist Program

The visiting scientist program sponsored by IOC, which has brought tsunami researchers to ITIC from many parts of the Pacific, will bring a tsunami specialist from New Zealand in July.

Mr. Norman M. Ridgway, Scientist at the New Zealand Oceanographic Institute, in Wellington, is scheduled to arrive at Honolulu on July 24, and to be at ITIC for a 6-week period. Among the problems he is planning to investigate is the impact of tsunamis on the coast of New Zealand.

Visitors to ITIC

ITIC has been pleased to welcome a number of overseas visitors in the last 3 months, including: Mr. G. H. Tomczak, FAO, Rome; Dr. Kumizi Iida and Taniguchi Hitoshi, Aichi Institute of Technology, Nagoya, Japan; Mr. Robert Cunningham, San Mateo Civil Defense, California; Dr. Mario Manansala, Bureau of Coast & Geodetic Survey, Manila; Dr. Ronald N. Richmond, Mineral Resources Division, Suva, Fiji; and Mr. Tom Melham, National Geographic Society, Washington.

Historical Study of Tsunamis

The International Tsunami Information Center has initiated a comprehensive study of past recorded tsunamis, to include not only those already known, but also those that through size or remoteness may not have been recognized or identified as tsunamis at the time of their occurrence.

A list has been compiled and computerized of known or suspected tsunamigenic events, and earthquakes of a size and position that could possibly have produced a tsunami. This list comprises about 1600 events of the past century, and has been tabulated chronologically and by area of origin.

ITIC is seeking individuals and agencies who would be interested in carrying out a systematic study of the marigrams from one or several tide stations to determine which of the events produced tsunamis, and to compile information in a standardized format of arrival times and heights for initial and maximum waves for each registered tsunami. Listing of events which did not produce a tsunami at the station will also be a significant part of the study. Procedures followed will be an extension of those used in the paper "Tsunami Threat to Port Alberni," available on request from ITIC. Tidal characteristics of the station, and the effect of the site in determining its response to tsunamis will be essential information, often not previously reported.

The collected information from a selection of tidal stations will serve a number of purposes. Among these will be increased data for studying tsunami frequencies and magnitudes, and directionality of propagation; data for calibrating numerical models of tsunamis in the ocean, and travel time charts; information for estimating the vulnerability of the gauge sites and adjacent coasts to tsunamis from various sources; and data for estimating the time duration that a tsunami may remain hazardous.

The study will also provide one foundation for correlating the seismic signals of past earthquakes and their tsunamigenic potential, and from this, possibly a basis for estimating the tsunami threat of future earthquakes at the time of their occurrence. Each study would provide the basis for a research paper or papers that would publish the basic compiled information, and could include analysis and interpretation of the recorded tsunamis.

Persons interested in this study are invited to contact Sydney O. Wigen, Associate Director, ITIC.

EDITORIALS AND LETTERS

The following letter is one expression typical of the response and support ITIC is receiving from individuals and agencies throughout the Pacific in systematic collection of tsunami records.

George Pararas-Carayannis
Director, ITIC

Dear Sir:

In connection with your letter dated 28 March 1977, Event No. 1977-4, we are transmitting herewith the 12-hour period of tide gauge diagrams of our two stations, Legaspi and Davao which do not show evidence of tsunami.

We would like you to know that this Office appreciates very much the studies and investigations being made by ITIC regarding tsunami records and occurrences and we will do the best we can to cooperate on this particular field of research.

Yours truly,

Antonio P. Ventura, Capt.
Assistant Director
Bureau of Coast & Geodetic Survey
Manila, Philippines

TSUNAMI WARNING SYSTEM IN THE PACIFIC

U.S. Tsunami Warning Instrumentation

As part of a joint effort by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS), the Albuquerque Seismological Laboratory (ASL) of the U.S. Geological Survey designed and assembled two prototype systems to transmit tidal and seismic data via the National Environmental Satellite Services GOES satellite telemetry system. The effectiveness of the Pacific Tsunami Warning System will be greatly enhanced by the improved communications provided by the GOES satellite system. Additionally, tidal and seismic data can now be obtained from remotely located areas using satellite telemetry.

