Structural Geology & Tectonics Division Spring Newsletter
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From the Editors...
As another Newsletter goes to press, we are reminded how important contributions from the Division are for the success of the Newsletter...our hats are off to Vicki Hanson, Tom Wright, Terry Pavlis, and the *ad hoc* committee for their thoughtful and insightful comments regarding the continuing dialog about future NSF funding, to Ben van der Pluijm for his comments concerning distance learning, to Alex Gates, Bill Haneberg, and Lucian Platt for their book reviews, and to the many contributors to the Have You Heard..? and Industry columns.

Congrats are in order for the SG&T student award winners: Delores M. Robinson (University of Arizona) for "Investigating the origin of the Chainpur Thrust through structural and petrogenetic examinations, western Nepal Himalaya"; and Kevin Mahan (University of Utah) for "Emplacement mechanisms for a granite intrusion: The McDoogle pluton, central Sierra Nevada, California"...keep up the good work! Also, congratulations are in order to Bert Bally for receiving this year's Career Contribution Award.

Greg & Scott

Chairperson's Message
I write this while experiencing one of the hottest Texas summers on record, desperately hoping that this summer is an aberration and not a predictor/indicator of global warming! In this, my last Chair's message, I touch briefly on concerns for the Division ranging from general business involved with running the shop, to goings-on at NSF, to the annual meeting schedule.

I start with a hearty thanks to the members of Division committees. I thank, in particular, members of the Best Paper Award committee and the Career Contribution Award committee for operating under tight deadlines, due in large part to misprints of nomination deadlines. Hopefully, we have the deadline snafu corrected once and for all. The extended deadlines allowed Division members more time to make nominations, but it really put the committees under pressure to evaluate nominations on a rigorous schedule imposed by GSA headquarters.

As many of you are aware, long-range planning is going on at NSF, and as a result, some NSF-EAR programs may undergo reorganization. Many of you heard Ian MacGregor (Director of NSF-EAR) speak at the Division Board Meeting in Salt Lake City. As I stated in the previous Chair's message, the board invited five members to form an *ad-hoc* committee to provide positive recommendations for programmatic changes affecting structural geology and tectonics programs at NSF, and to hopefully provide an avenue for direct communication between the Division and NSF. A report by the *ad-hoc* committee**Darrel Cowan**, **Mark Brandon**, **Eldridge Moores**, **Terry Pavlis**, and **Jan Tullis**is published in this Newsletter. Their report argues that any new long-range plans for Geosciences at NSF must include strong support for research in tectonics with modest grants to individual investigators as well as grants to multi-investigator projects. The report is being sent (as the Newsletter goes to press) to NSF Managers and bureaucrats, as well as to NSF and NAS-NRC advisory committees charged with helping to formulate long-range plans for the earth sciences. Many thanks to Darrel, Mark, Eldridge, Terry, and Jan for the time, effort, and careful thought that they put into this report. I encourage everyone to read their report, which provides an elegant discussion of several current research directions that illustrate the broad scope of tectonics. The report, coming at a critical time to dovetail with long-range planning discussions at NSF, will hopefully be carefully considered in NSF's planning process.

Tom Wright's letter to the Division in this issue about happenings at NSF touches on several aspects of NSF's long-range planning process, and issues in science policy that are being actively debated. The debate is one of broad science policy: How should NSF's service to the community be defined, and who should define it? It is important that the Division be involved in this process and the *ad-hoc* Division report provides one means for accomplishing this. Although a concern for long-range planning at NSF is obvious for those Division members writing and receiving (or not!) NSF funding, such concerns are also critically important to Division members who do not directly participate in writing or receiving research grants. The nature of what is funded, and how things are funded, have major impact on the future directions of our broad field. The so-called outer "envelope" of research is often defined by funding decisions at NSF, as are how our students are supported, and options for employment, graduate studies and post-graduate work. How and what is funded has the potential to govern how earth science is done in our country. Even if you don't think that happenings at NSF directly impact you, I encourage you to read Tom's letter if you are interested in the health of earth science across the country. In any case, here are some key points I think we should consider (and use as the focus for community input to NSF).

In Tom's letter, he outlines the nature of debate currently underway at NSF, a discussion about directions in earth science policywho decides what is funded and howand calls for input from the community. Who should decide earth science policy? Government and agency managers who will likely tie support to perceived public needs, or peers within the scientific community? In that government and agency managers will actually make the decisions, their input is definitely represented, but clearly NSF needs input from the peer science side, and the earth science community needs to be sure that their concerns are expressed and considered. Although there may be several avenues for community input, some of these seem to be disappearing. For example, inhis letter Tom thanks **Bob Wintsch** for a job well done as a rotator (and encourages us to thank Bob too!), yet he did not identify a new rotator. Is this a sign that structure/tectonics is currently without a representative from the earth science community at NSF? The loss of such an ambassador reduces the voice of our community at NSF, and at the same time it serves to increase Tom's work loadfactors that could prove detrimental to the tectonics program. Are rotators, and therefore ambassadors from the earth science community, disappearing in other discipline programs as well? And why have several program managers at NSF-EAR resigned in recent years? As peer scientists we should be concerned with these developments because program managers and rotators provide the most direct link between our community and NSF. In order to ensure that we do our part in partnership with NSF Management, the earth science community must speak clearly, and perhaps loudly! Although we must listen to potential plans and try to understand the political environment in which the NSF operates, we must make our thoughts and concerns heard.

Many rumors are flying with regard to EAR including the cutting of various discipline programs, a shift in dollars from individual investigators to large multi-investigator projects, and changes in discipline budgets. At this point it is unclear if anyone knows where these issues lie in reality-rumor space (I most surely do not!), but it is important that the community find out, and that the community voices its concerns with respect to potential changes. We need to ensure that there is a **public discussion** of NSF-EAR's future and long-range plans. As Tom outlines in his letter, good science policy decisions require a balance between "peer scientists" (that's us!) and NSF managers and bureaucrats. In our dynamic world, the only thing certain is change. Societal changes, of which we have seen many since the inception of NSF, may require institutional changes, but our earth science community must be involved in decisions affecting change at NSF.

Now, on to Toronto. The schedule for the Toronto meeting will soon be cast in stone, or at least in print. **Steve Marshak** and I are working on your behalf as I write this (the "beauty" of the web is that now you can almost be in two places at once; instead of sneaking off to Boulder to plan the annual meeting, folks all over the country now stay home, logon, and negotiate the annual meeting schedule as they attempt to get other things done!). One becomes frightfully aware that there are indeed only 480 oral presentation minutes in a meeting day, and that the meeting is 4 days longwhich seems 2 days too short as we attempt to resolve schedule conflicts, yet 1 or 2 days too long once the meeting rolls around! I apologize ahead of time for conflicts which will seem to some as blasphemous (believe me, no ill will meant). Steve and I are trying to catch as many conflicts as we can, but we will certainly miss some in the process, and others are simply out of our control (anyone wanting an earful just give me the sign!). Based on member comments from past annual meetings, we put all the SG&T discipline posters in a single session and we have tried to minimize overlap with oral sessions.

Some meeting highlights follow. The Division is jointly sponsoring two of the four new Pardee keynote symposia this year. **K1**: Tectonic evolution of Precambrian North AmericaA synthesis of recent results; and **K4**: Deep crustal processes. The division also is sponsoring or co-sponsoring three symposia: **S17**: Fault reactivations, neotectonics, and seismicity in the Great Lakes region; **S18**: Deformation mechanisms and microstructures; and **S20**: Role of partial melting during evolution of convergent orogenic belts. In addition, there are a host of Division-sponsored theme sessions, the regular discipline sessions, and a number of symposia and theme sessions sponsored by other divisions or groups that will interest the SG&T Division membership. The Division also is sponsoring three fields trips (two pre-meeting, one post-meeting): From front to interior: An Ontario transect of the Grenville Province; Sudbury to the St. Lawrence, A western Quebec Grenville transect; and Late Grenville horizontal extension and vertical thinning of Proterozic gneisses, central Ontario. Two pre-meeting short courses are: Analysis of veins in low-temperature environmentsIntroduction for structural geologists, and Deformation mechanisms and microstructures. This year, for the first time, the Division will award ten $100 scholarships to students (Division members will be given priority) to help defray the cost of enrolling in Division-sponsored short courses or Division-sponsored field trips. Details were outlined in the spring Newsletter. We hope that there is much that captures your interest, and that it is not all scheduled synchronously. Thanks to all those involved with the annual programand helping to organize the various symposia, theme sessions, field trips and short courses. The meeting is really what we make it.

The Division's Business and Awards Meeting is scheduled for Tuesday, Oct. 27th, from 5:30-6:30 PM, followed, as usual, by our no-host reception. As you may already be aware, this year's Career Contribution Award will go to **Bert Bally**, emeritus professor at Rice University. This year's SG&T Student Research Awards go to **Delores M. Robinson** (University of Arizona) and **Kevin Mahan** (University of Utah). Please come to the meeting to honor these folks, together with the winner of the SG&T Best Paper Award to be announced at the meeting. As Tom Wright mentioned in his letter, Ian MacGregor has agreed to come to the Board Meeting to continue the discussion started last year in Salt Lake City about changes afoot with NSF-EAR. I hope to see lots of you in Toronto! If you have thoughts about how to make the Division stronger, either in the long term or short, please contact any of the Board members.

Cheers,
Vicki Hansen

SUPPORT FOR RESEARCH IN TECTONICS AT NSF

A White Paper from the Division of Structural Geology and Tectonics,
Geological Society of America

PREAMBLE

This document states the position of the Division of Structural Geology and Tectonics, whose 1500 members belong to the Geological Society of America, a professional organization for earth scientists. We direct our comments to the management of the Geosciences Directorate, the Division of Earth Sciences, and the Division of Ocean Sciences in NSF, and also to the committees charged with addressing plans, such as GEO 2000, for research opportunities in NSF.
We contend that any new long-range plans for Geosciences at NSF must advocate continued and readily identifiable support for research in tectonics.
The record shows that advances in tectonics are achieved when research support is provided through small grants to individual PI's (e.g., Tectonics Program) ***and*** **through large grants to several PI's (e.g. Continental Dynamics Program).**
This report outlines the basis for our position. We begin with a definition of tectonics and a brief review of how its fundamentally cross-disciplinary and integrative nature places it at the heart of the earth sciences. We then summarize several areas of exciting research presently underway, each of which offers opportunities during the next five to ten years for major advances in our knowledge about earth processes and history. This document is intended to convey the character of research in tectonics by means of a few examples; it is *not* intended to be an exhaustive or comprehensive survey of past, present, and future research.

