

SOCIAL AND ECONOMIC ASPECTS OF EARTHQUAKES

edited by  
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and  
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PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE:  
THE SOCIAL AND ECONOMIC ASPECTS OF EARTHQUAKES  
AND PLANNING TO MITIGATE THEIR IMPACTS

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Dedicated to the  
Memory of  
Professor Viktor Turnšek, dipl. ing. gradb.  
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## PREFACE

Four years ago the US-Yugoslav Joint Board on Scientific and Technological Cooperation agreed to undertake a series of three international invitational conferences to report significant advances achieved over the past decade on various aspects of earthquakes through research by scholars in a number of countries and to identify gaps still remaining to be studied. The first of these conferences was held at Ohrid, Yugoslavia, in September 1979. Organized by Dr. Jakim Petrovski and Prof. Clarence R. Allen this Research Conference on Intra-continental Earthquakes dealt with geological and seismological aspects of earthquakes emphasizing prediction. The second event, the International Research Conference on Earthquake Engineering, was organized by Dr. Jakim Petrovski and Prof. Jack G. Bouwkamp and concerned the analysis, design and construction of earthquake resistant structures. It took place in Skopje, Yugoslavia, in June and July 1980. The third and final conference in the series, the Social and Economic Aspects of Earthquakes and Planning to Mitigate Their Impacts, was held in Bled, Yugoslavia, in June and July 1981. The host organization was the Institute for Testing and Research in Materials and Structures of Ljubljana. The papers in this volume were prepared for this third conference. All three meetings were sponsored by the National Science Foundation and the Council of Yugoslav Association of Self-Managed Communities of Interest for Scientific Research under the auspices of the US-Yugoslav Joint Board on Scientific and Technological Cooperation.

The concept behind the third conference was to assemble a broad spectrum of social scientists--economists, sociologists, geographers, political scientists-public administrators, and city and regional planners, together with earthquake engineers--from various parts of the world who were all engaged in research on earthquakes and other natural disasters to share their results, exchange their findings, and display areas in which further study is needed. The invitational conference was attended by 57 scholars and officials from 12 countries including: Belgium, Canada, France, Indonesia, Italy, Japan, Sweden, Switzerland, United Kingdom, United States, West Germany, and Yugoslavia. A wide range of disciplines was represented by the authors of the 43 papers which were presented and 2 others which were submitted by persons unable at the last moment to attend.

The fact that the Institute for Testing and Research in Materials and Structures was designated the host organization constituted

recognition of the contribution of its founder and former director, Prof. Viktor Turnšek. The conference was in a sense a celebration of the contributions to the field of this very productive and distinguished engineer who was among the founders of earthquake engineering research in Yugoslavia. The paper he presented at this meeting was the last of a very long series of reports of research results because he died the following month in August 1981. It is to his memory that this volume is dedicated.

Many individuals contributed to the organization of the conference, the intellectual stimulation and smooth conduct of the meeting, and the preparation of the proceedings. The authors of the papers and the participants at the conference, who are listed in appendices, established the content which was the essence of the meeting. The U.S. and Yugoslav Committees helped shape the program and conduct it. The U.S. Committee consisted of Dr. William A. Anderson, Prof. Jerome W. Milliman, Mr. Stanley Scott, Prof. Ralph H. Turner, and Dean Myer R. Wolfe. The Yugoslav Committee consisted of Prof. Sergej Bubnov, Dean Vladimir Frankovič, Mr. Vladimir Braco Mušič, Dr. Jakim Petrovski, and Dr. Stane Saksida. The Chairman of the US-Yugoslav Joint Board on Scientific and Technological Cooperation, Dr. Muris Osmanagić, took a personal interest in the conference. Various officials of the National Science Foundation played critical roles. Dr. Charles Zalar, Program Manager, Division of International Programs and a member of the Joint Board was directly responsible that the conference took place. Dr. William A. Anderson provided counsel, advice, and necessary additional financial support. Dr. Michael P. Gaus, who has spent a decade developing US-Yugoslav cooperative research on earthquakes, developed the idea for the conference.

