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AEES is a Technical Society of IEAust The Institution of Engineers Australia and is affiliated with IAEE

2/2001

AEES Newsletter

Contents

PRESIDENT'S PERAMBULATIONS

17 September 2001

I look forward to meeting many of you again (or for the first time) at the Annual Conference in Canberra in November. I have no doubt that the discussion on Earthquake Codes in the Real World will be informative and valuable.

At the AGM you will have the opportunity to elect a new Executive, since the present team will have completed a term of three years (the maximum permitted under our Constitution). A team from Adelaide is prepared to nominate.

I wrote to Emergency Management Australia in April to sound out the possibility of co-operating in the preparation of registers of engineers available for post-earthquake response. Responses were received from NSW, Victoria and ACT indicating no support for the proposal but advising that in each case there are arrangements in place to source engineers to assist with post-emergency aspects.

Three applications for the Research Scholarship were received and assessed by all members of the AEES National Committee. On the basis of this assessment, the Executive decided not to award a scholarship this year.

I was pleased to be able to write to the Queensland Premier congratulating him on the government's decision to continue earthquake monitoring in Queensland by entering into a contract with the Seismology Research Centre to upgrade and operate the state seismic monitoring network for the next five years. The collation of seismic information and its analysis from time to time cannot help but improve our ability to control earthquake damage.

Bill Boyce

AEES 2001 Conference and AGM

Earthquake Codes for Australia and the Region

Venue:	ADFA, Canberra
Date:	21-23 November 2001
Dinner:	Wednesday night Officers Mess at ADFA, (jacket and tie for males essential)
Special:	Thursday evening Champagne & nibbles reception at AGSO (casual dress ok)
Excursion:	Friday Earthquake Resistant Canberra Buildings & Structures and the Lake George Fault and ACT region Wine Industry

Organising Committee:
Kevin McCue, Charles Bubb, Gerhard Horoschun and Doug Finlayson

The Society

President - Bill Boyce (Brown & Root Qld)
Secretary - Russell Cuthbertson (SRC)
Treasurer - Colin Lynam (Qld Uni)

The state representatives are:

NSW	Michael Neville
Qld	Gary Huftile
Vic	John Wilson
Tas	Vagn Jensen
ACT	Gerhard Horoschun
SA	Mike Griffith
WA	Peter Gregson

IAEE National Delegate to 2004 is John Wilson (The University of Melbourne).

The AEES Webmaster is Vaughan Wesson (SRC).

Barbara Butler manages the Secretariat from The University of Melbourne.

The Society website/email list

Dear AEES Members,

The AEES web site is at www.aees.org.au where you can register for the November AEES conference in Canberra. Any contribution from you on the following topics is most welcome

- details of interesting recent publications
- significant research projects in earthquake engineering (in Australia?)
- links to other relevant Web sites

Please send me your contributions/suggestions via email

Cheers
Vaughan Wesson

The AEES email list is operated by the Seismology Research Centre, Melbourne. If you would like to register please notify Vaughan Wesson vaughan@seis.com.au

NUGGETS FROM THE NEWSGROUP - A Regular Feature By Charles Bubb

Lloyds website: Market Intelligence: A historic approach to earthquake underwriting.

'If history does not exactly repeat itself, it rhymes' is as pertinent to underwriters as to seismologists. As each new tremor echoes the last, Dr Gordon Woo of RMS believes underwriters in particular could benefit from a greater understanding of poetry in motion.

For any statesman hoping to make sense of fluctuating tensions in current affairs, a firm grasp of political history is prerequisite.

So too with seismic shifts, where an awareness of the nature and history of earthquakes is equally crucial - and can benefit far more than the relatively small group of scientists who study them. The insurance industry in general and underwriters in particular are a case in point.

While it is no great secret that earthquakes tend to occur in regions where they have occurred before, as the Bhuj earthquake in India on 26th January 2001 demonstrated, different faults may be activated on different occasions.

Not even the oldest senior citizens of Gujarat would have a recollection of their state being severely damaged by an earthquake. In fact, the 20th century record of seismicity in this corner of Peninsular India has been rather benign, with only an occasional moderate tremor to disturb the tranquillity of a region well distant from the main Himalayan tectonic plate boundary.

The 19th century was more eventful. On 16th June 1819, the Rann of Kutch was struck by a devastating earthquake, which killed several thousand people. Significant vertical uplift of the ground caused flooding and created a long natural dam - called the Allah Bund, or the Dam of God. But the geometry of this particular earthquake fault has never been fully resolved.