DEFINITION AND SCOPE

Tectonics, as we use the term here, is the study of large-scale features in planetary lithospheres that have resulted from deformation. Thus, tectonics concerns the nature and origin of features that would be visible in a single glance at regional geologic maps, maps of the physical face of the earth, or images of planets and moons: for example, ocean basins and continents, regionally developed faults and systems of fractures, mountain ranges and topographically subdued shields, and volcanic arcs. Many tectonic features on the earth are immediately visible because they contribute to the physical appearance of the environment of life.

Research in tectonics seeks not only to characterize large-scale features but also to investigate the deformationsforces and displacementsresponsible for them. As such, tectonics is inseparably linked to *structural geology*, which is the study of deformation at all scales. Research in tectonics has always been distinguished by two additionalattributes, regardless of the size or scope of a particular project. First, it is inherently multi-disciplinary and integrative, and, like the Greek *tecton*, or builder, it employs diverse tools. To study, for example, the growth and decay of mountainous topography, we need to investigate not only the forces and displacements at relevant plate boundaries, but also phenomena as diverse as the influence of climate on fluvial erosion and the influence of orogenic topography on local precipitation and global climate. Second, tectonics encompasses the whole of geologic time, from the early history of the earth and solar system to the immediate present. If our goal as earth scientists is to explain large-scale features, then we need to complement studies of active, ongoing tectonic processes with investigations focused on the geologic record of past events. For example, geodetic, geophysical, and geomorphological studies of the Himalaya are providing data on present rates of deformation, uplift, and erosion, which can be compared with rates predicted by geodynamic models. The Himalaya, however, preserve a rich record of subduction- and collision-related deformation and magmatism extending back tens of millions of years. The character and disposition of the active present-day chainand of most other tectonic features for that matterare partly determined by its earlier tectonic history.

To summarize:

Tectonics concerns the characterization, origin, and evolution of large-scale features of planetary lithospheres.

Tectonic processes have modified the lithosphere throughout geologic time. Investigating them requires studies of not only active environments but also the geologic record of ancient events.

Research in tectonics is inherently multi-disciplinary and is not restricted to either the marine or terrestrial realm. This multi-disciplinary approach characterizes not only larger multi-PI projects but also most of the smaller, single-PI projects.

EXCITING RESEARCH AREAS AND POSSIBLE FUTURE DEVELOPMENTS

We present below seven examples of research activities in tectonics that have developed rapidly during the past decade and which hold promise for further advances during the next five or ten years. This selective list illustrates and exemplifies the multi-disciplinary nature of research in tectonics. Some of these areas owe their rapid development to technological achievements, such as the wide availability of inexpensive, portable Global Positioning System (GPS) receivers. Some reflect novel and fruitful collaborations or the introduction of new ideas. The visibility and impact of research inthese areas is demonstrated by the regular publication of articles and papers in *Geology, Geophysical Research Letters, Nature,* and *Science*.

1. Rates and patterns of deformation

More precise geodetic measurements using GPS are providing present-day rates of displacements in actively deforming areas. The next decade will see closer collaboration

among field geologists, geodynamic modelers, and seismologists, which will result in better assessments of seismic hazards of large regions.
Every earth scientist studying a mountain chain or major structure has probably wondered, "How fast?" Tectonicists of all stripes want to know if models for plate motions can be confirmed with observational data. In a little over a decade, GPS has matured to where it can provide ever more precise answers to these and a host of other fundamental questions. Geodesy is serving as the bridge linking models for plate velocities, which largely derive from oceanic hot spots, with observed rates of horizontal and vertical movements on the continents. In the next decade, improvements in the ease of use of geodetic equipment and in the precision of horizontal and vertical measurements will allow routine study of structures within plate-boundary zones. This research will provide direct information about processes that at present remain inaccessible or difficult to study, such as seismic coupling, transfer of slip between structures, and the relationship of blind faults to surface folding.

2. Rheology of crustal faults

Improved laboratory apparatus allow new kinds of experiments on natural and simulated fault rocks. These studies, which demonstrate that earthquakes result from unstable frictional sliding, have led to provocative models for seismogenic behavior of tectonic faults. In the next decade, results from structural field studies, experiments, and possibly drilling in active faults will collectively be used to test these models.
Complete characterizations of the deformational behavior of earth materials, whether they are at the surface, in the crust, or in the mantle, require experimentally investigating their rheology. Recent technological advances allow experiments that better simulate conditions in the earth. For example, materials can now be deformed to higher strains under more realistic strain geometries and pore-fluid conditions. In the past decade, experiments have addressed the basic question of why slip on upper crustal faults ranges from aseismic to seismic, and why active faults like the San Andreas in California are apparently weaker than mechanical models predict. Lab studies of fault rocks like gougeand pseudotachylite indicate that frictional sliding may vary from stable and aseismic, to unstable (stick-slip) and seismogenic. In the future, collaborations among experimentalists and field geologists, who investigate active and ancient tectonic-scale faults, will yield empirically confirmed models for slip on upper crustal faults.

3. Mountains and climate

New models for the growth and decay of mountainous topography incorporate the effects of climate, surface processes such as erosion and mass wasting, and stresses related to plate boundaries. Multi-disciplinary teams are seeking to explain seemingly unrelated phenomena, such as how the uplift and exhumation of deeply buried metamorphic rocks might be related to patterns of erosion.
In the past decade, a re-phrasing of the "chicken-or-egg" puzzle has revolutionized research into the origin and evolution of mountain belts. Does climate change drive mountain building, or does mountain building drive climate change? We are now no longer content simply to model convergent orogens as accretionary wedges that grow entirely in response to plate subduction. Observational evidence and powerfully predictive models both suggest that surface processes influence not only the topographic form of mountain belts and massifs, but also attributes as diverse as the history of uplift, the nature of internal structures, and the internal disposition of metamorphic rocks. Interdisciplinary teams will address the coupled tectonic-geomorphologic

problem in active chains, where present-day rates of erosion and deformation can be measured, and in ancient orogens, where the effects of long-term surface and tectonic processes are visible.

4. Tectonic reconstructions in Deep Time

A burgeoning interest in how, when, and in what forms life originated on earth is forcing renewed investigations into the configuration of continents and ocean basins in early and pre-Phanerozoic time.

As earth scientists, we naturally are curious about the entire historiesnot just the past million years or soof our home planet and its kin in the solar system. Because the direct marine record of plate tectonics on earth only extends back to about 190 Ma, reconstructions of the positions of the continents in earlier times are more difficult to support empirically. Nevertheless, paleobiologists and astrobiologists have cast the spotlight on tectonics. They want to know the disposition and character of continents and oceans in what we call Deep Time, extending back from the early Phanerozoic Era. We now have models proposing that unusually rapid changes in plate configurations might have coincided with the explosion of life forms about 560 - 600 m.y. ago. In the next decade, we can expect new, empirically sound continental reconstructions that will beadvanced by the combination of geologic mapping, high-resolution isotopic dates, and paleomagnetic data.

5. Punctuated, non-linear tectonic evolution

Earth's history might have been punctuated by short-lived, "catastrophic" tectonic events that had profound effects on its atmosphere and hydrosphere, and on life itself. The frequency and causes of these events will be addressed using marine and terrestrial records of earth history.

The bolide-impact hypothesis for the extinctions at the Cretaceous-Tertiary (K-T) boundary has had the unintended consequence of reawakening our appreciation for the possibility that earth's tectonic evolution has not been linear or steady-state, but rather punctuated by catastrophic events. Investigations on land and in the oceans are adding to the existing record of tectonic instabilities: the Late Cretaceous superplume, voluminous but short-lived volcanism at divergent plate boundaries and within plates, the Precambrian anorthosite event, and, more speculatively, rapid episodes of true polar wander. Whatever the physical basis and causes of these events, these models of catastrophic tectonics will spawn deductions of their system-wide effects on the earth's atmosphere, hydrosphere, and biosphere.

6. Three-dimensional visualization and imaging

Rapid technological advances now allow three-dimensional computer-aided renditions of rock bodies and structures, and the combinations of virtually any kinds of geologic and spatial data on a map base. The Internet and the widespread availability of workstation computers will allow much greater circulation and use of map-based data, which in turn will generate a greater demand for high-quality geologic mapping.

Tectonic syntheses, which are based on diverse types of data and evidence, are conventionally reported using two-dimensional geologic maps and cross sections. Visualizing the three-dimensional disposition of rock bodies and structures has been left up to the user. Several technological advances are revolutionizing the acquisition of spatial data and the portrayal of geologic and physiographic features in three dimensions. Basic geologic data can now be acquired in the field in digital format. These can constitute part of a geologic spatial database, which can be digitally manipulated and combined with diverse geographic, cultural, and topographic databases or laid onto satellite imagery. The geologist or land-use planner can produce whatever kind of map suits the purpose at hand. In thenext decade, as software becomes more accessible and intelligible to academic researchers and students, three-dimensional renditions of surface and subsurface geology on the computer screenin the classroom and research labwill become the norm rather than the exception.

7. Natural tectonic laboratories

A few regions on earth have come to be considered as natural laboratories, each epitomizing a particular tectonic history or process. Additional natural laboratories will be developed where multi-disciplinary studies can illuminate other tectonic settings.

A natural tectonic laboratory can be thought of as a regionon a continent, in an ocean basin, or crossing the shorelinewhere a certain tectonic process is especially amenable to study. Each is further distinguished by two attributes. First, advances in knowledge can be gained by research projects of widely varying scope, from those directed by a single PI to those involving many PI's, and in all cases using a wide range of tools and disciplines. Second, the ideal laboratory allows the investigation of a process as it has acted over different time scales: historic (102 years); Recent (104 years); Quaternary (106 years); and late Cenozoic (107 years). All these time spans are relevant to understanding active tectonics. Data from laboratories in modern tectonic settings can be supplemented with information obtained from well-exposed and particularly illustrative ancient orogens, whatever their age. Well-known laboratories, which have been subjected to extensive geophysical, geochemical, and geological studies, include: the San Andreas fault of California and the Alpine fault of New Zealand as continental transform faults; the Himalaya and Taiwan as collisional accretionary wedges; and the Basin and Range province of the western United States as an extensional orogen. The next decade will see natural laboratories developed in orogenic chains in plate interiors, and in plate-boundary zones featuring strongly partitioned displacements.