The Tsunami Tide and Seismic Prototype Systems were developed at the Albuquerque Seismological Laboratory during 1974. These prototype systems were developed to

prove the design concept for Tsunami-related tide and seismic data platforms that would work in conjunction with the GOES Satellite System to remotely interrogate distant stations. When the Tsunami Tide stations are interrogated, the units will transmit via the GOES Satellite System forty previously stored tide readings. When the Tsunami Seismic stations are interrogated, the units will transmit via the GOES Satellite System four previously stored, seismic "P" arrival time readings.

LT Dennis Sigrist, Assistant Tsunami Specialist, National Weather Service, recently had the opportunity to meet with Harold Clark, Chief Engineer, Albuquerque Seismological Laboratory and review the latest microprocessor techniques used in the Tsunami Seismic and Tide Systems.

LT Sigrist reported, "The Tsunami Seismic and Tide Systems are now in the third generation of development. The prototype systems incorporated wire wrap circuits using Transistor Transistor Logic (TTL) at an approximate cost of \$6,000 per interface unit. Second generation systems incorporated discrete boards, reduced size, and a cost of about \$4,000 per interface unit. The present tide system installed at WSO San Diego incorporates the latest in microprocessor technology. Component cost for the entire interface system is less than \$300, a twenty-fold reduction over the original system developed by ASL. Additionally, the present system is physically smaller, draws less power to operate, requires less labor to build, contains "off-the shelf" components, and uses the latest in Erasable/Programmable (EPROM) chip technology."

The interface units of both the seismic and tide systems are almost identical, the only major difference is in the software programming.

The U.S. National Weather Service has a new agreement with ASL for the manufacture of two additional Advanced Microprocessor Tsunami Seismic Systems. Later this summer these units will be installed in the field and operationally tested over the GOES Satellite System.

NATIONAL AND AREA REPORTS

Tsunami Instrumentation in Japan

The March ITIC Newsletter carried an account of the proposal to install seismic and tsunami sensors up to 200 km. off the coast of Japan. From Dr. Norio Yamakawa, Chief Seismologist of the Meteorological Research Institute, ITIC has received the following further technical details, particularly about the sensors.

Our project on the development of an ocean bottom seismograph observation system includes the development of a tsunami recording system as one of its main objects. The outline of the tsunami recording instrumentation, is as follows:

- 1) *Pressure variation at the sea bottom due to the tsunami wave is converted to frequency variation by a quartz oscillator which is indirectly exposed to the ambient bottom water.*
- 2) *Electrically converted signals of tsunami waves, as well as those of seismic waves, are modulated and transmitted through co-axial cable to the shore station.*

This kind of tsunami recording system has not yet been established in Japan, so our project to develop the system is useful not only for tsunami observation but also for other oceanographic studies. Accordingly, the developed tsunami recording system will require the following characteristics:

- 1) Stability for long term observation.
- 2) Smallness of noise generation due to circumferential variation including temperature variation.
- 3) Detectability, or resolving power, of 10 cm variation of water depth.
- 4) Quantitative measurability of 10 m variation of water depth.
- 5) Easy transmission of output signal.

Conventional water pressure transducers including vibrotron are unsuitable because of the following defects at the deep sea bottom where the ratio [pressure deviation/total pressure] is very small:

- 1) Instability for long term observation.
- 2) Poor signal/noise ratio due to thermal noise.

On the other hand, the Scripps Oceanographical Institute successfully applied quartz pressure transducers developed by Hewlett Packard to measurement of water pressure in deep water.

