走向世界

——寄语21世纪的中国地震工作者

国家地震局人事教育司

地震出版社

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内 容 简 介

青年是未来的希望，青年科技人才的成长离不开中老年科学家的“传、帮、带”。本书收集了二十余篇由知名地震科学家和科技管理专家撰写的专题报告，作者们结合自己的科研工作实践和成长经历，展望了21世纪的地震科学，介绍了科学研究的方法和经验，以及做一个合格的科学工作者所必备的修养和训练。本书可供地震科学工作者参考，也适合地球科学方面的大学生、研究生、专业技术人员、科技管理人员阅读。

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纪人才！

陈章亮

一九九八、三、六

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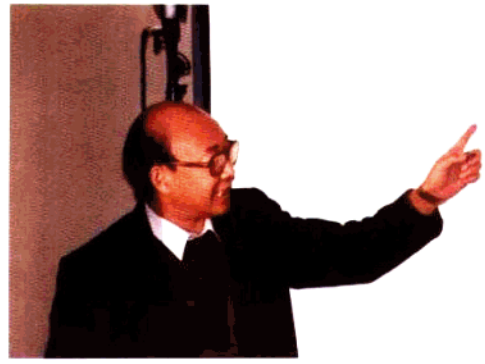

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序

1997 年夏，局人事教育司邀请局系统部分两院院士、中老年科学家、青年科学家，在黄金海岸举办了一次《走向世界》专题培训班，旨在充分发挥中老年科学家的“传、帮、带”作用，向青年科学家传授科研工作经验，帮助青年科学家进一步提高科研素质和国际竞争能力，带领青年科学家攀登科学高峰，走向世界。在培训中，老科学家结合自己的成才实践，讨论了科技人才成长的规律，科技人才应具备的素质和科技人才成长过程中应注意的问题，句句都是肺腑之言，语重心长。青年科学家也深深地被老科学家热爱科学、淡泊名利、造福人类的高尚品德，实事求是、谦虚谨慎、善于团结协作的优良作风，不畏艰险、百折不挠、勇于探索的大无畏精神所感动。培训班架起了老科学家与青年科学家的连心桥，迈出了“传、帮、带”的第一步。

科学技术的发展是无止境的，而一个人的生命是有限的，任何一个科学家都希望自己毕生为之奋斗的科研事业一代一代传下去，一代更比一代强。英国剑桥大学卡文迪什实验室主任、世界著名科学家、1906 年诺贝尔物理奖获得者汤姆逊（1856～1940）培养了许多出类拔萃的科学家，其中卢瑟福等 9 人先后获得诺贝尔物理奖和化学奖。1919 年，卢瑟福接替汤姆逊任卡文迪什实验室主任，也培养了一大批科学家，其中 11 人获得了诺贝尔奖。我国著名科学家庄圻泰教授，悉心指导青年数学家杨乐、张广厚研究函数值分布理论，有一次曾为他们二十几页的论文写出长达十几页的指导意见。这种乐育人才的精神，在科技界曾传为佳话。正是由于庄圻泰教授的悉心指导，才使他们成长为当时最年轻的学部委员。

科技人才在成长的过程中，争取名师指点，好比是在错综复杂的崎岖山道上找到一条平直的短程线。名师是饱含知识的“海绵体”，求教于名师会使自己吸吮到充足的知识乳汁；名师是科研道路上历经坎坷而终获成功的佼佼者，求教于名师会使自己攀登科技高峰的努力事半功倍。1931 年诺贝尔医学奖获得者德国学者奥托·沃伯格说过：“一个年轻科学家一生中最重要的事情是跟他那个时代的医学巨匠进行个人接触。”据统计，美国诺贝尔奖获得者，一半以上的人曾师承前辈诺贝尔奖获得者。这些经过获奖者指点的人，一般又比其他人获奖时间提前 7 年。我国现有两院院士 1049 名，其中师承国内外著名科学家的占多数。