Ad-Hoc Committee of the GSA Division of Structural Geology and Tectonics
Darrel Cowan, University of Washington, Chair
Mark Brandon, Yale University
Eldridge Moores, University of California, Davis
Terry Pavlis, University of New Orleans
Jan Tullis, Brown University
July 24, 1998

The views and positions expressed are those of the Board of the Division of Structural Geology and Tectonics and do not represent the position of either the membership of the Geological Society of America or its Council (Board of Directors).

NSF News

As NSF's Earth Sciences Division gears up for tackling a "long-range plan", an old subject has again risen to the surface and is being actively debated, and we would like to outline the important issues with the membership of the Structural Geology and Tectonics Division of GSA. Basically, the debate is over the definition of "service" to the research community that NSF should be providing and how the specifics of that service are decided upon. The philosophical differences on this subject go back to the origins of NSF, with Vannevar Bush in the early 1950s arguing for unfettered self determination for scientific peers to determine content, direction, style and support of science, while the opposition forces in Congress at the time argued that the Government and agency managers should dictate priority areas, styles of research and support criteria, all tied to perceived needs of the public. Bush won out and the principle of peer review for NSF was established. As originally conceived, this idea applied to the direction of research, choice of research subjects and choice of research styles in addition to the actual evaluation and prioritizationof groups of individual proposals. In the ensuing years, the theory and practice of "peer review" has been supported, challenged, modified and adjusted in many ways, but the two fundamental end members of Bush's day remain central to today's debates. Peer review continues to be a very strong component in the decision-making process in NSF research programs. The familiar mail reviews and panel deliberations determine funding decisions in the Tectonics program for the most part. As our articles in past issues of the Newsletter have discussed, the program directors do formally make the final decision and those decisions do not exactly match the results of the peer review. This departure from the strict peer review determination takes advantage of the insights NSF bureaucrats have and is generally agreed to be a reasonable way to operate. People who come from the research community for a year or two to serve as NSF program officers also function as ambassadors from the community. The input of NSF "rotators" with their fresh view from the outside, helps to guide the bureaucratic input into the final decision lists. This partnership between peer review and NSF program directors in making decisions works well.

The original idea of peer control of research direction, choice of research areas and styles of research support has also evolved in actual practice into a shared responsibility between the active research community and NSF management, but the bureaucratic component is generally stronger than it is in the proposal review process. It is generally true that decisions made at successively higher levels in any organization become successively more political, so it is not surprising that higher level decisions at NSF on such issues as new programs and long-range planning involve more active input from NSF managers than is the case at the proposal evaluation level. With lots of input from the community via such things as advisory committees, reports of planning workshops, National Academy studies and more informal discussion with researchers, NSF adjusts and responds to changing needs of both the research community and the political and public policy climate in which we operate. This partnership works well when the advantages and different insights of both researchers and bureaucrats are employed when these larger decisions are made.

Everyone wants the same outcome from a "long-range plan"; namely, the best possible roadmap for breakthrough progress on important and timely scientific issues, with fiscal and organizational efficiency and proper attention to the health of the research capabilities and people engaged in the science. Peers have, in aggregate, the most direct knowledge of current science and the most detailed insight into future directions and scientific opportunities simply because they are the ones actually doing it now and are thinking about what they, their colleagues and students ought to do next. Additionally, they consider the best ways of approaching their particular future research issues. Questions like "Should this problem be attacked by one or two people and their students or will it require a bigger collaboration of people and expertise to get the job done?" are standard elements in professional research planning. This information on plans and strategies, being generated in hundreds of offices and laboratories across the country, is exactly the raw material needed by the long-range planning exercise, but it must be gathered, organized and delivered to the planners. Ideally, compilations of this type should be prepared and transmitted to NSF at frequent intervals and NSF should regularly use them to update our perception of future research needs, factor them into our future budget plans, and use it as guide to assessing how well our present internal structure might serve the (changing) future needs of the research community. Just as in the individual proposal scheme, NSF's function in this broader contact is to keep abreast of the changing needs and to fold into the mix our unique views and knowledge of the political and practical boundary conditions, so that the final plan is the best that the combined efforts of each side can produce. Like the proposal processing analogy, resulting long-range plans, new programs or internal reorganizations do not exactly represent the wishes of either the community nor the first choices of the bureaucrats. In the history of NSF there are many examples of successful outcomes of the basic partnership between NSF management and the community they serve. Less satisfactory results are obtained when the partnership weakens. Should the researchcommunity lessen their "peer input" into planning efforts, NSF planners will have less to go on. Similarly, if NSF managers become overly enamored with current political attractions and discount the community's research agenda and goals, the resulting long-range plan suffers. If both weaknesses happen simultaneously, the damage is cumulative.

Peer review is a powerful tool, as witnessed by its use in our process of reviewing, ranking and funding (or not) of your proposals. As Tectonics program directors, we are convinced that decisions made in absence of mail reviews and panel review would be inferior, less fair and ultimately result in less significant results. This view is not universally held, even at NSF, and peer review must be constantly exercised, guarded and protected. Peer input is equally important and powerful in the task of planning future direction for the Earth Sciences Division at NSF, a process on which we are embarking. Your active participation in all facets in the development of the long-range plan is needed. There will be a variety of ways to communicate your goals and needs. At the Toronto GSA there will be a symposium on the long-range plan for the Earth Sciences Division by the NRC's Board on Earth Sciences and Resources, followed by a BESR symposium which is an All Union Session (U-02) at AGU in San Francisco. Ian MacGregor, the Director of the Earth Sciences Division, has agreed to return to the annual Structure and Tectonic Division meeting in Toronto, and continue the discussion begun in Salt Lake. These and other formal or informal community inputs are a critical part of the partnership. We at NSF are working to uphold our part of the bargain. Just as we hope our repeated plea for your input will strengthen the outcome, your monitoring and encouragement of our activities will also be beneficial to the successful outcome of the long range planning effort and ultimately the health and success of our sciences in the years to come. In other words, part of a successful partnership is to nudge the other side to do their part!

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In the last issue of the newsletter, we discussed how final decisions on proposals are made by program directors. In this installment we want to discuss how program decisions in the Earth Science Division are formally reviewed by outside representatives of the research community to help insure that the peer review system continues to work satisfactorily.

Strictly speaking, program directors only make recommendations to their managers, in our case to the Division Director of Earth Sciences. He must either sign off as "concurring" with the recommendation or send it back for more documentation or arguments. After being so blessed,

the proposals recommended for awards are then reexamined by an NSF grants officer (mostly for fiscal issues) who formally makes the award to the PI's institution. After award or declination paperwork is sent to the principal investigators, they have the opportunity to ask for a reconsideration if they feel that there are serious lapses in procedure, scientific evaluation and or fairness in the review. While few in number, especially for awards, these in aggregate do provide a sort of oversight. If the number of contested actions shows a big increase, for example, NSF managers would hear an alarm bell and look into the causes. Much more importantly there are several established ways to accomplish an oversight analysis of how well NSF is serving the research community. These include NSF panels, "Committees of Visitors", Advisory panels and special things like National Academy of Sciences reports and recommendation of various workshops.
The most immediate of these oversight functions occurs at the start of the panel meetings, when we pass out the "disposition list" of the last meeting. The panel can and does look this list over and ask what our logic was on some of the decisions. From this information the panel has an opportunity to judge how well we have done, and if they have serious problems they can take the matter up with the Division leadership, after they are finished with us. Probably one of the most insightful overviews can be provided by rotators after their tour of duty is completed. They commonly give their reactions and recommendations in "exit interviews" with NSF managers and later as they feel so inclined.

More formally, there is a requirement that each program be examined once every three years by a so-called "committee of visitors". The COV members are chosen from the research community and are charged with examining the program to determine if the peer review system is working and whether the program is meeting its goals etc. They hear from program directors and paw through as many actual proposal files as they wish (except their own, of course). By the end of the "visit", this group formulates a report on their findings that is addressed to upper NSF management. In prior years, each program was scrutinized separately or in small groups of related programs, but this year it was decided to examine all EAR programs at the same time. This is scheduled to happen in early September and Structure/Tectonics people are included. We will report on the outcome in the next issue.

Yet another way oversight is provided is through the workings of the Advisory Committees. The Earth Sciences Division previously had it own committee, but for the past several years, the Advisory Committee has been at the Directorate level, with Oceanographic and Atmospheric members as well as Earth scientists. Still, this group formally advises us on various planning and policy matters, part of which addresses oversight. NSF is also receptive to any views and comments that individuals or organized groups would like to contribute. These could be informal and focused on specific issues, but could be part of other reports such as workshop reports or planning efforts.

What does NSF do with this input? For some, there is a formal requirement for a response. For example, each Division must respond to each point made by the COV and indicate what action (if any) is being undertaken as a result. On others, the response is a letter or phone call to clarify and discuss the points made. Some inputs have identifiable impacts while others are seemingly ignored, but in aggregate they are clearly influential. In all these possible ways of handling the

oversight of programs it should be clear that research community advice, judgement and follow-up are very important to insure that your views get fully included in NSF's thinking.
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At the last panel meeting, several observations and ideas were brought up that the panel felt should be communicated to the memberships. Here goes:
There was a bit of a complaint by the panel about adherence to the guidelines for proposal preparation and submittal. These includes format, font, margins and other mechanical issues, that seem picky when thinking about one proposal, but become irritating when faced with scores of proposals. This "pushing the envelope" also forces the panel to worry about fairness. Is it fair to accept a proposal that uses fonts a smidgen less than 10 point (some copiers reduce what was legal size to a bit less than legal size, for example) when others that are over 15 pages are summarily returned unreviewed? When you are preparing proposals to send in to NSF, try to follow the spirit as well as the letter of the guidelines and consider the large work load of the panel members. It generally isn't a good idea to unnecessarily annoy those folks!

For better or worse, the Earth Sciences Division, like a number of other parts of NSF, has a policy of not accepting a revised version of a proposal turned down in the immediately preceding panel cycle. Adoption of this rule assured that the question: "How different does it have to be before it is a "new" proposal rather than a "revised and resubmitted" proposal? " will come up. Obviously, this is a continuum situation and it is not easy to lay out specific definitions to separate new proposals from "stealth" resubmissions from straight resubmissions. Again, with an eye on not antagonizing the panel, it is probably a good idea to not do a full-court press on this rule either. If you are in doubt about this, you can always call us for our advice.