For geologists involved in mapping active faulting, the obscurity of fault geometry poses an awkward problem of interpretation. On the one hand, for those for whom seeing is believing, the lack of evidence may be superficially reassuring - if interpreted optimistically as the absence of a manifest earthquake threat. On the other hand, the wary will have concern over unknown subterranean faulting.

If all active faults were visible at the Earth's surface, or were readily detectable through geophysical surveying, people might sleep more safely in their homes: proximity to a mapped fault would be a direct measure of seismic danger. However, in the absence of a universal census of regional active faults, the possibility cannot be excluded of a major earthquake occurring in the neighbourhood of past seismic activity. The above-mentioned Bhuj earthquake is a tragic realisation of such a possibility. The fault that caused this earthquake remains still to be adequately delineated, but its location is only a few hundred kilometres from the Allah Bund.

The question for both scientist and underwriter becomes: how can one deal with the uncertainty over the geometry of seismic sources? The description of uncertainty is best couched in probabilistic terms, and new ways are being developed for quantifying this uncertainty for insurance applications. The starting point is the recognition that each historical earthquake is a tectonic episode that might be replicated, albeit in some perturbed guise, at some unforeseen time in the future.

Kernel modelling: studying the seeds of destruction
Despite historical precedents, the magnitude of a future earthquake may of course be somewhat larger or smaller, and its epicentre may be geographically displaced. Thus the Nisqually, Washington, earthquake of 28th February 2001 was epicentred in the same general area as the Olympia earthquake of 13th April 1949, but was three-tenths of a magnitude unit
smaller.

The elementary notion that any past event carries the basic seed for multiple recurrences lies at the heart of so-called kernel methods of modelling seismic activity. Although kernel is a mathematical term, it is far from being an abstraction: kernel methods have already been used in mapping seismic hazard by the United States Geological Survey, and their usage is increasing worldwide. The value of these methods

does of course depend on the availability of well researched historical earthquake catalogues containing information on past event sizes and locations.

Thankfully, extensive studies over the past decade have greatly improved the quality of these catalogues in most countries where there is an insurance interest.

In addition, a substantial volume of information about historical earthquakes is now accessible via the Internet and seismological literature. Such data should help diligent underwriters learn their earthquake history sufficiently well that, in the event of a major earthquake, they could find a close historical precedent.

Based upon the kernel method, any such precedent may be said to have spawned the new event. In the spawning process, earthquakes do not exactly repeat themselves: earthquake history rhymes. Underwriters should not ignore this simple yet salient feature of seismic activity.

Dr Gordon Woo is a risk consultant for RMS and the author of the book, The Mathematics of Natural Catastrophes, published by Imperial College Press.

Charles

SESISMIC MONITORING IN QUEENSLAND

The Seismology Research Centre (SRC) has recently won a contract to re-establish the Queensland state seismic monitoring network. The contract involves the re-establishment of existing sites, the upgrading of outdated equipment and the installation of several new sites over a three year period and the operation of the network and all data analysis for an additional two years. This long term contract comes after a protracted period of negotiations in which State Government funding for the operation of the regional network by the University of Queensland was discontinued. The contract was negotiated principally by the Department of State Development and will be managed by the Department of Main Roads. The five year guarantee of funding, which comes from a consortium of Queensland state government departments, ensures a period of stability in which a viable state network can be established and operated.

Existing SRC Kelunji Classic recorders of the Joint Urban Monitoring Program (JUMP) in the major urban population centres of Queensland (Gold Coast, Toowoomba, Brisbane, Rockhampton, Townsville and Cairns) will be refurbished and installed in permanent housings. Data from these installations will be accessible via dial-up modems.

Outdated smoked paper and digital cassette recorders previously used to monitor Sunwater dams will be updated to the SRC Kelunji D Series recorders. Equipment at some sites will be moved to dams that Sunwater consider should be monitored. The recorders at these sites will be accessible either via dial-up modems or via modems connected to the Internet.

Continuous data from at least five sites throughout the state will be transmitted in near real-time to allow for a basic alarm system for the state's emergency managers and dam operators. Seismically triggered information from additional sites will be regularly transmitted to further improve the alarm capability.

Information from the state network will be shared with other network operators (Australian Geological Survey Organisation, South East Queensland Water Corporation, University of Queensland) to improve reliability and increase data redundancy.