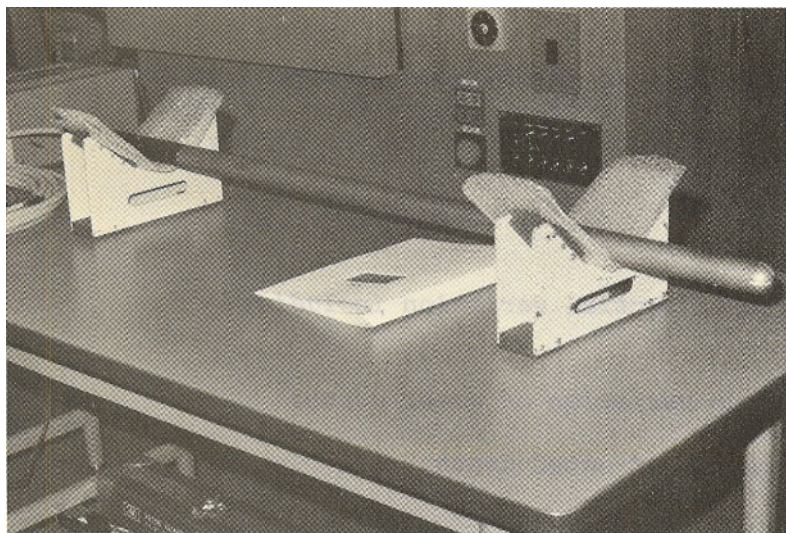
In view of these considerations, we tried to obtain all available information on transducers and related experiments. Then after careful consideration, we decided to adopt the Hewlett Packard transducer as the instrument to measure the tsunami wave and the elevation of water surface of the open sea. Because of the need for high reliability for the transducer, we added anti-corrosion equipment, made the instrument package waterproof and minimized the instrument temperature gradient effect.

Tests conducted during 1974-76 would meet the standards set forth above.

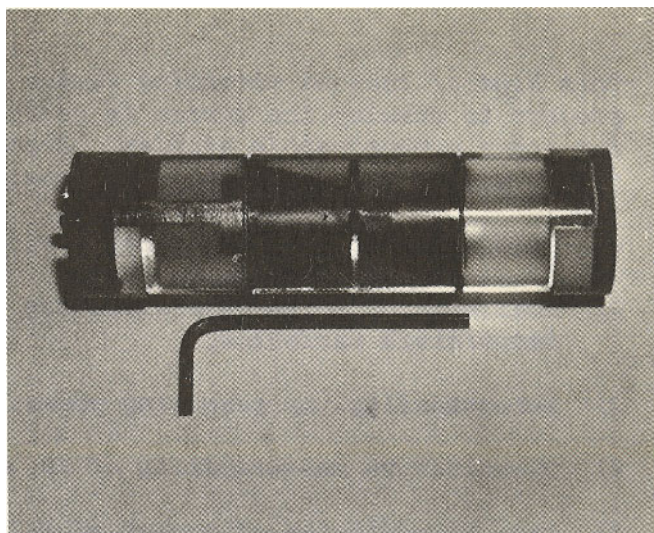
From the tests, we believe this quartz pressure transducer can record, under the background thermal noise, not only the tsunami wave, but if placed at the proper point, also the crustal upheavals of large earthquakes.

New Appointments at JMA

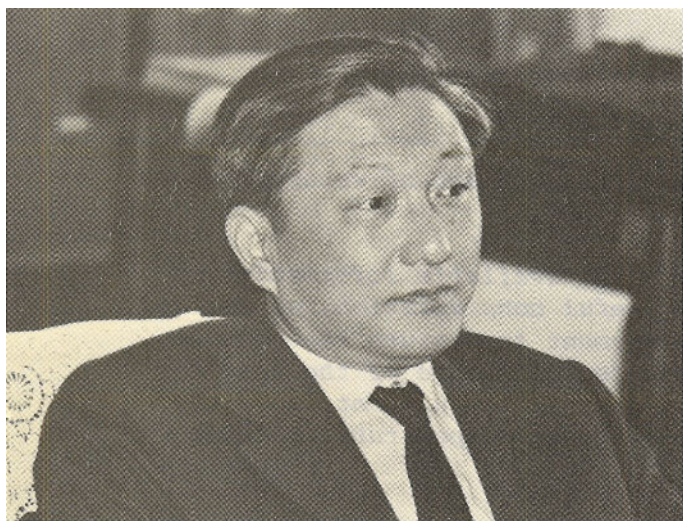
Dr. Shigeji Suyehiro, former chairman of ITSU (International Coordination Group for the Tsunami Warning System in the Pacific), has been appointed to a new post in Japan and he is now the Counselor of the Department of Observations, JMA. Dr. Hideo Watanabe succeeded him as Head of the Seismological Division, JMA. Dr. Watanabe is a tsunami specialist, who visited the ITIC some years ago.