Large earth science projects commonly proceed concurrently with several smaller projects on similar subject or areas. For example, a major deep seismic line across an orogen might be done at the same time as structural projects or sedimentological projects in parts of the same area. In fact, they are often complementary, with the structural studies precipitating interest in runningthe seismic line or the result of a new seismic experiment stimulating new structural work. The panel supports this interaction, but did want it pointed out that proposals to the Tectonics program should have their own clearly defined goals independent of those of the large project. It is fine to argue that the presence of the larger project provides the opportunity to do the proposed work or that the bigger project would also benefit from what you want to do. However, a few proposals have argued that the proposed work must be done in order for the larger project to really be successful without offering much about goals specific to the proposal sent to Tectonics. This places the panel (and the program) in an awkward situation. If it is clear that the work is indeed critical to the larger project, the question becomes why was it not proposed/funded under the larger project and how do we factor that into our decision. Alternatively, how can the panel judge the priority of the proposal against other Tectonic proposals when the discussion of goals and purposes are solely tied to these of the larger project? Again, before sending proposals in that have strings to other projects, look at it from the panel's viewpoint. We try hard to avoid building protective fences around our programs, and you can help us avoid such problems in the way you construct and defend your proposals.

Finally, the panel spends considerable time in discussing issues that affect the Division of Earth

Sciences in addition to ranking your proposals. They join us in strongly encouraging you to participate in the debate over long range plans, new programs and the like.

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The November 1 deadline for the Active Tectonics Initiative will remain unchanged. The fiscal 1999 budget for Active Tectonics will not be known for some time yet, but is expected to be approximately the same as in 1998, that is, 1.2 million. However, present reorganization plans reduce the staff of the Tectonics program to a single program director. For the November AT competition, it was decided that Tom Wright would handle the review of AT proposals in addition to the regular Tectonics proposals.

Bob Wintsch, who has handled the AT program as well as sharing responsibility for the Tectonics program will have completed his appointment as a rotator by the time this article is published. Bob has done a great job, and you should tell him "thanks" the next time you run into him.

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Congratulations to the following researchers whose awards were made between the ones reported in the last issue in July.

Tectonics Awards for January 1, 1998 to July 1, 1998

PROP #	PI	INSTITUTION	TITLE
9805	Arrowsmith	Arizona State University	Active Faults in Zones of Continental Collision: Quaternary Deformation in the Pamir-Tien Shan Region, Central Asia
9714	Ave Lallemant	William Marsh Rice Univ	COLLABORATIVE RESEARCH: Geologic and GPS Strain Study: Displacement Partitioning and Arc-Parallel Extension in the Aleutian Volcanic Arc
9805	Bickford	Syracuse University	COLLABORATIVE RESEARCH: How an Orogen Became a Craton: Thermochronologic History of The Trans-Hudson Orogen, Canada
9725	Chamberlain	Dartmouth College	Regional-Scale Fluid Flow in Collisional Mountain Belts: An Active System, Southern Alps, New Zealand
9804	Condie	NM Inst of Mining & Tech	COLLABORATIVE RESEARCH: How an Orogen Became a Craton: Thermochronologic History of The Trans-Hudson Orogen, Canada
9805	Hames	Auburn University	COLLABORATIVE RESEARCH: The Circum-Atlantic Large Igneous Province: Constraints >From Mafic Rocks in the Southeastern U.S.A

9726	Hirth	Woods Hole Ocean Inst	COLLABORATIVE RESEARCH: Dynamic Recrystallization: Microstructural Constraints on the Dynamics and Kinematics of Tectonic Processes
9804	Kodama	Lehigh University	Developing an Inclination Correction for Red Bed Remanence and its Application to Anomalously Shallow Inclinations in Tertiary Red Beds, Tarim Basin, China
9805	Liu	U of Missouri Columbia	Crustal Extension in Orogenic Belts: A Geodynamic Investigation
9805	Meert	Indiana State University	RUI: Neoproterozoic Madagascar: Its Paleoposition and Rolein the Assembly of Gondwana
9805	Nicholson	U of Cal Santa Barbara	Faulting and Folding in Oblique Convergence: Test of Fault-Related Fold Models For Western Transverse Ranges, California
9714	Oldow	University of Idaho	COLLABORATIVE RESEARCH: Geologic and GPS Study: Displacement Partitioning and Arc-Parallel Extension in the Aleutian Volcanic Island Arc
9805	Ruppel	GA Tech Res Corp - GIT	COLLABORATIVE RESEARCH: The Circum-Atlantic Large Igneous Province: Constraints >From Mafic Rocks in the Southeastern U.S.A
9804	Selverstone	University of New Mexico	Proterozoic Assembly of the Northern Colorado Front Range
9725	Tullis	Brown University	COLLABORATIVE RESEARCH: Dynamic Recrystallization: Microstructural Constraints on the Dynamics and Kinematics of Tectonic Processes
Active Tectonics Awards for January 1, 1998 to July 1, 1998			
9807	Dixon	University of Miami	COLLABORATIVE RESEARCH: Active Strain within the Pacific- North American Oblique-Divergent Plate Boundary Baja California Sur, Mexico
9802	Mayer	Miami Univ	COLLABORATIVE RESEARCH: Active Strain within the Pacific- North American Oblique-Divergent Plate Boundary, Baja California Sur, Mexico
9802	Umhoefer	Northern Arizona Univ	RUI: COLLABORATIVE RESEARCH: Active Strain within the Pacific-North American Oblique-Divergent Plate Boundary, Baja California Sur, Mexico

Ramblings of a Past Chair

As I pass into the records as a past officer of the Division, I want to put down a few thoughts on what I have learned after 4 years of working with the Division. I do this in hopes that this note might prompt more people to get involved in the Division because I think we've seen some grass-roots involvement that has led to positive actions. I've made plenty of mistakes, some of which have led to a few lost hours of sleep, but I tried my best to be an advocate for the Division and the interests of the membership. That undoubtedly did not please everyone all of the time and I have really learned a lot about how politicians operate as a result of this experience. Nonetheless, I've enjoyed the experience and thank you all for the opportunity to serve the Division.

I've spent a lot of time working for GSA over the past few years; first on the program committee when the annual meeting was in New Orleans (Laura Serpa was the one who did the real work, but I tagged along) and then as an officer in the division. As a result of that experience I learned some important things about the organization.

First, the organization as a whole, like any large organization, is inherently conservative and slow to make changes. This may be even more extreme at GSA because of its governance structure which largely depends on committees of volunteers. Nonetheless, the organization does respond to membership interests. If you have a strong opinion about something the organization is doing or not doing, let people in Boulder know---they will pay attention. However, if you really want to see changes in the organization there is one easy way to make it happen---volunteer.

Second, at the present time GSA is probably more open to change than in the past. Witness the changes in the annual meeting as an example. A lot of this is the result of Don Davidson, who in my opinion has had a tremendous positive impact on the organization. This is significant because I have become increasingly convinced that GSA needs to completely redo its section vs. division structure and I think Don is in agreement. I believe the days of sections has passed and GSA needs to move toward stronger divisions, including topical meetings and other activities sponsored by the divisions. This is a complicated issue, however, because it is woven into a complex relationship between GSA and the associated societies with which it holds an annual meeting. During my tenure on the management board of the Division, I tried to push this governance issue as much as possible, but it will take a long time to complete any kind of transition of this sort. For example, last year we tabled the idea of a separate division meeting in the short term because there were too many logistical hurdles. I'll do my best to try to continue the job of increasing the impact of divisions---e.g. I was on an *ad hoc* committee on the subject this past year. Nonetheless, if this is an important issue to the membership, you need to keep the issue before the management board, and communicate to the board if you want to help with something like organizing a special meeting, field conference, etc.

Finally, a note on politics. Although this is a small organization, my experience in the Division certainly gave me a better feeling for the problems elected officials face. Last fall as I was in transition from chair to past-chair, I felt caught in a whirlwind of activity that I couldn't see clearly out of at the time. Even the 20/20 vision of hindsight leaves the thing murky, but the whirlwind was in reference to planned changes at NSF that Dr. Ian MacGregor (head of EAR) presented at the Division business meeting. After the business meeting, many people approached me about polling the membership on this issue (reminiscent of lobbyists buttonholing a congressman). I felt obliged to do something by virtue of the office, and as a result we (management board) conducted the e-mail survey reported in the last Newsletter. The extent of the response was startling to me, and convinced me that we should, as an organization, do more of this kind of thing. Nonetheless, what was the effect of the effort? On the short term, some plans were changed. The last that I heard, the plan was to reverse the planned expansion of the CD program by splitting it into two distinct entities---two types of "multi-disciplinary programs". Was this consistent with what the membership wanted? I am not sure. It certainly wasn't what we asked for. Indeed, I fear that tectonic studies at EAR could actually have been hurt, unless the membership continues to give feedback to the NSF. The CD program, which has clearly had a huge positive impact on the earth sciences through multi-disciplinary studies it has sponsored, may have been crippled. Our intent was not to attack the CD program, rather to communicate that the membership was concerned about continued erosion of support for basic programs at the expense of the multi-disciplinary programs. I must accept most of the blame here. I did the final edits on the e-mail documents and failed to step back and take a critical look at the final document that was sent to NSF. Looking back at it now, it reads like an attack on the CD program; yet, the intent of the communication was to try to communicate the membership's support for the Tectonics program, not attack CD. This is particularly ironic for me personally because I had considerable inside knowledge of the workings of the CD program and was simply trying to communicate opinions of the membership---a good example of what I mean by learning how politicians feel when they represent their constituents even though they may not agree with all of their wishes.

So what is the bottom line on this? The squeaking wheel gets greased and even if round 1 did not produce all the results we may have wanted, we did attract attention. This was one of the first times in my memory that the SG&T community attempted to speak as a voice on an issue and we were listened to. That to me is extremely encouraging because geologists have always been the worst group for infighting, rather than speaking as a group. However, if we slide back into our old mode and ignore what is happening, the whole exercise is likely to have been for naught, or even negative. We need to continue to communicate the importance of our own special interest group and pass on the information to organizations like NSF, but probably more importantly we should communicate to people like congressional representatives. If we don't, support for our efforts will continue to erode and we'll become a part of the history of geology rather than a major player in the science.

Terry Pavlis

"HAVE YOU HEARD ... ?"