Many of the staff of the Institute for Testing and Research in Materials and Structures assisted in various ways. They include: Miha Tomaževič, Ludvik Bonač, Darija Podbevšek, Janez Kutnar, and Martin Ozimek. The conference was arranged by the staff of the Congress and Cultural Center: Maya Bajželj, Darija Tomanič, Marko Miklič, and Jože Odar. At Cornell University Ellen Weeks did the bibliographic research for the proceedings, Beverly Buckley handled correspondence and administrative matters, and Jen Gage prepared the manuscript.

We are very grateful to all who contributed in any way.

Jože Vižintin  
Barclay G. Jones

Co-Chairmen

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## FOREWORD

Almost any attempt to organize so voluminous and heterogeneous a set of papers as that which follows is bound to be arbitrary. Arraying the papers or placing them in some order implies a categorization, and such classifications are rarely satisfactory. In the first place, most of the papers will span several of the categories that have been devised. The question then arises whether a paper deals chiefly with one category or another. In the second place, many different dimensions emerge. These include the nationality of the author and the organizations, institutions, and research traditions in that country; the scientific discipline of the author and the perspectives this may give to the approach to the subject; the particular phase or phases of a disaster situation the author treats; case studies or specific disasters from which the research has been drawn; and a number of others. Again, the papers are likely to transcend those particular bounds and exhibit commonalities across nationalities, disciplines, cases, etc. Were it possible to organize the papers in  $n$  dimensional space such as can occur in various multivariate techniques like factor analysis, one might be able to juxtapose papers appropriately to each other. However, language is linear and unidimensional. Spoken language presents material in an immutable temporal sequence. Written or printed language necessitates the same constraint but with the important exception that it can be violated. The reader is free to reorder the material to suit various interests and purposes. The reader can begin in the middle of the manuscript, move backwards or forwards, select and omit at will. Editors do not have this privilege and must impose an order of some kind.

The system of organization that has been chosen is a traditional one in the field relating roughly to the temporal sequence of a disaster. Concerns with the predisaster situation are dealt with first, followed by the event itself and the emergency situation attending it, and finally the post-disaster period is treated. Thus a form of symmetry between the organization of the material and the nature of the event is imposed. Since most events are recurring ones, the post-disaster period becomes by necessity a predisaster situation. Many of the papers that follow will span a number of these phases of the event. It was necessary to select that point in the continuum that seemed to constitute the most pertinent contribution of the paper. Many of the authors may be disconcerted at the ways their papers have been classified and placed. Readers, too, may not agree with the choices

that have been made. The editors can only hope that the order may provide the reader with some direction in selecting the material of greatest interest and that some of the juxtapositions that have been made will provide new insights.

The first section contains three of the presentations that were made at the opening session of the conference. Mrs. Zupančič Vičar speaking on behalf of the host country gives a lucid description of the organization that has evolved in Yugoslavia to deal with earthquakes and other disasters. It is interesting to compare her statement with papers by Mušič, Bubnov, Zelenkov, Orožen Adamič, Štukelj, Ladava, Kirijas and Turnšek which together provide one of the most complete discussions of disaster organization in Yugoslavia that is available in the literature.

Dr. Zalar sets the context for the conference in terms of the long tradition of US-Yugoslav cooperative research on earthquakes and relates the subject matter of the conference to the full range of research efforts that have been carried out. Dr. Anderson describes briefly social science research on earthquakes in the United States, the necessary international dimension of it, and the necessity for the international exchange of research findings.