To manage the project, SRC have set up a regional office in Brisbane under the management of Russell Cuthbertson. This office will form an additional node in the large network of seismographs operated by SRC in Tasmania, Victoria, New South Wales and Queensland. The sharing of data between the SRC nodes will ensure a continued operation of an alarm service should any one node become inoperable in the event of an earthquake.

In addition to upgrading, re-establishing and operating the state network, the contract requires that the seismic data obtained be used for regular upgrading of hazard estimates which would subsequently be used in updating the earthquake loading code.

Russell Cuthbertson

Earthquakes in Australia ML≥3

January to June 2001

The following extract is from the AGSO database which includes data from Primary Industries and Resources SA, the Seismology Research Centre Victoria and Universities of Tasmania and Queensland.
No significant damage was reported in this period. Some readers may be surprised at the number of earthquakes in the six month period though the largest was only magnitude ML4.0. A magnitude 4 earthquake is about the expected long-term-average largest monthly earthquake.

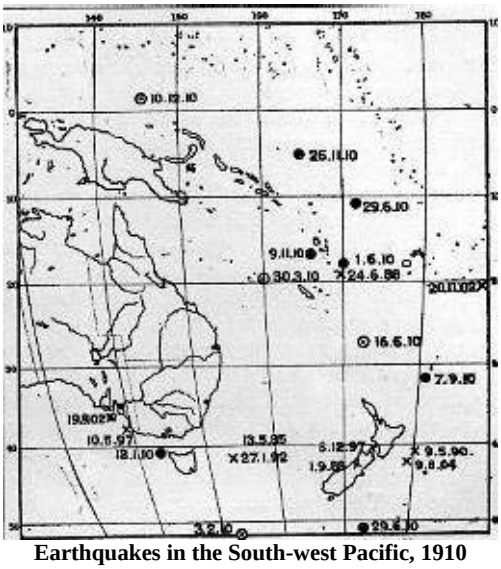
Remember though that a magnitude 6 or greater earthquake occurs somewhere in Australia every 5 years on average (there were 20 in the 20th century). The last was in August 1997, a magnitude 6.3 earthquake at Collier Bay in NW Western Australia, such an isolated area that little damage was reported.

Date	Time	Lat S	Long E	ML	Place
Jan					
1	234152	36.89	150.81	3.1	Tasman Sea*
4	212340	28.95	123.47	3.5	Lake Rason WA
14	230545	38.08	122.10	3.5	South of Australia
15	5548	37.91	122.34	3.6	South of Australia
19	24849	19.89	134.14	3.0	Tennant Creek NT
25	140650	18.35	126.45	3.3	Fitzroy Xing WA
Feb					
2	32201	20.92	122.41	3.1	Gt Sandy Desert WA
6	173219	19.84	133.95	3.4	Tennant Creek NT
27	10206	28.67	142.08	3.3	Cameron Corner Qld
Mar					
1	42100	41.26	151.49	3.3	Tasman Sea
2	85516	19.88	134.05	3.0	Tennant Creek NT
9	161002	28.60	142.00	3.2	Cameron Corner Qld
13	123530	33.91	147.22	3.2	West Wyalong NSW*
27	45847	32.55	122.38	3.3	Norseman area WA
29	185313	27.03	135.13	3.2	Oodnadatta SA
Apr					
1	84204	19.86	113.21	4.0	Exmouth Rise WA
4	51946	19.83	133.88	3.4	Tennant Creek NT*
4	141724	33.12	138.96	3.1	Peterborough SA*
9	133102	12.63	136.77	3.2	Caledon Bay, NT
12	72749	33.13	138.34	3.4	Pt Pirie SA*
12	81903	19.88	134.10	3.2	Tennant Creek NT
12	182233	25.73	137.54	3.4	Simpson Desert NT
12	201250	19.91	134.01	3.8	Tennant Creek NT*
12	223760	25.95	137.45	3.5	Simpson Desert NT.
16	52646	19.82	133.87	3.2	Tennant Creek, NT
18	44049	19.84	134.20	3.8	Tennant Creek, NT.
21	85625	19.83	127.32	3.4	Billiluna, WA.
25	233716	30.91	124.28	3.3	Lake Boonderoo WA.
29	195431	27.74	114.01	3.3	Kalbarri WA*
30	233850	24.50	113.07	3.4	Indian Ocean WA.
May					
2	13513	37.09	144.45	3.0	Near Bendigo Vic*
4	132232	19.75	133.93	3.2	Tennant Creek NT
9	21836	33.65	138.67	3.1	Clare SA*
9	23252	35.30	137.32	3.5	Investigator Str SA*
18	183702	34.29	148.78	3.2	Boorowa NSW
24	95138	12.15	122.64	3.2	Ashmore Reef
28	74314	26.50	131.68	3.0	Musgrave R SA
Jun					
3	65214	43.98	146.08	3.0	South of Tasmania
13	202758	34.89	149.48	3.2	Collector, NSW
14	120515	31.79	138.19	4.0	Hawker SA*
23	220208	21.98	112.86	3.8	Exmouth Rise WA
26	225610	20.17	119.49	3.0	Pt Headland WA*
28	140457	21.98	112.95	3.2	Exmouth Rise WA

* indicates the earthquake was reported felt, ML is Richter magnitude.