Sometime in September, perhaps by the time you read this, members of the Cordilleran Section will be asked to vote on whether or not the Section should change its name. Officers of the Section (including this writer) have proposed that the Section's name be changed from "Cordilleran" to "Pacific Rim", effective as of the year 2000 meeting in Vancouver, B. C. Such a name change, as the Section officers see it, has the potential of revitalizing the Section by expanding its scientific mission geographically and geologically. In May, the Society's governing bodies agreed to permit the Cordilleran Section to poll its membership regarding the proposed name change.

Why should a name change be considered? The North American Cordillera, especially its contiguous U. S. portion, is no longer the vast, unstudied terrane it was at the founding of the Section in 1899. Geologic studies in the U.S. Cordillera, where most of Section membership lies, have greatly matured over the past three or four decades. With that maturing, an ever-increasing number of Cordilleran earth scientists have initiated overseas research by far most of those studies in Pacific Rim countries (including Oceania). This trend in our science is exemplified by the theme of the Section's 1999 Centennial meeting in Berkeley: "Century of the Pacific Rim: The Past as Prologue to the Future." There are numerous common geologic grounds between western North America and other convergent and transform terranes surrounding the Pacific Ocean. By renaming the section the Pacific Rim Section its annual meetings could become a forum for the presentation of a greatly enlarged sphere of research enlarged geographically and expanded in geologic processes not active in the present Cordillera (e.g., Pacific marine and Pacific arc processes, and the ongoing continent-arc and continent-continent collisions of eastern Rim areas).
If the name and mission change is approved by Section members, might other ocean-bounding GSA sections themselves look oceanward for geographic and geologic expansion? Hmmm ....

This last spring I conducted an informal survey of overhead rates for U.S. government-sponsored research at academic institutions. Such overhead rates are negotiated between various governmental agencies and the respective academic institutions (Southern Cal's rates, for example, were negotiated with NIH). The results of my rather random survey are interesting and worth sharing with those of you who submit research proposals to NSF and other governmental agencies. I received information on overhead rates and overhead application policies from Division members at 31 public and private universities and two colleges. On-campus rates varied between 69% (Harvard!) and the low 40's. On-campus rates for the eight private universities I received data from range from 45-69%, but six of the eight had overhead rates between 56 and 69%. The range of on-campus overhead rates for state universities is lower and narrower than for most of the privates between 54 and 43%, with only three below 43%. Rates for "off-campus" research (defined and applied very[!] differently among the various academic institutions) have a narrower total range, with all but one university (MIT @ ~ 10%) in the range between 31 and 21%; there is no pattern of differences between public and private institutions. An obvious implication of the data in these days of tightened research monies is that proposals from PI's at public institutions may have an overt to subliminal advantageamongst program directors over PI's with comparable proposals from private schools. For example, an imaginary two-year proposal to NSF with direct costs of $123K (including $56K for foreign travel and overseas salary) can range in total cost (including overhead) from $203K (private) to $156K (public) using data from the 33 responding institutions. I was surprised at just how large a $ disparity can exist between comparable, competing proposals.

People news! Let's start off with honors, awards, and new responsibilities for some of our Division members. **Clark Burchfiel** (MIT) has been accepted into the Chinese Academy of Sciences as a foreign member, a high honor indeed! **Jan Tullis** (Brown) is the worthy winner of the 1998 "Outstanding Educator Award" from the Association of Women Geoscientists (AWG)

Foundation. **Bob Yeats** (Oregon State) is the 1998 recipient of the "Michael T. Halbouty Human Needs Award" from the AAPG. The award, given last May, is in recognition of Bob's use of industry subsurface data towards earthquake hazard mitigation in southern California. From Arizona comes good news concerning two Division members. **George Davis** has been named a Regents Professor at the University of Arizona, the highest faculty title possible at the three Arizona universities and one selected by the Regents themselves on the basis of quality and impact of scholarship and teaching. Given that George was also recently named an AAPG Distinguished Lecturer for 1998-99, its been a fine year for him! Also from the U of A comes news that **Steve Reynolds** (Arizona State) has been awarded a 1998 Alumni Achievement Award from the Department of Geosciences. Division member **Carol Simpson** is the new Spring Meetings Chair for AGU's Boston meetings over the next three years no small task that! Congrats also to **Marcia Bjornerud** for receiving tenure at Lawrence University in Appleton, WI.

Across the "Pond" from Boston, **Sue Treagus** has been awarded a 5-year NERC Senior Research Fellowship to be held at Manchester University for "Characterizing the rheology of rocks from geological structures and modelling." Just up the road from Manchester is Leeds, where soon-to-be Oregon State Ph.D. **Lisa McNeill** (**Bob Yeats** adviser) has been awarded a Dorothy Hodgkin Royal Society Fellowship for four years. She will work with **Richard Collier** at the University of Leeds. The only other Commonwealth news on hand is that **Ray Price** is now Professor Emeritus at Queen's University; despite his retirement, it will come as no surprise to anyone that he will continue his studies of Cordilleran tectonics and thrust and fold belts at Queen's.
As always, there is news of new positions for Division members. New academic and industry hires we've learned about are noted, respectively, here and in the "Industry" column elsewhere in this "Newsletter". **Clyde (CJ) Northrup** leaves a post-doc position at Boston U for a faculty slot at Boise State this fall. Mount Holyoke College, MA, will welcome **Michelle Markley** to its tenure-track faculty this fall as well. Michelle's 1998 Ph.D. adviser was **Christian Teyssier** at the University of Minnesota. Two 1998 Ph.D. graduates from **Dave Pollard's** and **Atilla Aydin's** structure-tectonics program at Stanford have gained tenure-track positions this year. **Juliet Crider** will go to Bryn Mawr College, and **Simon Kattenhorn** to the University of Idaho. **Basil Tykoff** of Rice University is now a new faculty member at Wisconsin. In January, **Jane Gilotti** of the New York State Geological Survey, will leave Albany for a position in structural geology at the University of Iowa. **Michael Wells** of the Department of Geosciences at UNLV has been promoted to Associate Prof with tenure. That department has now received final approval for a Ph.D. program designed to approach the Earth as an integrated dynamic system.

Post-doc news: **Dave Dinter**, a **John Bartley** post-doc at the University of Utah has been advanced to Research Assistant Professor. Two new post-docs have joined **John Suppe's** Princeton 3D Structure Project. They are **Luther Strayer** (Ph.D. Minnesota, adviser **Peter Hudleston**) and **Aurelia Hubert Ferrari** (Ph.D., Tectonics lab of IPG Paris, working with **Rolando Armijo** and **Geoffrey King**). **Ben Fackler-Adams**, a recent Ph.D. from UCSB (adviser **Kathy Busby**) is now post-doc'ng at UCLA with **Gary Axen** on Tertiary tectonics in Baja California.

Sad news department: **Brian Wernicke** was badly injured in a car accident in July while doing field studies in southern Nevada. His field vehicle was hit nearly head-on by a car which left its incoming lane and crossed into his. Fortunately, the bulk of his vehicle protected him to some extent and by the time you read this he will, hopefully, be as chipper and healthy as ever! "GSA Today" announced in April that Division member and GSA Fellow **Thomas Kesler** of Bellevue, Washington, passed away last November. Thomas had been a member of GSA for over 50 years since 1945.

GAD

Editors' note: We apologize for omissions to people-type news in this and its counterpart "Industry" column, but we do try our best to solicit such information. Please do not be shy about contacting us yourselves if you'd like mention of your new job or position, transfers, honors and awards, etc. We won't identify you as the source for such information. Honest!

SG&T in Industry

We're pleased to report that not only are structural geologists finding gainful employment in industry, but that some of our industry colleagues are representing the Division on the national and international fronts as well. Specifically, this past spring **Carlos Dengo** (Exxon Exploration Company) completed a tour of Central & South America as an AAPG Distinguished Lecturer, where he presented two talks: "Managing Technology in Today's Exploration Environment" and "Tectonic Architecture of the Subandean Fold and Thrust Belt: Structural Style, Variations and Occurrence of Hydrocarbon Traps". As Carlos rotates off, **Ron Nelson**, structural geologist in Amoco's Exploration and Production Technology Group, has started traveling to Southeast Asia asone of AAPG's Distinguished International Lecturers. His presentations focus on exploration and exploitation of fractured reservoirs.

New hires and transfers...in Canada, **Marian Warren** (1998 Ph.D. at Queen's supervised by **Ray Price**) has joined PanCanadian Petroleum in Calgary and is working on the tectonics and petroleum resources of southern Quebec. Also above the border, **Rob Scammell** and **Greg Soule**, structural geologists formerly with Amoco Canada, have recently moved to Poco Petroleum (Calgary) and to Rigel Resources (Calgary), respectively. Down in Colorado, **Bob Ratliff** and a team of programmers responsible for the structural restoration software GeoSec and GeoSec 3D have left Paradigm Geophysical following its purchase of CogniSeis Development. They plan to create a new generation of structural analysis applications under the original company name of Geo-Logic Systems and intend to be "very supportive" of academic and research users. Bob has also been working with the Gulf of Mexico consortium group at the University of Colorado. Staying in the west, the Quantitative Structural Geology, Geomechanics,and Active Tectonics program at Stanford (co-directed by **Atilla Aydin** and **Dave Pollard**) have found their students in high demand. In addition to 2 graduates beginning academic careers, **Judson Jacobs** (M.S., advisor **Atilla Aydin**) is starting with The Mitchell Madison Group. and **Thomas Roznovsky** (M.S., advisor **Atilla Aydin**) joins Occidental Petroleum Corp. Chevron seems busy these days....**Gregor Shoenborn**, recently a professor at Nuechetel, Switzerland, and **Joao Keller**, recently with the University of Calgary, have joined the Structural Geology Team at Chevron Petroleum Technology Company, in La Habra. **Bill Higgs** is leaving this group to take an assignment with Western Australia Petroleum, in Perth. **Mary Parke**, a recent Ph.D with **Rick Allmendinger** at Cornell, has joined Chevron in San

Ramon,CA, working on Nigeria. **Erin Campbell-Stone**, a Ph.D. with **Barbara John** at Wyoming, is now working for Chevron in Lafayette, Louisiana, as a development geologist. And lastly, **Robert Hooper**, structural geologist with Conoco, is moving (this month) to Aberdeen (Scotland) for a stretch in their North Sea exploration facilities. Good luck all!

MEMORIAL TO BENJAMIN M. PAGE
1911-1997

We lost Ben Page on January 31, 1997; he died at his home in Palo Alto, California at 85. GSA memorials need to serve several purposes. This one for Ben provides a brief summary of his vitae, career, and research, and of how his contributions were recognized by our profession. I also intend for it to convey some of Ben's personal attributes, which make recollections of him so indelible for his professional friends, colleagues, and students.