Outerview of Tsunamimeter Without Protector



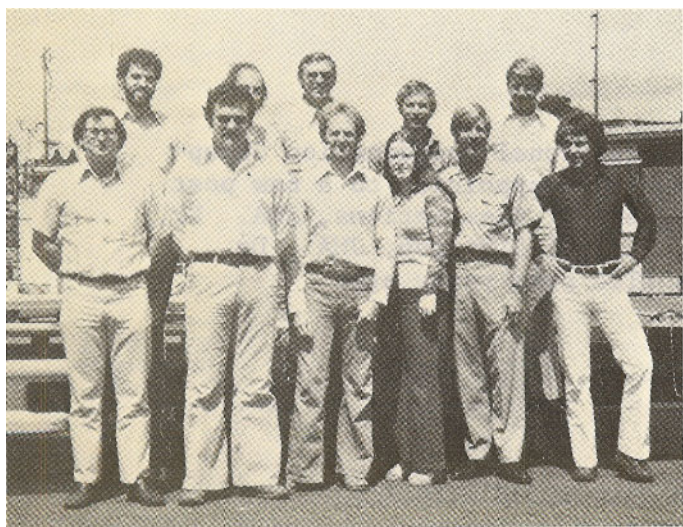
Quartz Pressure Transducer of Tsunamimeter



Dr. Shigeji Suyehiro
Counselor, Department of Observations, JMA



Dr. Hideo Watanabe
Head, Seismological Division, JMA



NOAA's Pacific Tide Party

Front Row (L-R) - Dave Jones, LT Greg Segur,
LT Garth Stroble, Laura Julian, LTJG Roger
Morris, and Ken Welker.

Back Row (L-R) - LT Dick Moore, Bill Miller,
Mickey Moss, LTJG James F. McGough, and
LT Dennis Sigrist.

Not Pictured - Ethel Mitchell

NOAA's Pacific Tide Party Holds Meeting

For the first time in over two years, the entire Pacific Tide Party was in one place at the same time. This rare occurrence prompted two and one-half days of meetings in their new office trailers at the Pacific Marine Center in Seattle, Washington.

The meetings provided an opportunity to discuss and standardize procedures and to document potential problem areas in the Pacific Tide programs.

The meetings were held May 24-26, with Tuesday the 24th proving to be a very effective day with the participation of LT Dennis J. Sigrist, Assistant Tsunami Specialist for the Pacific Regional Headquarters of the National Weather Service.

Ecuador Tsunami Preparations

The National Department of Civil Defense of Ecuador held a conference which included a session on tsunamis in the city of Guayaquil, February 15-17. Señor Pedro Rizzo Pastor, delegate of the Instituto Oceanográfico de la Armada (INOCAR), directed the session on tsunamis. The session provided information to the participants on the principal aspects of tsunamis, their nature, origin, frequency, propagation, history, and effects on the coast of Ecuador and the island region; and discussed the prevention, mitigation and rehabilitation in case of disasters.

A national tsunami warning system and its relation to the Pacific Tsunami Warning System was considered, as were responsibility for organization and communications needed in disseminating alerts and warnings to ports in the event of an expected tsunami.

USSR Report for 1976 on Tsunami Activities in the Far East

By V. M. Popov - National co-ordinator of the International Tsunami Warning Service, station in the Pacific Ocean.

1. No tsunamis were observed in the Far East in 1976.
2. For earthquakes with a magnitude greater than 6 occurring in the Kurile Kamchatka trench, tidal observations were taken at USSR tide stations.
3. In the absence of tsunamis, there was no need for using the communication channel -- South Sakhalinsk - Khabarovsk - Tokyo - and Honolulu.
4. On January 21, a communication was received from Honolulu requesting observations of sea level. At the same time two communications were received from Tokyo announcing a tsunami alert along the Pacific coast of Hokkaido, after which there was a cancellation of alert. During that period of time the Tsunami Service of the Far East conducted observations on sea level.