Hazard, risk and vulnerability to earthquakes and other natural disasters are characteristics of human populations in space and time and of the social systems they comprise. They relate, therefore, to the pre-event situation. The second section deals with these in particular ways. Hazard has usually been considered an attribute of the physical environment at a point in space. However, Hewitt and Baker raise questions about whether or not changes induced in physical environments by their social occupancy may not change their hazard characteristics. While Baker does not deal with earthquakes there are interesting parallels with the type of disaster he treats. Risk and vulnerability are high correlates of other attributes of social systems. Pelanda deals with this relationship specifically and other papers expand on it in different ways, particularly Ribarič, Quarantelli, Geipel, Cattarinussi, Cavazzani, and others.

The third section contains papers which deal specifically with hazard assessment, risk analysis, and vulnerability determination. The perspective is primarily in terms of the man-made environment of structures and buildings in a locale. Karnik defines the terms and displays the relationships. Lapajne generalizes on these concepts in developing a procedure for the assessment of acceptable seismic risk and in devising a scheme for managing risk. Fournier d'Albe discusses the difficulty of assessing the seismic risk of existing buildings. Wangsadinata suggests the use of the intended structural lifetime of buildings and relating this to the seismic hazard of their locations in determining structural design. Turnšek addresses the problem of increasing the seismic resistance of existing building stocks which will comprise the majority of the structures in any impacted area. The importance of this problem is referred to later by Bubnov and other writers dealing with specific cases such as Geipel and Orožen Adamič. Jones proposes a method for estimating the building stock in a region and determining the structures at risk. Such estimates relate to needs implicit in Karnik, Milliman and Schulze. The usefulness of such estimates in post-event situations is noted by Orožen Adamič and others.

Anticipating the economic effect of an earthquake and determining whether the costs of preventive measures are justified is the subject of the papers in the fourth section. Milliman proposes changing current models of regional economic analysis to make them useful for estimating impact. Schulze devises analytical procedures to assess the costs of imposing seismic building codes and establishing whether the benefits to be obtained from them are greater or less. The necessity of having advance estimates of the economic impact of an earthquake is dealt with explicitly or touched upon by Parr, Zelenkov, Bubnov and others.

The actual attitudes towards risk held by individuals inhabiting areas subject to hazard may or may not resemble assumptions of rational models that have been devised. Consequently behavior may not conform to expectations. Various analyses of attitudes towards risk are the subjects of the papers in the fifth section. Turner and Palm survey populations in hazardous locations which have not been subject to recent disasters. They explore their awareness and perception of the hazard and the ways in which this influences their behavior. Akimoto and Chandessais deal with actual situations. Akimoto studies the effects of predictions of aftershocks following an actual earthquake. Chandessais studies the effects of a false alarm of an earthquake due to a mechanical malfunction of the alarm system. Saarinen studies the behavior of people in response to warnings about an impending volcanic eruption.

Reducing the vulnerability of social and economic systems is the subject of the next two sections. Governmental responsibility for vulnerability reduction is the subject of the papers in section six. Given the evidence presented previously that individuals subject to hazards that recur sporadically at long intervals tend to discount risk unduly in their behavior, the necessity for responsible leadership is more apparent. Scott discusses the necessity for this leadership and the difficulty in developing it at the regional and local level drawing specifically on experiences in California. He points out the difficulties in absorbing technical information into public policy. Olson describes the leadership that has been provided by the State of California and generalizes from it. He notes that disasters are useful in developing policy response. Wyner surveys officials and reports the variability in willingness on the part of local leaders to assume responsibilities. Earthquakes are not issues that generate sustained political support: dedicated officials and professionals are necessary. Governmental roles in other countries are dealt with in papers in other sections by Alrasjid, Štukelj, Bubnov, Akimoto, Geipel, Cattarinussi, Cavazzani, and others.

Urban and regional planning, covered in section seven, is an instrument for reducing vulnerability. It has not been extensively used for various reasons. Mušič discusses this in general and gives examples of post-earthquake reconstruction planning that has had as one of its objectives the reduction of vulnerability citing cases in Yugoslavia. Two of these cases are covered by Zelenkov. Wolfe outlines the ways in which planning can be used to reduce the vulnerability of urban systems. He uses examples of pre-event planning from California. Germen indicates the potential role of planning is not being realized in reducing vulnerability and suggests a failure of interdisciplinary communication is a major cause. Compare Scott. Kirijas outlines the information that planners must take into consideration in planning if they are to make urban areas less vulnerable.