Missing Australian Earthquakes?

Seismologists, including the author, have often claimed that all magnitude 6+ earthquakes of the 20th century in Australia are known. After all, the first Milne seismograph of the original world network of seismographs was installed in Perth in 1901 and that should have provided the necessary coverage. By 1910 there were additional seismographs in Adelaide, Melbourne and Sydney. The Riverview seismograph, at Australia's longest running observatory, was installed in 1909.



Earthquakes in the South-west Pacific, 1910

When AGSO closed the Mundaring Geophysical Observatory in WA in 1999, their library was transferred to AGSO Canberra. In the collection was a paper published in 1912 in the Transactions of the NZ Institute by George Hogben which included the above map.

The great surprise was the 13 January 1910 earthquake off NW Tasmania; it was not mentioned in AGSO's database but it must have been large because it was located using the insensitive seismographs of the day. On the other hand, if large it should have been felt in Melbourne and throughout Tasmania if correctly located.

A check of the excellent RIV bulletins, #1 January 1910, showed that indeed there was an earthquake on that date, with P and S arrival times, ground motion amplitude and period, and the comment that its epicentral distance was 1100 km from Sydney. At this distance, the earthquake had to be intraplate. A check of newspapers in Melbourne and Hobart disappointingly unearthed no reports of the earthquake – a puzzle.

IGNS seismologist Gaye Downs responded to my query with a reading of the earthquake from the Christchurch station. Interestingly Hogben made a point in 1912 of thanking the observers of the Sydney, Adelaide, Perth and Christchurch stations for copies

of their records so history has been reversed. Many thanks Gaye. The reading was far too late to be a P wave (given the distance from Sydney). However assuming it was an S wave (the recorder was a horizontal instrument) we were able to do a 2-station computer location which placed the epicentre in the Tasman Sea northeast rather than northwest of Tasmania.

One of the two possible solutions was an epicentre at (44˚S, 155˚E) near a large seafloor volcano and a known active earthquake source zone. Interestingly this is near Hogben's location of the 1885 and 1892 earthquakes which were felt throughout Tasmania and are now thought to have been centred near Flinders Is (Ripper 1963, Michael-Leiba 1989). The last large earthquake Ms 5.8 under the guyot was in 1983. It was not felt in Australia either. This is the more plausible of the two possible epicentres, the other the mirror image about the line connecting Sydney and Christchurch.

The amplitude and period reading at RIV correspond to a magnitude of 6.0 so it was indeed a large earthquake.

It is surprising that the redoubtable Father Pigot, then Director of the Riverview Observatory, did not attempt to locate the epicentre, though he obviously recognised it as a regional event. Perhaps he was not concerned given there were no felt reports.

We conclude that Hogben's epicentre is not correct and that the premise that all magnitude 6 earthquakes in Australia since 1901 have been observed is still a reasonable proposition.

Kevin McCue

Clearance offer on Conference Proceedings

Barbara Butler still has copies of our early conference proceedings, more than she can store. We can't sell them quickly so will give them away! Proceedings are yours for the price of postage or collect at the Conference/AGM in Canberra: fax: 03 8344 4616 or b.butler@eng.unimelb.edu.au

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The AEES subscription year is the fiscal year. It is expensive to send each member an individual reminder that fees are due so please help us by sending your subscription for 2001/2002 to AEES if you haven't already done so (attn: Barbara Butler, Civil and Environmental Engineering Dept, Melbourne University Parkville Vic 3052) or renew through IEAust's annual subscription system by marking AEES your preferred Society. If you change address or if you know a member who is not receiving the newsletter please advise the Secretary or Barbara.