Altogether 28 information bulletins were received from Honolulu which gave information about the most powerful earthquakes and evaluation of their tsunamigenesis. Twenty-eight communications were tsunami dummy tests, sent for the purpose of checking communication response.

ABSTRACTS AND RESUMES

Papers Presented at Ensenada Tsunami Symposium

1. Harvey, R.R. Seismic results from the 1975 Soviet-American Tsunami expedition.
2. Abe, K. Determination of the fault model consistent with the tsunami generation of the 1964 Niigata earthquake.
3. Murty, T.S. and S.R. Durvasula. Tsunamis generated by landslides in eastern Canada.
4. Pararas-Carayannis, G. and S.O. Wigen. Philippines earthquake and tsunami of August 17, 1976.
5. Kajiura, K. Some remarks on the tsunami height prediction.
6. Iida, K. Tsunami distribution function in Chile.
7. Heath, R.A. The tsunamis generated by the earthquakes in the Kermadec region in late 1975 and early 1976.
8. Iida, K. On the tsunami magnitude and intensity.
9. Silgado, E. Recurrence of tsunamis in the western coast of South America.
10. Wigen, S.O. Tsunami threat to Port Alberni.
11. Pararas-Carayannis, G., S.O. Wigen and D. Sigrist. Hawaiian Islands tsunami of 1975.
12. Alexeev, A.S., V.K. Gusiakov, L.B. Chubarov and Y.I. Shokin. Numerical simulation of tsunami generation and propagation in the ocean with real bathymetry, nonlinear model.
13. Garcia, W.J. Simulation of tsunami generation by computer model.
14. Voyt, S.S., A.N. Lebedev and B.I. Sebekin. On one model of tsunami excitation by finite bottom motions.
15. Radok, R. Propagation of tides and tsunamis in the Pacific Ocean.
16. Preisendorfer, R.W. A transport formulation of the tsunami propagation problem.
17. Loomis, H.G. A tsunami prediction scheme using Green's functions.
18. Nakano, M. On the path of propagation of tsunami waves.
19. Doronin, Y.P., V.G. Buhteev and N.L. Plink presented by R.O. Reid. Mathematical modeling of tsunami propagation and transformation over the real bottom topography.

20. Lebedev, A.N. presented by S.S. Voyt. On the Kelvin type edge wave propagation in the variable Coriolis force field.
21. Spielvogel, L.Q. and M.A. Sklarz. Some important solutions to the Navier-Stokes equations.
22. Nishimura, H. On the accuracy of high order solutions of the Stokes and the cnoidal wave theories.
23. Shaw, R.P. Long waves obliquely incident on a continental slope and shelf with a partially reflecting coastline.
24. Cherkesov, L.V. and V.F. Ivanov presented by K. Kajiura. Effect of dispersion and nonlinearity on tsunami type waves.
25. Miyoshi, H. Two theories connected with warning, directivity and efficiency of tsunamis.
26. Brandsma, M., D. Divoky and L.S. Hwang. Circum-pacific variations of computed tsunami features.
27. Farreras, S.F. Resonant conditions of Concepcion Bay (Chile) under tsunami waves.
28. Bernard, E.N., A.C. Vastano and K.L. Olsen. Tsunami response at Wake Island: Comparison of observed and computed spectra.
29. Lyatkher, V.M. and A.N. Militeev. Abstract read by D.B. Rao. Estimation of tsunami wave transformation in a coastal zone.
30. Babiy, M.V., V.F. Ivanov and R.A. Yaroshenya. Abstract read by D.B. Rao. Some results of calculation of the bay amplification coefficient.
31. Odulo, A.B. and E.N. Pelinovsky presented by R.O. Reid. On evaluation of nonlinear topographic waves.
32. Rao, D.B. A numerical procedure for computing resonant periods of natural waterbodies.
33. Bernard, E.N. and A.C. Vastano. Numerical computation of tsunami response for island systems.
34. Jonsson, I.G., O. Skovgaard, O. Brink-Kjaer and I.A. Svendsen. A mild-slope wave equation and its applications to tsunami calculations.
35. Chen, M., D. Divoky and L.S. Hwang. Application of the three-dimensional Boussinesq type equations to tsunami modeling.
36. Lee, Y.K. and L.S. Hwang. Waves generated by horizontal oscillations in bays.
37. Pelinovsky, E.N. and T.G. Talinova. Change in the height of a solitary tsunami wave in a coastal zone.