Education and information are instruments for both reducing vulnerability of social systems and managing emergencies when disasters occur. The eighth section contains two papers that deal with this. Battisti describes a post-event situation and a decision to develop an educational program that will lead to vulnerability reduction and make emergency behavior more appropriate in subsequent events. The situation he describes deals with a population similar to that studied by Chandessais and comparisons are interesting. In another section, Ladava and Štukelj describe response situations in which some education had taken place before the event, and it is useful to compare their reports with Battisti. Scanlon develops a model of the predicted response of the media in an emergency situation. It is interesting to compare Akimoto and Saarinen who report actual emergency behavior of reporters. Dynes refers to the social function of information.

The management of emergencies is the subject of papers in the ninth section. Dynes discusses alternative models of planning for managing emergencies. Comparison of his preferred emergent human resources model with the operation of various systems in emergencies as reported by Ladava, Štukelj, Cavazzani and others is illuminating. He also covers the function of information in emergencies: see Akimoto and Scanlon. Bighinatti makes a plea for non-proliferation of international disaster relief mechanisms and indicates that a system which responds to specific requests from the impacted region will result in more appropriate response. Lechat deals with managing the very serious health problems that can arise in an emergency and also points out the dangers of well intentioned but entirely inappropriate response.

Post-disaster response is the subject of four papers in section ten. Alrasjid describes the earthquake disaster mitigation program in Indonesia with greatest emphasis on the post-disaster response phase. Štukelj describes the contrasting system that exists in Yugoslavia: compare Lechat and Battisti. Ladava displays the organization outlined by Štukelj more directly in the context of its actual operation after an earthquake. Cavazzani reports some of the problems in the Italian response mechanism which were revealed in the earthquake in Southern Italy in 1980. It is interesting to compare this account with Battisti and the Northern Italian situation described by Cattarinussi and Geipel.

Measuring the impact of an earthquake or other disaster on a social and economic system is difficult and complex. This is the topic of a number of quite different types of papers in section eleven. Ribarič suggests that the impact of an earthquake is an attribute of the resources available to it to assist in its recovery. He develops a scale for making international comparisons of the specific destruction of earthquakes. Compare Hewitt. Quarantelli explores what constitutes a disaster and in doing so details the various kinds of impacts not only of earthquakes but of a variety of disasters. Compare Baker. Bates develops a level of living scale for making cross-cultural comparisons of the relative effects of earthquakes and other disasters. Although Bates uses data from a specific event, the 1976 Guatemalan earthquake, the first three papers in this section deal with the subject in general. The last three papers deal with specific cases and arrive at generalizations from them. All three draw their material from the 1976 earthquake which struck Northeastern Italy and Northwestern Yugoslavia. Geipel details the impact of the earthquake by describing its effect on the culture of a social and economic system in space. Cattarinussi

surveys the social and psychological impact. It is interesting to compare some of his survey results with those of Chandessais. Orožen Adamič looks at the social and economic impact of the physical destruction in various communities in Yugoslavia and develops a composite scale as a measure. He discusses the use of the damage rating scale mentioned by Bubnov, Turnšek and others.

The final stage of the disaster sequence is that of reconstruction. Finding ways of financing reconstruction is a critical problem and is the subject of the papers in section twelve. Decisions on how to finance reconstruction are an aspect of emergency planning and, therefore, could be considered as an element of the pre-event phase. However, the event itself is the ultimate test of the adequacy of the plan and it is natural to make re-evaluations in the post-event phase. Bubnov describes the model currently in use in Yugoslavia. It has already been pointed out that it is useful to compare his statement with Zupančič Vičar, Turnšek and others. Zelenkov reviews the Yugoslav financing system and suggests what amounts to an insurance trust fund financed by individual tax levies prior to the event rather than the post-event financing which occurs now. Parr develops a strong argument for earthquake insurance drawing on the New Zealand experience.