First, some vital statistics. Ben was born in Pasadena, California as the grandson of Henry Markham, a congressman and governor of his native state. Ben's well-known, life-long devotion to Stanford University, where he spent practically his entire career as a teacher and scholar save for a brief stint on the faculty of the University of Southern California from 1937 to 1941, is understandable: his parents graduated in the Stanford Class of 1899, and Ben himself received his Bachelor's (1933), Master's (1934), and Ph.D. (1940) degrees in geology from Stanford. His wife, Virginia (Ginny) Ingrim Page, who died in 1995, was also in the Class of 1933. Ben and Ginny are survived by their daughter Nancy Page, son Benjamin I. Page, and five grandchildren.

Ben was appointed to the faculty at Stanford in 1943, and he became Emeritus Professor in 1976. I am just one of hundreds of students who benefitted from his classes on subjects such as introductory physical geology, structural geology, and tectonics. Earlier generations knew him from the summer field course, the Stanford Geological Survey, in which he participated as a student in 1932 and directed from 1939 to 1949. He served twice as head of the Department of Geology, first under Dean Charles Park in the 1950's and then under Dean Richard Jahns from 1965 until 1968.

Ben's field research and publications addressed topics as diverse as the origin of chaotic rocks in the Apennines, on Taiwan, and on the Stanford campus, and the geology of Nevada. His singular contribution to our science was his appreciation, which began in the late 1960's and lasted the remainder of his life, that many of the seemingly intractable geologic complexities of the California Coast Ranges were readily understandable in the context of plate tectonics. Ben combined a remarkable willingness to consider and evaluate new ideas, with evidence from geologic mapping, field observations, and geophysics. He gave us a steady stream of papers, geologic maps, and cross sections illustrating how plate-tectonic processes are expressed in the geologic record, both on land and just offshore.

The scope of Ben's interests and scholarship can be judged from his bibliography. To many of us, it seemed that he was as active as an emeritus in his ninth decade as he had been earlier! For example, Ben helped his Russian colleagues, especially Lev Zonenshain, publish their works in

English. He edited the English translation of the 1992 book "Paleogeodynamics" byZonenshain and Kuzmin, which AGU published posthumously in 1997. He also continued to work on his compilation map of the geology of the Stanford lands, which has been completed and published as a memorial to his long-term interest in the campus and vicinity. In recognition of his professional accomplishments and stature, Ben received a Guggenheim Fellowship, which he used to study the geology of the northern Apennines in 1959-1960. He was elected a Fellow of the American Geophysical Union, and he served as Editor-in-Chief of the AGU journal Tectonics from 1985 to 1988. In 1993, he received the prestigious Career Contribution Award of the Division of Structural Geology and Tectonics of GSA.

Most of what is printed above more or less typifies the content of formal memorials. I write the following on a much more personal level, because whenever I think of Ben Page, I see and hear the person, not the vitae and accomplishments. I believe that anyone who knew him well or even casually would want to remark here on his unfailing courtesy and kindness and his consideration for the opinions of others. His friends would probably wish to relate an anecdote or two that captures some aspects of Ben's character and personality.

My little story concerns a couple of weeks we spent together in the early summer of 1970; I can even recall specific conversations as though they occurred yesterday. I was still a graduate student at Stanford when Ben invited me, as earlier he had another student, to assist him as he mapped part of the Coast Ranges just north of San Luis Obispo. Always careful to credit other workers for their ideas and observations, Ben explained how he was drawn to this area by suggestions that the mafic and ultramafic rocks there might be a slab of late Mesozoic oceanic crust, which we now call the Coast Range ophiolite. He honored the original work of H. W. Fairbanks by showing me the 1904 geologic map of the San Luis quadrangle from U.S.G.S. Folio 101 and pointing out that Fairbanks had recognized all of the pertinent rock units, even if their origin and disposition must have seemed mysterious at the turn of the century. By 1970, Ben was reveling and fully participating in the exciting reinterpretations of California geology, which were engendered by plate tectonics. Notwithstanding his homage to contemporary colleagues, I privately thought that Ben had figured out a lot of these reinterpretations by himself. Watching him I learned, really for the first time, the predictive power of a fruitful idea. I was impressed when he would say, for example, "I think the serpentine on Fairbanks's map probably constitutes landslides, but we have to go check the contacts." He said that Fairbanks's unit of Cuesta Diabase might be where we would find the distinctive but volumetrically minor albite- and quartz-bearing igneous rocks, which we would later come to know as plagiogranite. Sure enough, one day we found these exposed along a dirt road near Cuesta Pass. As our discovery sunk in, he said very slowly but emphatically, "Oh, fine!" Ben was always the opposite of frantic or hyper, but on this occasion he looked at me and said, "I think I'm going to let out a yell." I replied, "I will too!" The site of our extravagance is recorded in Figure 7 of Ben's 1972 paper in the GSA Bulletin.

The days were already hot. Once I was sitting in the shade under a tree while Ben busily examined an outcrop nearby and started to write his notes. "Darrel, Charlie always liked to measure strikes and dips while I was writing notes." How perfectly this comment epitomizes for me his tact! Others might have abruptly told me to get off my butt and do something useful, or instead might not have said anything while privately writing me off as a slacker. Beneath Ben's self-effacing and"aw-shucks ' demeanor were firmly held opinions, which he would not hesitate to express if the occasion were appropriate. He engaged in any debate, geological and otherwise, with courtesy and with respect for points of view that were at odds with his own.

We liked to camp on top of Cuesta Ridge. Our afternoon ritual was to wash up under a trickle issuing out of a pipe stuck in a roadcut and then relax in camp with a can of juice. I favored Kerns apricot nectar, but one afternoon I secretly coveted Ben's V-8, looked in the cooler, and, finding none, sat back down. Ben asked if I were still thirsty, and I replied that I was looking for a V-8 but that he had apparently gotten the last one. He immediately got up, tried to hand me his, and said, "Oh here, finish mine!" I declined politely but firmly, privately wondering when I would learn not to tempt his ever-present inclination for self-sacrifice and his concern for the well-being of others.
As I implied above, anyone else memorializing Ben could relate similar anecdotes. Each of mine is insignificant, but if all of ours were added together, they would tell the story of someone who we were very fortunate to know. Beyond the enjoyment of daily field work with Ben that summer, I remember another personal milestone that I achieved, and I can now thank Ben for having reached it even though I would never have been able to tell him so in person. Some evenings, as we sat and chatted in our little makeshift camp surrounded by the Sargent cypress on Cuesta Ridge, I sensed the wonderful realization that our relationship was no longer one of the hierarchical senior professor and graduate student. We were simply two colleagues swept along by our mutual respect, curiosity, and love of the geology.

Darrel S. Cowan

University of Washington

Theme Session Summary
Feedbacks between Tectonics and Surface Processes in Orogenesis
Convener: Nicholas Pinter & Doug Burbank

The "Tectonics and Surface Processes" theme session was held on Thursday afternoon of the GSA meeting. In spite of the thinning ranks of meeting attendees (with even some session speakers running for flights and field trips), the theme session was well attended. **Doug Burbank** and I convened this session to bring together researchers from the broad spectrum of disciplines working on the interactions between tectonics, climate, and geomorphic processes in regional landscape evolution. Qualitative and quantitative landscape models have leapfrogged forward with the recognition that orogenesis acts as a dynamic system, with powerful feedback mechanisms linking tectonics, topography, and erosion. The evolution of mountain ranges seems to be the focus of this research because rates of both tectonics and surface processes are greatest in these regions. The theme session was noteworthy for the breadth of research approaches, investigators, and study areas represented. The speakers were an international crowd, with the U.S., Britain, Australia, Austria, Ireland, Germany, and Japan represented among the authors. Field areas discussed were similarly global, including southern Africa, the Alps, Turkey, the Pyrenees, the Andes, the Rockies, the Basin and Range, Spitsbergen, the California Transverse Ranges, the Sierra Nevada of California, the San Gabriel Mts., the Olympics, the Southern Alps, and the Japan mountains.

The talks within the theme session were organized thematically into: 1) regional syntheses, 2) techniques applicable to orogenic research, and 3) sweeping models of tectonic-geomorphic interaction. The session opened with the somewhat enigmatically titled presentation, "*The*

`Cybernetic' Model of Orogenesis" by **Pinter**. This talk outlined some of the implications of a strongly coupled tectonic-climatic-geomorphic system, and it suggested that this system can be called "cybernetic" because that term referring to "command and control processes in electronic, mechanical, biological, [and geological] systems" emphasizes the interconnectedness and mutual-regulation of the elements in the orogenic system.

The next seven talks were excellent regional syntheses. **Mike Summerfield** presented fission-track ages and numerical models of escarpment retreat to show the interaction of denudation, flexural isostasy, and topographic evolution in southern Africa. **Kurt Stüwe** discussed the linkages between relief, denudation, and the geological structure of the eastern European Alps. **Yildirim Dilek** discussed the structural and geomorphic evolution of central Anatolia. **Gareth Morris** presented topographic, structural, stratigraphic, and geochemical data from the central and eastern Pyrenees that documented the tectonic genesis and exhumation of the region. **John Gephart** outlined the tectonic and climatic controls on the evolution of the central Andes. And **Merri Lisa Formento-Trigilio** and **Shari Kelley** presented a pair of talks on the post-Laramide evolution of the Southern Rocky Mountains.

The next batch of talks focused on the technical state-of-the science in coupled tectonic-geomorphic history. Much recent research seems to utilize numerical simulations of landscape evolution, thermochronological analyses, and/or regional analysis of topography using digital elevation models (DEMs). **Michael Ellis** and **Robert Anderson** both presented results from runs of the ZSCAPE finite-difference model, Mike working on range-front evolution in the Basin and Range, and Bob looking at degradation of wave-cut coastal terraces. **Ann Blythe** presented an overview of the use of apatite fission-track ages for determining thermal and exhumation histories. **Martha House** discussed exhumation results from (U-Th)/He apatite dating in the Sierra Nevada. **Eric Fielding** presented topographic analyses of very high resolution (5 m and 10 m) DEMs constructed from NASA TOPSAR datasets. Finally, **Sean Willett** used a coupled tectonic-erosional simulation to evaluate the major controls on exhumation in convergent orogens.