38. Houston, J.R. Tsunami response of the Hawaiian Islands calculated by a finite element numerical model.
39. Camfield, F.E. An overview of tsunami-structure interaction.
40. Hulman, L.G., W.S. Bivins and M. Fliegel. Tsunami protection of coastal nuclear power plants in the United States.
41. Adams, W.M. Inter-relationship of instruments and police in the Hawaii Warning System.
42. Cox, D.C. Economic justification of tsunami research: A specific example based on reduction of false alarms in Hawaii.
43. Haas, J.E. Human response to the Tsunami Warning System.
44. Nakamura, S. A concept of tsunami economics.
45. Loomis, H.G. Socio-economic effects of the 1968 Flood Insurance Act in Hawaii.
46. Shinmoto, D.Y. and M.J. Vitousek presented by R.R. Harvey. An inexpensive air-deployable mid-ocean tsunami gauge.
47. Saxena, N.K. Improvement of tsunami prediction by marine geodetic techniques.
48. Larsen, J. Detection of Long period oceanic motion by electric field measurements.
49. Spaeth, M. Operation of the Tsunami Warning System in the Pacific.
50. Schank, R. Hazard reduction and the mitigation of tsunami effects through effective public warning in Hawaii.
51. Nakamura, S. An experiment on shoaling and run-up of long period waves on a gently sloped beach in a small water basin.

Propagation of Tsunamis from Sources off the Pacific Coast of Northeast Japan

Tokutaro Hatori
 Earthquake Research Institute
 University of Tokyo

Abstract: Refraction diagrams of representative historical tsunamis off the Pacific coast of northeast Japan are drawn to see distribution of tsunami effects along the coast. The source areas inferred from old documents and observations of the recent events are located from off east Hokkaido to Boso area at likely places along the Japan trench. The course dimensions, which are given in reference to the respective earthquake magnitude, fall in a range of 90-300 km in length. Distribution of coastal wave height in the historical tsunamis are compared with those of shoaling and refraction factors along the bathymetric line of 100m, which are calculated by use of Green's formula.

Events investigated include the tsunamis of 1611 at Keicho, 1677 at Enpo, and 1856 at Ansei.

Wave Source of the Hawaii Tsunami in 1975 and the Tsunami Behavior in Japan

Tokutaro Hatori
Earthquake Research Institute
University of Tokyo

Abstract: The Kalapana tsunami was generated off the south coast of Hawaii Island, accompanying the earthquake of magnitude $M=7.2$ (NOAA), at 14h 48m (GMT), Nov. 29, 1975. Some features of this tsunami are investigated on the basis of tide gauge records of NOAA and Japan, adding the reports of the US field investigation.

The tsunami magnitude has been calculated from heights observed at near and distant locations. Source dimensions and displacement are inferred, and the tsunami energy is calculated. According to statistical relation, the present tsunami is large compared with the earthquake magnitude.

Catalog of Tsunamis in the Hawaiian Islands

Dr. George Pararas-Carayannis, Director ITIC, and LT Jeffrey P. Calebaugh, NOAA Corps, National Geophysical and Solar-Terrestrial Data Center, Environmental Data Service, have completed an updated version of the Catalog of Tsunamis in the Hawaiian Islands. It has been published as a World Data Center-A for Solid Earth Geophysics report, similar to the Catalog of Tsunamis in Alaska, which was published last year. The work on the updated version of the Tsunami Catalog for the Hawaiian Islands was undertaken as a joint cooperating effort between the International Tsunami Information Center and the World Data Center-A Tsunami, which is located in Boulder, Colorado. That Tsunami Catalog for the Hawaiian Islands goes as far back as written records of Hawaii are available, 1819.