本书收集了《走向世界》专题培训班上中老年科学家和科技管理专家的全部发言材料。本文集不是科技论文集，但她是关于论文的论文集；不是人才学著述，但她似关于人才成长的配乐 VCD 影碟；不是名人传记，但她似名人传记文摘，相信读后，一定能让你受益匪浅。本文集的作者们不似远在天边的牛顿、麦克斯韦、爱因斯坦，他是近在身边的导师、“一个战壕的战友”，相信读后，一定让你感到无限的新鲜、振奋和感慨，领悟到什么叫平凡中蕴育着的伟大。

岳昭生

1997 年 10 月

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展望 21 世纪的地震科学

The State-of-the-Art of Earthquake Disaster Prevention and Reduction in the World

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1 Preface

The Earth, where the mankind live, provides a proper environment for our residence and multiplication, and also provides great variety of resources for the social improvement and development. On the other hand, however, many natural disasters frequently occurred on the Earth, seriously threatening the human existence and social progress. Earthquake is one of the most serious natural disasters.

Earthquakes are mainly concentrated along the two major seismic zones in the world, they are, the Circum-Pacific Seismic Zone and the Eurasian Seismic Zone (or Mediterranean-Himalayan Seimic Zone). The earthquakes are frequently occurred in those countries and regions located along the two large seismic zones. According to the statistics, there are at least 35 countries and regions which are facing the threat of destructive earthquakes, and there are on average about 18 earthquakes with magnitude over 7 occurred every year in the world and most of those earthquakes occurred in those earthquake-prone countries, such as Japan, China, USA, Turkey, Iran, the Philippines, Italy, Greece, Kazakstan, India, Indonesia, Mexico, Chile and othres. Those earthquakes often caused a great deal of casualties and economic losses.

According to the statistics, during the period of 1900 to 1980 there occurred 98 earthquakes with magnitude over 8 (with poorer accuracy), about 1.2 times per year. In addition, according to the catalogue of strong earthquakes from 1980 to 1993, there occurred 18 earthquakes with magnitude over 7.5, about 1.2 times per year. Of course, the magnitude is lower than that of the previous period.

According to the statistics made by Prof. Zhao Rongguo from the Institute of Geophysics, SSB in 1996, the death toll caused by earthquakes is 6.4 million people on average (6.25～6.56 million people) in the whole world from 1 AD to 1995; And the average death-toll per year is about 3200 people. And in China the death toll is 2.35 million people (2.3～2.4 million people), and the average about 1200 people.

In the past several decades, with the acceleration of urbanization process and increase of the urban population and city properties, the tremendous casualities and economic losses were caused by destructive earthquakes occurred in urban areas.

The above-mentioned facts demonstrate that seismicity is a serious threat to the progress and development of the mankind society. So, in the programme of IDNDR under the organization of UN, one of the important contents is to minimize the earthquake disaster to a maximum extent.

2 Common Ways to Earthquake Disaster Prevention and Reduction

The serious earthquake disaster is directly caused by the destruction and collapse of buildings, including personal casualty and injury as well as destruction of productive facilities and infrastructures. The experience of mankind' s struggle against the earthquake disaster shows that there are two ways through which people may mitigate the earthquake disaster effectively. One way is earthquake prediction. Before a strong earthquake occurs, people can get pre-warning and then escape form dangerous buildings and withdraw valuables from houses and turn off those vulnerable facilities in motion (such as running trains and cars, nuclear power plants in operation) or release reservoirs' water. So we can reduce losses effectively even though a strong earthquake does occur. This is the way to achieve the goal of earthquake disaster prevention and reduction through earthquake prediction. The other way is anti-seismic fortification according to a certain intensity for buildings to resist the earthquakes (for example, according to the seismic intensity zonation map or assessment of seismic risk) to make buildings have the anti-seismic ability and remain undamaged under action of a certain intensity. This is the way to achieve the goal of earthquake disaster prevention and reduction through anti-seismic engineering. From the facts we know

now, these two ways are effective for reducing earthquake disaster, but there are still some unsolved problems.