The last group of talks was a pair of sweeping discussions, outlining some of the broad andsignificant implications of "systems-based" or "feedback-rich" models of orogenesis and regional landscape evolution. **William Hay** discussed recent results and the current thinking on the Late Cenozoic history of climate change and global mountain building. Bill discussed a number of possible causal mechanisms, presenting evidence from the Alps, the Caledonides, and the Variscan mountains. The last talk of the session, and indeed of the entire meeting, was presented by **Hiroo Ohmori**. Dr. Ohmori presented a broad model of tectonic-topographic interactions, based on the landforms and the hypsometry of Japan. At its heart, this model suggests that the balance between tectonic and erosional rates leads to three stages in mountain-range evolution: 1) a stage where altitude and relief increase, 2) a stage where uplift and denudation are in dynamic equilibrium, and 3) a stage where climate change or tectonic shifts cause regional altitudes and relief to decline. This model was a provocative note on which to end the theme session. Following a decades-long backlash against W.M. Davis' Cycle of Erosion, recent multi-disciplinary field-, laboratory-, and simulation-based studies of orogenesis may have brought research full circle, back to models of time-dependent landscape evolution. In the discussions that followed the session, there seemed to be a consensus that the recent research was making such strides because of the considerable synergism from the different approaches being employed. The new sweeping models seem to be significant, solidly-grounded on empirical data, and represent an important contribution to structural, geomorphic, and tectonic research.

Nicholas Pinter

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Book Review

" *FUNDAMENTALS OF ROCK MECHANICS*"

Ruud Weijermars

Alboran Science Publishing, 1997, Amsterdam; ISBN 90-5674-002-4

Ruud Weijermars has written an interesting and idiosyncratic textbook intended for a one semester lecture and laboratory course in geology. The book begins with an unusual series of prefaces that include descriptions of related books by the same publisher, a biographical sketch of the book's editor, and information for prospective authors in essence, an advertisement for the publisher. The heart of the text is divided into two parts, the first on mechanics and rheology and the second devoted to tensors and deformation analysis. Unlike other rock mechanics texts that are oriented towards engineers, this book is slanted heavily towards structural geology students.

Part 1 contains chapters titled: Introduction to Rock Mechanics; Physical Quantities and Continua; Force, Pressure, and Stress; Stress; Elasticity; Brittle Failure; Ductile Creep; and Viscosity and Flow Laws. The material contained in these chapters is standard, supplemented by interesting Practical Hints (for example, visit a rotary drilling rig and ask the drilling engineer about mud weight and lithostatic pressure to get a taste for mechanics in real life) and Exercises with solutions provided at the end of the book. I especially enjoyed photographs of "... two distinguished field geologists, using airspace to gesticulate movement patterns, while verbally explaining their kinematic models of rock deformation", although I think that in most cases the last thing that structural geology students need is more instruction in arm waving! A table of symbols, including the SI units associated with each symbol and the number of the equation in which the symbol is first used, is a welcome addition. Other tables, such as those including SI units for things such as radiation (the Bequerel) and magnetic flux (the Weber) seem superfluous. Likewise, rock mechanics problems generally do not involve quantities for which units of length are conveniently expressed in picometers or parsecs, although this material is included.

The sections on force and stress contain simple introductions to topics such as stress on arbitrarily oriented planes and Cauchy's principle, sliding blocks with and without pore water pressure, and the standard lithostatic state of stress. These are generally well done and at a level suitable for undergraduate geology students.

Concepts such as the stress ellipsoid and stress trajectories are also introduced intuitivelyand geometrically in Part 1, leading to the inclusion of plots of principal stress orientations for situations such as stresses around pressurized domes and the results of a vaguely described finite element simulation of a salt dome. In other words, solutions that are far beyond the ability of students just being introduced to the art and science of geomechanics. This, in my opinion, is a shortcoming because it encourages the practice of concluding that mechanical insights can be

gained by intuiting things such as principal stress orientations rather than by formulating and solving boundary value problems. Along the same vein Anderson's three idealized fault types are not presented as idealized end members based upon a series of simplifying assumptions, but rather as the way faults are in reality. In my experience, explicitly working through all of Anderson's assumptions and limitations is an excellent way to illustrate how one moves between idealized models and field observations.
Rheological models are illustrated throughout Part 1 using one-dimensional models, experimental results, and photos of geologic phenomena that presumably embody the rheological properties being discussed. Diagrams of elastic springs, peak strength plugs, and viscous dashpots abound. When teaching geomechanics, I generally prefer to separate idealized rheological models from real geologic processes in order to emphasize that rheological models are human idealizations and rocks are nothing more or less than what they are. In other words, a particular rheological model may be useful for explaining some of the general patterns that we see in nature, but this isn't to say that rock are inherently elastic, viscous, viscoelastic, or anything else. And, a rock that is elastic to the seismologist interested in wave propagation on a short time scale may well be viscous to the structural geologist interested in the folding of layered sequences on a long time scale! In this regard, I much prefer the rheological approach outlined in Arvid Johnson's "Physical Processes in Geology" to that employed by Weijermaars.

Part 2 begins with a chapter titled Mathematical Review, including an interesting discussion of the carnage that can arise when geologists collide with mathematics. Weijermaars lightheartedly represents the problem with a cartoon showing a perplexed "geo math genius" teetering between the happy Land of Mathos and the sad Land of Nomaths. The mathematical overview includes a quick tour of differentiation and integration, basic matrix operations, and a description of both ordinary and partial differential equations (but no advice on how to solve them!), which sets the stage for the remainder of the book. Bringing geology students up to speed in mathematics is a sometimes daunting task, and I think that it deserves more attention than is given in Weijermars' book. Detailed, step by step example problems throughout the text would have been a great improvement over a short summary.

The remaining chapters in Part 2 are: Stress Tensors; Strain and Strain Tensors; Deformation and Deformation Tensors; Particle Movements and Stream Functions; Deformation of Single Layers; Practical Strain Analysis; and Outlook for Rock Mechanics. In general, each chapter concentrates on the components of various tensors, and how the tensors can be decomposed and manipulated. A great deal of attention is devoted to topics in finite strain, and analysis of deformation is taken to mean principally the visualization of strain ellipsoids and velocity fields by one technique or another. The chapter on particle movement and stream functions, for example, includes examples of calculated velocity fields and streamlines but does not specify the origin of the fields. The critical issue of boundary conditions (and how they are related to features observable in the field) is sidestepped because, with the exception of superficial mention of the biharmonic equation, no attention is devoted to the relationships between stress and displacement or velocity. It is suggested that in practice stream functions are obtained by integrating known velocity fields, which has limited applications in geology because there are few processes for which we can measure actual velocity fields. Glaciers and landslides, perhaps, and maybe lava flows, but how does one determine the velocity field in a fold that formed in the past?

The text almost completely ignores the great progress that has occurred during the past 20 to 30 years in the application of continuum mechanics to structural geology problems, such as the folding of multilayers and the growth of fracture systems, both in terms of the material selected for inclusion in the body of the text and the suggested readings given at the end of each chapter. I find this disheartening, because it signifies to me that good old fashioned arm waving has been replaced with tensor waving at the expense of mechanical insight. This is not to say that the various tensorsof importance in continuum mechanics should not be covered, but rather that tensors and their manipulation shouldn't be seen as ends unto themselves.

Form can go a long way towards making substance digestible and, aside from its technical content, I was disappointed by the layout and production quality of the book. Many pages of the book combine figures, hints and/or exercises in gray shaded boxes, with two column text wrapped around the figures and boxes. In many cases, column widths change in mid-paragraph to accommodate odd sized figures, and the overall appearance is that of a book assembled on a desktop publishing system with little concern for aesthetics. This makes for difficult reading. But, the author should not be faulted for the publisher's sins.
I opened the book unfamiliar with Ruud Weijermars' work but with high hopes, because there is a desperate need for good geologically oriented mechanics tests, and closed it in disappointment. I'm sure that many will disagree with my assessment, because the approach taken in Part 2 of the book is popular among many structural geologists. For my money, however, Johnson's "Physical Processes in Geology" , Turcotte and Schubert's "Geodynamics", and Oertel's "Stress and Deformation" remain superior choices for introducing structural geology students to mechanics.

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Book Review

" STRUCTURAL GEOLOGY AND MAP INTERPRETATION"

Ruud Weijermars

Alboran Science Publishing, 1997, Amsterdam; ISBN 90-5674-001-6

The author went to college in Holland, received a Ph.D. at Uppsala, and now teaches at the university in Dhahran, Saudi Arabia. The book is not about how rocks deform, but is an interesting description and discussion, with exercises, about reading geologic maps and other kinds of images. The English is simple, direct, and unambiguous. The text assumes that the student has some geology already, but the presentation is basic. What the book describes, and illustrates with numerous helpful figures, is completely explicit. The presentation suggests to me that the author has taught a good many students who lack much comprehension of geometric relations in three dimensions.

The seventeen chapters will help any student understand the content of geologic maps and remote-sensed images. There are chapters on cross sections and construction of three-dimensional perspective drawings. Remembering that this is a book about geologic maps makes it easy to see why sink holes and glacial moraines are discussed in Chapter 15. Chapter 16 gives a brief outline of methods of remote sensing, including aerial photos, ground penetrating radar, and satellite digital imaging, including useful tables and figures comparing the minimum-size features resolvable by each. For those of us who walk around on the ground and draw contacts with a 5-H pencil, it may be sobering to find out that some satellites cannot recognize the existence of some formations visible on geologic maps at a scale of 1:250,000. One pixel of the digital image can be wider than the formation, a beautiful example of the need to understand what one is looking at in order to understand what one sees.

I believe the exercises are useful. There is adequate drill on how folds and faults look on maps, including possible ambiguities in movement direction of faults. The author is to be complimented on recognizing that for many students just because a subject was pasteurized doesn't guarantee that the student will grasp its ideas. Even to an old field geologist, a few of the exercises are interesting (e.g. 6-5 and 8-11). Although several involve completing a map from scattered outcrops, the book contains no instruction about field methods of making a map; this is the topic of a separate book scheduled to appear in 1999.

The practical uses of information on geologic maps are brought out in many places. in the introductory chapter, and applications in mining and civil engineering are noted. Finding oil traps and ground water are on the mind of any geologist in Saudi Arabia, and these topics are brought up in many places in this book. Chapters 14 and 15 give attention to recognizing mudflows, nue ´e ardentes and landslides on maps, with vivid examples from Peru, western U.S., and northern Italy. In my opinion, a good many textbooks spend too much energy on esoterica; Weijermars interests students in the everyday usefulness of his subject.