Experience in the recovery and reconstruction phase is dealt with in the last three papers that constitute section thirteen. Mader investigates land use planning after earthquakes using three case studies from California. The purpose of such planning is vulnerability reduction, and there are, of course, direct relationships with the papers by Mušič, Wolfe, Germen and Kirijas. Since the cases describe governmental behavior, there are interesting comparisons with Scott, Olson and Wyner and as a concrete reflection of attitudes with Turner and Palm. While Kreimer treats housing reconstruction, the concern is in relationship to vulnerability reduction planning and planning to achieve other social goals particularly in regard to the management of patterns of urban growth in developing countries. Hultaker studies the impact on families made homeless by a landslide through the reconstruction process. The process was so lengthy that this becomes a study of long-term impact, and it is interesting to compare it to the long-term results obtained by Cattarinussi. Recovery processes were described in many other papers including Geipel, Alrasjid, Ladava and others.

These brief descriptions establish that the papers that follow are rich and varied. Any attempt to do justice to them by summarizing their content would result in an excessively long introductory essay. Hopefully, this short exposition of the way in which the papers have been organized and the actual juxtaposition of the papers themselves will serve the purpose better than a lengthy review. The papers will speak for themselves. In editing the papers, a major attempt has been made to clarify the meaning in many instances by changing the phrasing and the structure of sentences. Uniform use of footnotes and references has been imposed and much time has been spent checking citations. In all instances every effort has been made to be faithful to the original content of the paper. The views expressed represent those of the authors and not necessarily those of any sponsoring organization. Errors of content or fact are the responsibilities of the authors. In any editorial process, additional errors are inevitably introduced. The editors sincerely regret any instances of this kind.

**SECTION I**  
**INTRODUCTION**



## WELCOMING REMARKS

Marija Župančič Vičar

Allow me to greet you most cordially on behalf of the Executive Council of the Assembly of the Socialist Republic of Slovenia and to wish you great success in the work you are undertaking. Your previous meetings have brought a range of fruitful results that have been incorporated in organizations and laws for preventing and mitigating the impacts of natural disasters such as earthquakes.

Major catastrophic earthquakes that have struck Yugoslavia and Slovenia have encouraged the working people and citizens of our socialist self-management society to pay more attention to the problems of preventing and eliminating the impacts of natural disasters. Various kinds of natural disasters continually endanger the safety of people and damage resources in citizens' ownership and social property. Among the natural disasters in the region of SR Slovenia that have caused high material losses, and in some cases claimed victims, earthquakes are the most frequent. Two catastrophic earthquakes occurred in the 16th century, and in 1895 a particularly serious one nearly razed Ljubljana to the ground. In recent years earthquakes inflicted heavy damage in the region of Kozjansko in 1974 and the Soča Valley in 1976.

The working people and citizens, associated into basic and other organizations of associated labour, in self-managing organizations and communities, local communities, communes, and republic, have the right and responsibility to develop systems to reduce vulnerability to natural disasters and assure that the impact of such disasters should affect as small a number of the population and as few of their possessions, as well as social property, as possible. For that purpose organizing and activities have been undertaken in order, first, to mitigate disasters, in the event of disasters to rescue lives and property efficiently, and after disasters have occurred to eliminate their impacts through organization and solidarity.

Experiences to date, as demonstrated by the reconstruction of Kozjansko and the Soča Valley, prove the power and ability of our socialist self-management society in such extraordinary conditions as major disasters to enable and assure, through self-management, self-organizing, and socialist solidarity, the mobilization of the initiative and actions of all

affected and all working people and citizens and the organization of their material, technical, professional, personnel, organizational, and other forces for mitigating disasters, recovering from their impacts, and restoring normal living and working conditions in impacted areas.