2.1 *Earthquake Prediction*

Earthquake prediction can acquire actual effect in seismic disaster reduction. Though the progress in earthquake prediction has been very slow since the Haicheng earthquake with magnitude 7.3 in China in February 5, 1975, we have several successful attempts, including some imminent predictions, for instance, Menglian earthquake with magnitude 7.3 at the border of China and Myanmar in July 12, 1995, the Baiyu earthquake with magnitude 6.5 in Sichuan in 1996, and the Jiashi two strong aftershocks in March, 1997 in Xinjiang region. In the world, according to the reports, the Greek seismologists (VAN group) have used the method of terrestrial electricity to make several successful predictions of the moderate–strong earthquakes. Taking the Menglian earthquake as example, the risk possibility of moderate–strong earthquake with magnitude 6～7 was pointed out by Seismological Bureau of Yunnan Province at the beginning of 1995, and this risk possibility was proved three months later. An earthquake with magnitude 5.5 occurred near Menglian in May 30, 1995, then a possibility of another earthquake with magnitude over 6 was pointed out by specialists of the provincial bureau based on local feature of seismic activity. When an earthquake with magnitude 6.5 occurred in Menglian on 10 July, the provincial bureau immediately sent an expert group to the site and through careful analysis they pointed out that this shock wasn' t the main earthquake corresponding to that earthquake with magnitude 5.5 and another stronger earthquake may occur in the coming days. They reported the predictive suggestion to the local government, and the local government paid great attention to it and immediately organized more than 20 working teams and evacuated residents from dangerous houses and students from the dormitories. When the strong earthquake with magnitude 7.2 occurred in the morning on 12 July, only 11 people died and a little more than one hundred people injured. This should be attributed to the measures efficiently taken in time. In March of this year, when two strong aftershocks with magnitude 6.4 and 6.5 occurred in Jiashi, Xinjiang Uygur Autonomous Region, the casualty was zero since the imminent prediction was made and measures were rapidly taken by the local government. However, the prediction has not been solved yet in science. The earthquake prediction, especially the imminent prediction of most strong

earthquakes hadn' t been made, such as the Tangshan earthquake and several current strong earthquakes (the Lijiang, Baotou earthquakes and others). At present, we can only make prediction to a certain extent for a special type of earthquakes under a special condition. So at the present stage it is non–scientific and unpracticable to lay the base of earthquake disaster prevention and reduction only on the earthquake monitoring and prediction. We can say, we' ll continually work hard, research and practice, and do our best to find out the definite precursors, then give a warning before a strong earthquake occurs, especially in some important areas for preventing and monitoring. But we cannot make imminent prediction surely and accurately at the moment.

2.2 *Anti–seismic Engineering*

Anti–seismic fortification of engineering and buildings is also an effective way to prevent buildings from damage and destruction when a strong earthquake occurs. According to the investigation, over 95 percent of those buildings built in accordance with the anti–seismic construction code revised in 1981 remained undamaged after the Kobe earthquake in November 17, 1995; A few villages were rebuilt based on requirement of earthquake intensity 7 utilized the loan of the World Bank in the area of the Datong–Yanggao earthquake with magnitude of 5.9 in December 1989; three years later an earthquake with the similar intensity occurred again, as a result, those houses built in accordance with the required standard remained undamaged. All these facts show that anti–seismic fortification of buildings is effective, but anti–seismic engineering needs economic strength. Now the situation in the world is that quite a few earthquake–prone countries are developing countries belonging to the Third World and have large population and their economic force is weak, For example, 41 percent of Chinese territory are located in zones of earthquake intensity 7 and over. So, from the current economic strength, we can only build the important engineering and life–line engineering and others on the basis of the anti–seismic construction code, and it is hard to build the general industrial and civil buildings, especially the resident buildings all in accordance with the anti–seismic fortification standard for the time being. So, we cannot place all the hope of earthquake disaster prevention and reduction on the anti–seismic fortification of engineering and buildings.