News

IAGA-IASPEI General Assembly
Hanoi, Vietnam, 19-31 August 2001

The IAGA-IASPEI Joint Assembly was held in Hanoi during August 2001. There were about ten participants from Australia, including Brian Kennett (current IASPEI President) and Malcolm Sambridge (ANU), Gary Gibson, Amy Brown and Trevor Allen (SRC), Trevor Jones and Charles Barton (Geoscience Australia).
This report covers three distinct parts:

1. A pre-assembly Workshop on Regional Seismological Cooperation.
2. The main Assembly, held over two weeks, with business meetings for all Commissions and Working Groups of IASPEI, and also a meeting of the International Seismological Centre.
3. A post-Assembly excursion along the Red River Fault system to the northwest of Vietnam to the border with China.

Pre-Assembly Workshop

The pre-assembly Workshop on Regional Seismological Cooperation was convened by Jens Havskov of the University of Bergen and Gary Gibson, and supported by IASPEI with funding of US$10,000.
The workshop was intended to give practical experience in exchange of seismological data for selected key seismologists from countries in the Asia-Pacific area. All were required to submit data for five selected earthquakes in January 2001 in standard formats before the workshop. Four seismologists from the Vietnam Institute of Geophysics were able to attend the workshop. There were also two participants from Thailand, Philippines, India, Russia and Iran, and one from China, Indonesia and Australia. The participants were helped by Jens Havskov and Lars Ottermoeller (the originator, and the recent developer of SEISAN), Gary Gibson and Trevor Allen (SRC).
The emphasis was on working with data, and each participant had a computer for personal use. The workshop was held in the Business School at the National University of Vietnam. All participants were experienced in digital seismograph analysis, although there were very few systems in common use. The only analysis system used by more than two of the nine participating countries was that provided by the GARNET system, although several had used elements of SEISAN.
The workshop was held in three main stages. The first was an introduction to the use of SEISAN, and the second was for the seismologists from each country to analyse the selected earthquakes using data from their own country alone. The final stage saw the participants re-group to concentrate on one particular event for each group, using all available data. The

latter analyses showed significant improvement over the analyses using single-country data.

One of the most interesting results was for the Mindanao earthquake in the Philippines. This was recorded by both short period seismometers and accelerometers on nearby stations. When these records were calibrated and all converted to displacement, velocity or acceleration, the resulting waveforms were very similar, with similar calibrated amplitudes.

All participants gave presentations about the state of seismology in their respective countries. Discussions were held regarding a data exchange to facilitate short-term communication between active earthquake observatories in the Asia-Pacific area. Recommendations were prepared for the Asian Seismological Commission meeting the following week, and the establishment of the data exchange was approved at that meeting.

The meeting emphasised the difficulty of data exchange when almost all regional observatories used different analysis systems and different file formats. The use of SEISAN as a common system was most successful and most participants were able to produce response curves from either parametric, or poles and zeroes information. As a result, most were able to estimate magnitudes on scales that they had not previously used (ML, mb, Ms and Mw).

IASPEI Assembly

IASPEI

The International Association of Seismology and Physics of the Earth's Interior (IASPEI) holds its Assembly at two-year interval

s. Most branches of earthquake seismology hold their meetings and major conferences at the Assembly. IASPEI is an International Association that forms part of the International Union of Geodesy and Geophysics (IUGG).

International Union of Geodesy and Geophysics (IUGG)

International Union of Geodesy and Geophysics (IUGG) is a non-governmental, scientific organization, established in 1919. IUGG is one of the 25 scientific Unions presently grouped within the International Council for Science (ICSU).

IUGG is dedicated to the international promotion and coordination of scientific studies of Earth (physical, chemical, and mathematical). These studies include the shape of the Earth, its gravitational and magnetic fields, the dynamics of the Earth as a whole and of its component parts, the Earth's internal structure, composition and tectonics, the generation of magmas, volcanism and rock formation, the hydrological cycle including snow and ice, all aspects of the oceans, the atmosphere, ionosphere, magnetosphere and solar-terrestrial relations, and analogous problems associated with the Moon and other planets.

IUGG holds General Assemblies at four-year intervals, and each of its Associations organize Scientific Assemblies as well as topical symposia in the intervening period between General Assemblies. IUGG is committed to the principle of free exchange of data and knowledge among nations, and encourages unreserved scientific participation by all peoples.

Revised IASPEI Structure, 2001

The IASPEI Bureau that was elected at the last IUGG Assembly in Birmingham during 1999 has devised a new structure for IASPEI. This structure was announced in late 2000 by the new President of IASPEI, Brian Kennett, and its implementation was commenced at the Hanoi Assembly.