The solidarity actions in the cases of Kozjansko and the Soča Valley produced important material, financial, and socio-political results, since the action was organized in such a way that every working person or citizen could participate. The solidarity action was quick and effective in meeting basic needs for living and working, and at the same time a larger solidarity action for eliminating the impacts of the disasters was carried out.

At present the most important role in activities of defense and rescuing people and property when earthquakes have occurred has been undertaken by working people and citizens through their self-protection activity, headquarters for civil defense and organization of associated labor, social and other organizations which are directly incorporated into civil defense.

We must emphasize especially the connection and solidarity between the citizens and our army, as well as the large contributions and participation of Yugoslav youth in working on the reconstruction of affected areas after an earthquake. In such actions thousands of working people, members of the Yugoslav National Army, youths, and citizens cooperated through their voluntary work.

An important consideration in the efficiency of actions is that they quickly attend first of all to restore the basic means for living and conducting social activities of the economy in eliminating impacts of natural disasters.

The public media significantly contribute with objective and engaged reporting in providing information about the catastrophe, conditions, and requirements in impacted areas, measures that have been taken and their effectiveness. In these ways they promote the success of solidarity actions for eliminating the impacts of natural disasters.

In the Federated Socialist Republic of Yugoslavia, as well as in Slovenia, we have since 1963 normatively stipulated principles of counter-earthquake construction as preventive measures to protect ourselves from the impacts of earthquakes. Civil engineering and urban legislation provide the basis for earthquake resistant construction, taking into consideration all points of view for life safety, rescue procedures, and measures taken when natural disasters occur (adequate distance between buildings with respect to height, possibilities of access of emergency vehicles, etc.). Special attention is paid to training and equipment of civil defense units and citizens in general.

A uniform methodology for evaluation of primary losses from disasters has been developed and adopted to establish the principles of republic or federal solidarity participation. This provides a standard procedure for ascertaining impartial evaluation of items. Competent bodies in the socio-political community decide in which cases in the commune or republic the evaluation of loss should be carried out.

The responsibilities and liabilities for preventive and defensive measures against natural and other disasters are being stipulated in their

middle-term and annual plans by socio-political communities, local communities, and other organizations of associated labor, as well as self-managing communities of interest and other self-managing organizations and communities.

Everyone within the limits of his abilities is liable for financing preventive measures against disasters in his area, as well as for ensuring funds for implementing relief when disaster occurs and for restoration after the disaster. In the case of major natural disasters, at the republic and federation level, a system of solidarity is formed, based on social compacts and legal regulations.

The law on forming solidarity funds for eliminating impacts of natural disasters of 1975 defines the level of the amounts to be paid by respectively employees, retired people, farmers, and other citizens. Also, by this law, solidarity week is introduced in which in various ways solidarity funds are collected (e.g., one-day's earnings of all employees employed by the organizations of associated labor, etc.). The 1975 social compact on the manners for usage and management of solidarity funds for eliminating natural disasters was concluded in order that such funds are used for the intentions for which they are collected. The social compact regulates that solidarity funds can be used in a commune only when the loss, ascertained by the uniform methodology for evaluation of primary losses from disasters, exceeds 3% of social production of the previous year. In less developed communes, as defined by the law, the criterion is 1.5%. On the proposal of the committee of signers of the social compact, the signers define to what extent and in what regions the solidarity funds should be used for eliminating impacts of natural disasters. In the case of major disasters, where elimination exceeds the possibilities of the republic, pursuant to the criteria of the social compact, concluded by the republics and autonomous provinces in 1974, the solidarity funds of nations and nationalities of Yugoslavia, can be used.

We have introduced an extensive system for ensuring funds for implementation in cases of natural disasters. But even then we can see that the funds, collected as stipulated by the law, are not sufficient to meet the needs of major natural disasters. That is why in such examples agreements are being concluded for additional pooling of funds in communes, local communities, basic organizations of associated labor, and self-managing communities of interest.