ANNOUNCEMENTS

International Symposium on Long Waves in the Ocean, June 6-8, 1978

This symposium, sponsored by the Canadian Department of Fisheries and the Environment has been scheduled to stimulate the exchange of information on current studies and practices in the field of long gravity waves in the ocean. Both the theoretical and practical aspects will be treated, including consideration of processes of generation, propagation and interaction, as well as methods of observation and analysis.

Six sessions are planned, and are tentatively titled:

- Tidal Theories
- Tidal Observations and Analyses
- Instrumentation
- Tsunami
- Storm Surge
- Continental Shelf Waves

For information or preliminary registration, write:

Organizing Committee
Long Wave Symposium
Marine Environmental Data Service
Department of Fisheries and Environment
Ottawa K1A 0H3, Canada

"Coastal Zone 78" Conference

"Coastal Zone 78," a multidisciplinary conference, has been scheduled for March 14-16, in San Francisco. The purpose of the conference is to provide an opportunity for scientists, engineers, and planners to discuss coastal zone management, beneficial use, protection, and development, and so contribute to a better understanding of the interrelationships between the environmental, socio-economic, engineering, and regulatory decisions involved.

For information write to the attention of Mr. Orville T. Magoon, Chairman, Waterways, Port, Coast and Ocean Technical Group, San Francisco Section, American Society of Civil Engineers, P.O. Box 26062, San Francisco, California 94126.

New Journal

Marine Geodesy, an International Journal of Ocean Surveys, Mapping, and Sensing is an interdisciplinary publication serving the sciences and technologies requiring precise measurement in the ocean. Areas of interest include topography and mapping, positioning and navigation, tsunamis, geoid determination, acoustic and space instrumentation. One aim of the journal is to promote problem oriented marine geodetic research, and some articles may be controversial. The editor plans to include papers on tsunamis regularly. For information on the journal, write Crane, Russak, and Co. Inc., 347 Madison Avenue, New York, N.Y., 10017. Subscription rate is \$40 per year; personal subscriptions may be obtained at half price.

PACIFIC TSUNAMI WARNING CENTER REPORTS

Honolulu Observatory Name Change

Effective July 1, 1977, Honolulu Observatory will be known as the Pacific Tsunami Warning Center (PTWC). According to CDR Eddie Bernard, Geophysicist-in-Charge, messages have been filed with local authorities, seismic observatories, tide monitoring stations, and dissemination points announcing this name change. Other than the new name, no operational changes will occur at the Center.

Seismic Summary (March 1 to Press Time)

<u>Event No.</u>	<u>Event</u>	<u>Location</u>	<u>Action Taken</u>
1977-3	Mar 4 1922 7.2	Northern Romania 45.8 N 26.7 E	No Action
1977-4	Mar 18 2144 7.0	Western coast, North Luzon Is., Philippines 19.2 N 119.3 E	Press Release Queried tide stations at Legaspi, Okinawa, Koror, Yap, Shimizu, Guam.
1977-5	Apr 2 0715 7.2	Tonga Trench, South of Samoa Is. 16.2 S 171.6 W	Press Release Queried tide stations at Pago Pago, Suva, Canton Is., Noumea, Marsden Pt., Kwajalein, John- ston Is.
1977-6	Apr 20 2313 6.5	Solomon Islands 9.5 S 160.4 E	Press Release
1977-7	Apr 20 2343 7.1	Solomon Islands 10.7 S 159.5 E	Press Release Queried tide stations at Truk, Suva, Kwajalein, Noumea, Apia, Legaspi.
1977-8	Apr 21 0424 7.5	Solomon Islands 11.1 S 160.7 E	Tsunami Watch, Watch Cancellat- tion, Queried tide stations at Truk, Suva, Kwajalein, Noumea, Apia, Legaspi.
1977-9	Jun 22 1208 7.0	Tonga Trench 20.9 S 177.4 W	Press Release