Over the past few years, the Assembly program has developed a thematic approach, with eight major themes. The IASEPI Commission structure has been adapted to correspond with the Assembly themes. Each Commission will be responsible for the development of the relevant Assembly program. The new structure eliminates Sub-Commissions, and includes establishment of any specific Task Groups within Commissions.

The eight new IASPEI thematic Commissions include:

1. Earth Structure and Geodynamics
2. Tectonophysics
3. Physics and Chemistry of Earth Materials (IASPEI/IAVCEI).
4. Seismological Observation and Interpretation
5. Earthquake Sources - Prediction and Modelling
6. Earthquake Hazard, Risk and Strong Ground Motion
7. International Heat Flow Commission
8. Education and Outreach

Five additional Commissions are mainly based on regions rather than themes.

- European Seismological Commission (ESC)
- Asian Seismological Commission (ASC)
- International Commission on Earth Sciences in Africa (ICESA)
- International Ocean Network (ION)
- Federation of Digital Seismographic Networks (FDSN)

The new structure is much simpler than the old combination of commissions, sub-commissions, committees and working groups. There are now 13 IASPEI commissions, and all other working groups are associated with one of these.

IAGA-IASPEI Joint Scientific Assembly, Hanoi, August 2001

The Assembly was held over eight days from Tuesday August 21 to Thursday August 30, 2001. It was held at the International Convention Centre, located in

central Hanoi. The venue was strongly air-conditioned, providing a contrast with the outside weather conditions of 35°C and 90% humidity that are characteristic of Hanoi at this time of the year.
About 850 people attended the Assembly, most for both weeks. This was a little below normal, mainly because of the limited number of local Vietnamese participants. About 800 of the participants were from overseas, and 50 from Vietnam.
Three keynote lectures were given:

T. Yagi, Developments of Laboratory High Pressure Experiments and the Structure of the Earth's Deep Interior

G. Suarez, Verification System of the Comprehensive Nuclear Test Ban Treaty

D. Gubbins, Thermal Core-Mantle Interactions: Theory and Observation

At most times during the Assembly these were three or four parallel sessions running in earthquake seismology. Most participants found it difficult to schedule enough time for poster presentations, and this area was often busy during lunch periods and after the afternoon session papers were concluded.
The organisation by the Local Organising Committee in Vietnam was excellent, both prior to the Assembly and during the Assembly. The web-based registration and hotel booking worked well, and visas were pre-arranged. Internet and money-changing facilities were provided at the venue. There were only a few minor problems relating to scheduling, the duration of poster sessions, and a couple of projector faults. The Accompanying Persons program was excellent-regarded as unsurpassed by experienced Accompanying Persons. The associated cultural program was also excellent, including lunchtime lectures by university historians and other academics.

International Seismological Centre (ISC)

The ISC is not part of IASPEI or IUGG, but it holds a meeting of its Governing Council at IASPEI and IUGG Assemblies every two years.
The ISC is a non-government organisation charged with the final collection, analysis and publication of standard earthquake information from all over the world. The Centre's main task is to redetermine earthquake locations making use of all available information, and to search for new earthquakes, previously unidentified by individual agencies.
Earthquake readings are received from almost 3,000 seismograph stations throughout the earth. The office of the ISC is at Thatcham, west of London in England, and a staff of about eight people process the data and maintain the database. The Director of the ISC is Ray Willemann, and the Senior Seismologist is Dmitry Storchak.
The ISC meeting in Hanoi was held on Monday, August 20, the day before the opening of the IASPEI Assembly. During this meeting, the Chairman of the ISC Executive, Jens Havskov, reached the end of his appointment. Chris Browitt from the British Geological Survey was elected as the new Chairman, and Gary Gibson was elected to the Executive.

Post-Assembly Excursion

A post-Assembly tour was held along the Red River Fault in northwest Vietnam. This is a major fault, of similar dimension to the San Andreas Fault in California, associated with the plate collision of India with Asia. Tens of kilometres of left-lateral motion have been followed in the past few million years by kilometres of right-lateral movement. The main fault and a series of sub-parallel smaller faults also show considerable dip-slip movement.
Together with erosion effects, the faults are marked by topographic relief exceeding a kilometre in the northwest, and hundreds of metres in north-central Vietnam. The fault passes into the Red River delta, with alluvial sediments removing any topographic relief, passing close to Hanoi. While there is little doubt that the activity is greatest in the northwest and reduces to the southeast, its presence provides a potential hazard for Hanoi.
Slip rates based on geology are the order of 1 to 5 mm per year (or 1 to 5 km per million years). Although there were two earthquakes exceeding magnitude 6 in the north of Vietnam last century, neither of these was on the Red River Fault. There is some historical evidence of a major earthquake in the Hanoi area. The slip rate implied by recent seismicity is at least two orders of magnitude less than that seen in geological evidence over the past few million years.
This major discrepancy must be resolved to allow reliable earthquake hazard estimates for Vietnam, and to allow development of appropriate building code standards. The seismicity in the central and southern part of the country is low by any standards.