Post-earthquake reconstruction requires a large and complex step. It is not enough that the previous situation before the earthquake be restored. Something more must be provided to impacted areas through the solidarity funds and complete engagement of all working people and citizens. Steps must be taken to ensure the development of the economy, social activity, infrastructure, and housing. The evaluation of post-earthquake reconstruction in the areas of Kozjansko and the Soča Valley shows that in that respect we have completely succeeded.

In short, I have described the operation of the unique system which was adopted in our Socialist Republic of Slovenia, assigning responsibilities and liabilities for eliminating the effects of natural disasters, among which earthquakes are the most frequent.

The Third International Conference--Social and Economic Aspects of Earthquakes and Planning to Eliminate Their Impacts shall undoubtedly

result in many exchanges of points of view and experiences with new solutions which should contribute to better organization for eliminating the impacts of natural disasters of which earthquakes cause heavy material losses and claim many victims. Once again, I wish you much success in your work and a pleasant stay in this beautiful part of our country.

## OPENING REMARKS

Charles Zalar

Permit me to say a few words on the present and past cooperation between the United States of America and Yugoslavia in the field of the earthquake sciences.

In 1963, an earthquake destroyed the capital of the Republic of Macedonia, Skopje. The city of Skopje was soon rebuilt through the tenacity of Yugoslav engineers and with the assistance of engineers from countries all over the world.

This international cooperation marked the beginning of the establishment of a new institute in Skopje, the Institute for Earthquake Engineering and Engineering Seismology, which, in only 16 years, has developed, under the sagacious leadership of Professors Tiberije Kirijas and Jakim Petrovski, into a world-class scientific institution.

In October 1969, another earthquake severely damaged the Yugoslav city of Banja Luka. In response to a Yugoslav request for U.S. participation in a multi-disciplinary research project, a 14-man research team, representing U.S. government science agencies and universities and coordinated by Dr. Michael Gaus of the National Science Foundation, visited Banja Luka, Skopje, and other Yugoslav cities, in February 1971. A few months later, Dr. Gaus initiated a series of joint U.S.-Yugoslav research projects in seismology and geophysics, earthquake engineering, Karst hydrology, and urban planning.

These studies have been conducted by well-known Yugoslav experts, such as Professors Kirijas, Petrovski, Hahamović, Trumić, Žeželj, Aničić, Somborski, and Turnšek, in cooperation with American Professors Bouwkamp and Wilson of Berkeley, Hudson of Caltech, Yevjevich of Colorado State, and Jones of Cornell University.<sup>1</sup>

Some three or four years ago, the National Science Foundation of the United States of America took the initiative to bring together scientists and engineers from all over the world for discussion and extensive study of earthquake phenomena. It was only natural that Yugoslavia was selected as the gathering place for these scientists.

In 1979, the First International Conference on "Intra-Continental Earthquakes" was held in Ohrid, Macedonia, and in 1980, the Second International Conference on "Earthquake Engineering" took place in Skopje. Both conferences were very successful and resulted in a great

number of studies which have been or are about to be published. For the excellent organization of the first two conferences we have primarily to thank Director Jakim Petrovski and his associates.

The Third International Conference on "Social and Economic Aspects of Earthquakes and Planning to Mitigate Their Impacts" is being held--as were the first two conferences--under the auspices of the U.S.-Yugoslav Joint Board on Scientific and Technological Cooperation, sponsored by the National Science Foundation of the United States of America and the Yugoslav Association of Self-Managed Communities of Interest for Scientific Research. The conference has been organized under dual chairmanship: the indefatigable American Co-Chairman, Professor Barclay Jones, Director of the Program in Urban and Regional Studies of Cornell University, and the Yugoslav Co-Chairman and your host, Dr. Jože Vižintin, Director of another fine institute, the Institute for Research and Testing Materials and Structures in Ljubljana.