The main content of anti–seismic engineering now is anti–seismic structure, at the mean time, scientists are also researching the technique of base isolation. In

this aspect, the better progress is achieved in USA and New Zealand etc. But to adopt this technique needs relatively higher investment , only those important buildings can be built using this technique at the present stage.

Based on these two situations, the way to comprehensively prevent and mitigate the earthquake disaster at the moment is adopted by most earthquake–prone countries in the world, of course, the importance of the method varies with different situation in different countries.

3 Brief Introduction to Earthquake Disaster Prevention and Reduction in the World

(1) UNDDSMS (UN Department of Development and Support Management Survice) put forward a project of " Integration of Public Administration and Science of Disaster" through a lot of investigation and studies for several years. DDSMS emphasizes that when science and technique of disaster prevention develops and is applied, only through public administration can it get efficiency of disaster prevention, including having the public mastering science and technique and understanding the knowledge of earthquake disaster prevention. They think, administration and management is the key to make the disaster scientific results and disaster scientists' opinions become the public' s action, in other word, one side of administration and management is disaster science, the other side is the public facing disaster. They are deeply interested in the prediction and disaster reduction of the Haicheng earthquake and the Menglian earthquake in China and have sent the working groups to the earthquake–strucken regions and investigate in detail, including the precursors and information obtained by the seismologists before earthquakes, procedures of analysis and study, and how to make out the prediction and judgment, how to report to the local government and how to make dicisions by the local governments and how to take measures for reduction of the losses, etc. They think it should be the best model for achieving the efficiency of earthquake disaster prevention and reduction, their goal is to summarize this procedure and raise the working procedure of disaster reduction. Here, I would like to mention one matter, that is, DDSMS wanted to spread the so–called " Qinglong experienc" as a model. But SSB and the Tangshan government didn' t agree with it. Because we all knew that we didn' t really make imminent prediction in advance for the Tangshan earthquake with magnitude 7.8 in July 28, 1976, but

before the event, seismologists had had different opinions about some precursory anomalies appeared in North China. A person in charge of Qinglong Seismological Office, according to a suggestion that there would be possibility of an earthquake with magnitude 5 or 6 in North China proposed by few seismological experts, reported this suggestion to the "Revolutional Committee of Qinglong County", and the county immediately took measures, withdraw all people from residence houses, department stores, offices and schools, pitched anti-seismic tents, set up anti-seismic temporary stores and classrooms. As the result, when the Tangshan earthquake occurred, there were nearly one hundred thousand houses collapsed, but no person was killed or injured in Qinglong County. For this, objectively speaking, this should be a good thing due to avoiding lots of people from death and injury, but it is not proper and not practical to spread Qinglong' s practice as an experience, because the prediction opinion, based on which Qinglong government took measures, was baseless and the earthquake prediction hasn' t come to true up to now so it is not proper to spread "Qinglong experience".

(2) The secretariat of IDNDR in recent years pays its attention of earthquake disaster reduction to cities, especially big cities' disaster reduction. Some big earthquakes just beneath large cities, such as the Los Angles earthquake in January 17, 1994, and the Kobe earthquake in January 17, 1995, brought about large losses in big cities, the economic losses caused by the Kobe earthquake reached as high as one thousand billion USD. Of course, the Tangshan earthquake is also the kind of earthquake beneath the city. So, IDNDR raised a project named as RADIUS (Risk Assessment Tools for Diagnosis of Urban Area Against Seismic Disaster), the goal of the project is to promote activities of earthquake disaster reduction in cities, especially in developing countries in the world. The focus of RADIUS is to develop a common way to make assessment of seismic risk in urban areas, to improve the awareness of earthquake disaster among the public and to reduce the losses of earthquake disaster. The concrete content of the project includes: compilation of a spot report notebook of earthquake losses in urban areas; the designing of a software of analogue figure in computer; the studying of samples of earthquakes, the making out of a brief assessment guidance of buildings and houses, and the filming of some material concerned, etc. Dr. Okazaki, in charge of the project, has visited SSB when he attended the meeting of "Integration of Public Administration and Science of Disaster" in Beijing. He said that