Gary Gibson

Recent Large Regional Earthquakes

InfoBeat - Japan coping after earthquake
March 24, 2001 Hiroshima, Japan, Mw 6.8

By CHIKAKO MOGI
Associated Press Writer
KURE, Japan (AP) - Aftershocks rattled southwestern Japan on Monday as residents began picking up the pieces following a powerful earthquake that killed two people and damaged the region's infrastructure.

The magnitude 6.4 temblor struck southwestern Japan on Saturday afternoon, collapsing buildings, snapping power lines and severing water mains. The quake shook windows as far away as South Korea.

The strongest of 22 aftershocks to shake the region was a magnitude 5.2 earthquake that struck at 5:41

a.m., the Meteorological Agency said. Koji Fujimoto, a spokesman for the police in Hiroshima state, said Monday that there were some reports of small cracks on roads, but no other damage or injuries were reported after the latest quake.

Monday's aftershock was centered about 31 miles under the seabed off the southern coast of Hiroshima state, very close to the epicenter of Saturday's quake and the smaller aftershocks. A magnitude 4.7 tremor Sunday night was strong enough to disrupt high-speed train service. Railway officials found no damage on tracks Monday, but bullet trains were running at a reduced speed in the affected area.

Hiroshima, 430 miles southwest of Tokyo, was the hardest hit of seven southwestern states that recorded heavy seismic activity in Saturday's earthquake.
The quake's toll stood at two dead and 174 injured. An
80-year-old woman died in the town of Kure when she was buried under rubble. In nearby Ehime state, a 50-year-old woman fleeing her home was killed by falling roof tiles.

A total of 7122 buildings in southwestern Japan sustained some damage, the Home Affairs Ministry in Tokyo said. The quake littered streets with roof tiles and window shards. About 120 people living in and around the bustling city of Hiroshima had to leave damaged homes, said Masayoshi Yatsu, a spokesman for the government's disaster prevention office. The economic impact to Hiroshima industries was estimated at around $2.8 million.

In Kure, a town of old-fashioned wooden houses and narrow winding streets about 12 miles south of Hiroshima, residents cleared away rubble to let cars pass and lined up outside relief centers for water and vinyl sheets to patch broken roofs. About 10,000 homes remained without water Sunday.

``I've never been so scared in my life," said Kure resident Hatsue Michinaka, 84, said as she swept up debris from a collapsed wall. Japan is one of the world's most earthquake-prone countries. It straddles three tectonic plates, the huge slabs of land that cover the surface of the Earth.

Saturday's quake was centered off the coast of Japan and relatively deep under the sea, some 40 miles below ground, which may have softened its impact.

In October, a magnitude 7.3 earthquake struck a largely rural area in Tottori state, northwest of Hiroshima. No one was killed but at least 120 people were injured and some 2000 homes damaged. Some 6000 people died when an earthquake devastated the western Japan port city of Kobe in 1995.

June 23, 2001 Near Coast of Peru, Mw8.4
At least 95 people were killed, 1500 injured and there was extensive damage in the Arequipa-Camana-Tacna area. An additional 20 people died and 55 are missing following a tsunami in the Camana-Chala area.

Landslides blocked highways in the epicentral area. Many historical buildings in Arequipa were damaged or destroyed. Some people were injured and damage was reported in the Arica, Chile area. Shaking was felt strongly in much of southern Peru and northern Chile. It was also felt in Bolivia.

A tsunami was generated with recorded wave heights (peak-to-trough) from selected tide stations: 2.5m at Arica; 1.5m at Iquique; 1.0m at Coquimbo, Chile. It was barley recorded on SE Australian tide gauges. The earthquake occurred at the boundary between the Nazca and South American tectonic plates.

The two plates are converging at a rate of about 78mm per year. The earthquake occurred as thrust-faulting on the interface between the two plates, with the South American plate up and seaward over the Nazca plate. Southwestern Peru has a history of very large earthquakes. The June 23 shock originated just southeast of the source of a magnitude 7.7 earthquake that occurred in 1996, and it appears to have involved rupture of part of the plate-boundary segment that produced an earthquake of magnitude approximately 9.0 in 1868.