I have the pleasure to greet on behalf of the National Science Foundation the representatives of the Yugoslav government authorities and of Yugoslav scientific institutions Engineer Marija Zupančič-Vičar, Prof. Dr. Muris Osmanagić, Prof. Dr. Sergej Bubnov, and finally, an internationally known expert in the field of the mitigation of natural catastrophes, the former Rector of the University of Ljubljana and present President of the Slovenian Academy of Sciences and Arts, my dear friend Prof. Janez Milčinski.

And now, I am pleased to extend on behalf of the National Science Foundation warm greetings to all the participants of this conference, and wishes not only for fruitful professional discussions but also for a pleasant sojourn in this beautiful country.

#### FOOTNOTES

1. The following series of studies resulted from this initiative:

Prof. V. Yevjevich of the Colorado State University and Prof. A. Trumić of the University of Sarajevo conducted "Analytical and Field Studies of the Hydrology, Water Resources, Pollution, and Economic Development of Karst Regions."

Prof. J. Bouwkamp and E. Wilson of the University of California at Berkeley and Prof. J. Hahamović of the University of Sarajevo in conjunction with other experts from Belgrade (B. Žeželj), Zagreb (D. Aničić), and Skopje (J. Petrovski) conducted "Analytical and Full-Scale Studies on the Earthquake Design of Buildings Constructed by Industrialized Methods and of Four Different Dams."

Prof. D. Hudson of California Institute of Technology and Prof. T. Kirijas of the Skopje University supervised "The Establishment of a Basic Instrument Network for Recording Strong Earthquake Motions in the Six Republics of Yugoslavia."

Prof. B. Jones of Cornell University and Prof. M. Somborski of the University of Sarajevo cooperated in a project of "Large-Scale Integration in Urban Planning with Trial Application to the Banja Luka Region."

At this time, Prof. Bouwkamp is cooperating with Engineer D. Aničić of the Institute of Civil Engineering of Croatia, and Engineer V. Turnšek of the Institute for Research and Testing Materials and Structures of Slovenia, in studies on "Earthquake Resistant Design of Buildings."

## OPENING REMARKS

William A. Anderson

As one of the representatives from the National Science Foundation's Earthquake Hazard Mitigation Program, let me say that we are delighted to be in Yugoslavia and to participate in this Third International Conference. The Earthquake Hazard Mitigation Program includes engineering and architectural components, as well as a social science element called Societal Response Research. Societal Response is the principal program in the United States supporting research on the social and economic aspects of earthquakes. Researchers from such disciplines as economics, sociology, political science, geography, law, and anthropology are supported through the program.

Societal Response was established as a program in the mid-1970s. It is designed to complement the engineering and related mitigation research funded by NSF. For example, while engineers are developing knowledge for designing safer structures, social scientists supported under NSF's Societal Response program are conducting investigations which will help put more of that knowledge into practice. Social scientists are informing us how earthquake hazards are viewed by vulnerable populations, what the barriers to the adoption of building codes and land use planning measures are, and how these barriers might be overcome through regulations, incentives, and education. In a similar way, this Third International Conference, with its emphasis upon socioeconomic factors, should complement the first two conferences which dealt with geophysics and earthquake engineering.

Many of the U.S. social scientists participating in this conference are receiving, or have received, support from the Societal Response program. Their work reflects the emphasis placed by Societal Response on developing knowledge on the social and economic aspects of mitigation and preparedness, on disaster impacts and responses, and on hazard and disaster information dissemination.

While the focus of the work supported by Societal Response has been on problems in the United States, we are also interested in experiences of other societies. We have even supported researchers to conduct studies in other countries. For example, Dr. Frederick Bates will be presenting some of the findings of his NSF funded study on the 1976 Guatemala earthquake. We have also supported and participated in international workshops and conferences. For example, Dr. E. L. Quarantelli, another participant at this conference, was awarded a



grant by NSF to organize a U.S.-Japan Conference on social science disaster research in the two countries. At this conference, then, as in our previous international activities, we look forward to both learning from and sharing our experiences with our colleagues from Yugoslavia and around the world.