The 1868 earthquake was destructive in towns that were heavily damaged in the June 23 earthquake. The 1868 earthquake produced a tsunami that killed hundreds of people along the South American coast. The 1868 tsunami also caused damage in Hawaii and alarm in Japan. Complex event. The initial onset consists of two events separated by about 6 seconds. It is followed by at least one larger complex event occurring about 40 seconds later.

FORTHCOMING CONFERENCES

•21-23 November 2001 AEES 2001 Conference and AGM ***Earthquake Codes for Australia and the Region*** ADFA, Canberra. (see insert).

•5 - 7 December 2001 8th East Asia-Pacific Conference on Structural Engineering and Construction, Nanyang Technological University, Singapore.
•28 April - 1 May 2002 3rd National Seismic Conference and Workshop on Bridges and Highways http://mceer.buffalo.edu
•21 - 25 July 2002 7th US National Conference on Earthquake Engineering, Boston USA.
• 9 - 13 September 2002 The 12th European Conference on Earthquake Engineering Barbican Centre London.

•16 - 19 September 2002 3rd International Conference on Continental Earthquakes. www.icce.ac.cn

NEW BOOKS (& OLD) / REPORTS

Australian Seismological Report - 1997 AGSO Sales Centre ph: 02 6249 9519, fax: 02 6249 9982

Caught in the Crunch - Earthquakes and Volcanoes in New Zealand 1999 by Rebecca Ansell and John Taber. Harper Collins NZ.

Photo: Participants in the pre-Assembly Workshop on Regional Seismological Cooperation (000127F3)

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AEES CONFERENCE - 2001
Optional Technical Tour - Bus

Friday 23 November

Depart 09:00	Olims Hotel
09:10 - 11:30	Australian Museum
12:00 - 13:00	Lake George Fault - Dan Clarke
13:00 - 15:00	Bungendore
16:00	Canberra Airport
16:30	City

AEES CONFERENCE - 2001
Programme (Draft)

Wednesday 21 November

08:30 - 10:00	Registration	Barbara Butler
09:00 - 09:05	Program Notes	Organising Committee
09:05 - 09:15	**Welcome**	Assoc. Prof. Stephen Yeomans, ADFA
09:15 - 10:00	**Theme**	**Dr George Walker, AON Reinsurance**
10:00 - 10:30	*Morning Tea / Posters*	
10:30 - 12:00	**SESSION 1**	**(Chair Bill Boyce)** Dr Jim Beavers, USA Dr John Wilson, University of Melbourne
12:00 - 13:30	*Lunch / Posters*	
13:30 - 15:00	**SESSION 2a**	**(Chair Kevin McCue)** Andrew King, BRANZ Dr Graham Shorten, SOPAC Dr. Emad Gad, University of Melbourne
15:00 - 15:30	*Afternoon Tea / Posters*	
15:30 - 17:00	**SESSION 2b**	**(Chair John Wilson)** Gary Gibson, Seismology Research Centre Dr Cvetan Sinadinovski, AGSO Dr Nelson Lam, University of Melbourne
17:15 - 17:45	**AEES AGM**	
18:45 -	**CONFERENCE DINNER**	ADFA Officers Mess

Thursday 22 November

08:30 - 10:00	Registration	Barbara Butler
09:00 - 09:05	Program Notes	Organising Committee
09:05 - 10:00	**SESSION 3a**	**(Chair Doug Finlayson)** Athol Yates, Inst. of Engineers, Aust. Dan Clarke, AGSO
10:00 - 10:30	*Morning Tea / Posters*	
10:30 - 12:00	**SESSION 3b**	**(Chair Dr George Walker)** David Brunsdon, Spencer Holmes, NZ John Prabaharan, Curtin University Tuan Ngo, University of Melbourne
12:00 - 13:30	*Lunch / Posters*	
13:30 - 15:00	**SESSION 4a**	**(Chair Gary Gibson)** Dr John Schneider, AGSO David Stewart, AGSO John Stehle, AGSO
15:00 - 15:30	*Afternoon Tea / Posters*	
15:30 - 17:00	**SESSION 4b**	**(Chair Russell Cuthbertson)** Trevor Dhu, AGSO Michael Neville, NSW Public Works Trevor Jones, AGSO Michael Turnbull, University of Central Qld
18:45 -	**Champagne Reception**	AGSO