For a first printing, the book is pretty light on typos and errors, but there are a few. In Fig. 9-6b, the older rocks beneath the unconformity would strike west of north on a flat surface after tilting and beveling for the second time. The solution in Appendix D to Exercise 12-3 has a misdirection. In three figures, hachures are on the wrong side of faults. Fig. 12-21 lacks the A-B line required for Exercise 12-12. On page 248, the reference to Fig. 15-14b is really to Fig. 15-17b. All in all, a trivial list mostly reflecting changes in figures through the iterations involved in producing such a book.

The 17th and final chapter is titled "Computerization of Map Analysis" and seems a bit jargon-stuffed to me. The author states that equipment and software change too rapidly for him to be up to date by the time the book is read, but there are some useful hints here. Then come 80 pages of appendices and indices and a surprising ten pages of addresses of firms and bureaus from which one can get maps, aerial photos and software, including quite a few advertisements.
In summary, this is a basic book about reading geologic maps with quite a bit of the practical applications of such maps. The inclusion of a chapter about remote sensing, especially satellite imagery is useful, but I didn't get much out of the chapter on computer manipulation of map data. The book is carefully written, and the exercises serve well the intended purpose of drill on the basics. A student who looks at the multitude of illustrations will certainly learn a great deal.

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Book Review

"EARTH STRUCTURE:AN INTRODUCTION TO STRUCTURAL GEOLOGY AND TECTONICS"

Ben van der Pluijm and Stephen Marshak

WCB/McGraw-Hill, 1997, ISBN 0-697-17234-1

The primary uses of a textbook are to coordinate with lecture material and to provide background and detailed explanations for students in the class. Therefore, no review would be complete without the input from students. After all, they buy and use the textbook. For this review, I not only read the book, but also used it in an introductory Structural Geology course in the spring 1998 semester. I collected informal and verbal formative evaluations throughout the semester as well as voluntary written summative evaluations.

In the preface, the authors state that this is a different kind of textbook. The book is designed with the student in mind, employing a "distillation" of the material to avoid overwhelming students. It also uses a "breezy" writing style, wherever possible using familiar analogs. Neither one of these ideas is unique, but the degree and combination appears particularly effective. The students liked the book and felt that they understood concepts that were being explained. I have never had such positive student feedback for a textbook.

I did not cover all of the chapters in my class. I can barely cover Structural Geology in one semester without adding detailed Tectonics. The chapters were used out of order with no particular problem. All topics that I wanted to cover in class had corresponding chapters. I always used the book to accompany my lectures.

Generally, the book is very good to excellent. For its purpose, it could be the best book onthe market. Several features are especially useful. Instead of having one large glossary at the end of the book, there are glossary tables of definitions of the chapter topics within each chapter. As I used terms, students could read the definitions. The figures and illustrations are also of excellent quality and quite complete in most areas. I handed out only four or five photocopies of figures for lecture all semester. The other useful feature is the series of essays by guest authors. There are many orogens described by some of the experts. They are an excellent addition. Even though they are billed as distillations, several of the chapters are the best I've seen in any structural geology textbook. Of those that I used, the chapters on Ductile Deformation and Processes and on Primary and Neotectonic Structures are in that category. The chapters on Convergence and Collision and on Whole Earth Structure and Plate Tectonics are also first rate. None of the chapters are poor.

The major shortcomings that I found with the book are primarily not over erroneous material or completeness, but rather organization. These organizational problems are both between and within chapters. Chapter 8 on Faults and Faulting defines many features of faults that are appropriate to later chapters on specific fault systems. Without the proper context, the significance of a duplex structure or a positive flower structure cannot be appreciated. When lecturing on the later chapters, the class had to constantly flip back and forth to chapter 8 because many of the figures are better there and commonly the material and figures are not repeated. This problem affects the chapters on thrust systems, extension, and strike-slip tectonics. Organization within some of the chapters is also insufficient. The chapter on folds has classification in the anatomy section, anatomy in the classification section, and classification in the facing, fold systems, and special cases sections. The figures showing some classification are literally thumb-nail sketches and combine two variables (axial plane and fold axis) rather than showing each separately. Fold shapes are not described in the classification section and only less common ones are included. The term circular fold is never used. I harp on this point because throughout the semester when I asked students to classify folds, they would give me half a classification and show me that the book didn't include most of what I was looking for as part of a classification scheme.

The chapters on extension and strike-slip tectonics could use some revising. The extension chapter concentrates heavily on features of active rifting and does it very effectively. However, there is only a passing reference to Gulf Coast type structures and one regional seismic line. Considering that many students could wind up working there or in a similar region, a bit more emphasis would be appropriate. The strike-slip chapter could use some better figures and description. Strike-slip duplexes are impossible to decipher from the figure and an extensional strike-slip duplex is labeled as a negative flower structure. The step-over descriptions are poor and only show extensional features; there is no pop-up structure.

There are also a few comments of substance that I found. I will provide examples of them as types rather than addressing each one. At times, I found the breezy writing inappropriate. For example, Riedel shears have distinct sequences of opening with specific angles based on angle of internal friction, and under specific shear strains. The textbook has a poorly labeled figure with a vague discussion and none of the constraints. Of the components rotation, translation, and distortion, the term distortion was replaced with strain. Further, translation was illustrated with the example of brittle faulting. This means that a student can walk up to a rock that had experienced 30% extension through a series of brittle normal faults and claim that it is unstrained. Many old structural terms have been replaced with new ones without references. If a student reads about tension gashes or polished slickensides or any number of terms in another book, they will have no clue what is being referred to. On the other hand, they can read about chattermarks on brittle faults in the textbook (also an outdated term) rather than R, T, or P criteria.

In summary, I found the book to be generally very good and a pleasure to use. The students enjoyed it and gave it high ratings as well as praise. I will definitely choose it again for next year's class. It could be improved, however, in a second edition to become the classic text for introductory Structural Geology.

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Structural Geology & Computers: The Virtual University

These days everywhere you look "The Virtual University" seems to pop up. The New York Times (search "distance learning" on site http://search.nytimes.com/search/daily/) among many papers has articles on distance learning, as do news magazines. We are no longer just talking the Journal of Higher Education here. You may have read about the apparent success of the University of Phoenix (not entirely virtual; http://www.uophx.edu/) or the Western Governors University (http://www.wiche.edu/elnet/guanajuato/presentations/WGU/index.htm). Perhaps some units in your own institution offer similar services (like the UC system). In particular, politicians and upper-level university administrators have taken an interest in this topic. Perhaps that immediately signals caution, but let's see what this is about. I do not claim, by any means, to be an expert on the topic. Rather, as a member of our Provost Task Force on Distance Learning, I gave the topic at least some thought.

Over the past few months a group of about 12 people from all corners of academia and administration met to discuss the topic of distance learning. Members from professional schools, liberal arts departments, administration, etc. were all represented. During these discussions it became clear that there are several, but not necessarily mutually exclusive, forces at work. Some consider distance learning an opportunity to export courses to off-campus students, thereby broadening the audience. Others see the current technological revolution as an opportunity to enhance traditional instructional techniques (i.e., on-campus instruction), while yet others see distance learning as an opportunity to make more/new money for universities. One can (cynically) imagine a final group who would consider this a unique opportunity to change the traditional structure of universities, where permanently employed professors in firmly established disciplines define the academic culture; this view was not advanced in our task force. You can likely guess who would most identify with each of these perspectives.

Whereas there is obvious overlap, I distinguish between *distance learning* and *digital learning* for now. The former, distance learning, emphasizes the delivery of material to off-campus communities; outside the traditional university structure. This is mostly where the Virtual University comes in; no campus, no set curriculum, and primarily product-based instructional staff. The latter, digital learning, emphasizes new instructional opportunities, particularly internet-based interactive student activities. A virtual field trip complemented by online questions would be one example of this (in a later column I will discuss some efforts in this particular arena).

Let's first focus on distance learning in the restricted sense, and concentrate on the lecture component of classes only. Take a pertinent class for SG&T Division as an example. In the early part of my structure/tectonics course, I make extensive use of visual aids, such as hand specimens, analog materials, maps and simple experiments (aided by an excellent () text). Rather than merely supporting what is being said by me, I ask students to describe what they see in the specimens and in the experiments. The aim, of course, is to stimulate personal observation, expression of thought and begin to develop an intuitive understanding of deformation through hands-on experiences. Only then I move to stress/strain/rheology, where the classroom observations are quantified. Now, imagine that I want to export my class to an off-campus audience (with foreign accent and all...). I would think that the cornerstone of my class approach, interaction and discussion, will become lost. Rather, experiments, samples, slides, etc. can only be presented as set images in the course package. These images may be fancy (animation, video, audio, etc.), but they are prepackaged nonetheless. Only through online chat rooms or other synchronous communication (e.g. video conferencing), could I perhaps offer some directinteraction. This would require that off-campus students are simultaneously instructed in remote classrooms with internet/video connection. Or, I would simply have to change my instructional approach in off-site classes. A second example. I also teach a general science class, "How the Earth works", which seems to be perfectly suited for distance learning. I already offer webpages with text, animations and videos, I give online exercises, have interactive study guides, which can all be accessed from any computer location. Communication with the class is arranged through webconferencing (a password-protected, non-removable database of questions and answers that can be accessed from any browser, anywhere), and submission of completed exercises occurs through web forms (type answer and click on submit button). Wondering why I still bother with classroom instruction brings us to the heart of my argument. Instruction is more than exchanging information with a (un-)willing audience. Person-to-person interaction is more often than not required to motivate students. Offering well-written and well-produced material makes the beginnings of a good course. But I have to spend a considerable fraction of my time trying to get the students to talk and think for themselves. They need to explore alternative views and learn to accept errors in interpretation. Distance learning, in contrast, seems more skill-oriented education, and therefore works perhaps best when specific techniques or trades (such as metal stamping, small-business accounting, liposuction) are offered to a well-motivated audience. Does this apply to your students?

Distance learning seems quite suitable for high-demand classes in professional schools, such as business and nursing. It offers the opportunity for students to take different courses and to select those with a particular perspective (courses on public health from the UK and from the US will likely be quite different). Looking at a screen and working on a keyboard, however, is not the most inspirational way to learn for everyone nor necessarily appropriate for all topics. But modern computer technology offers new opportunities to innovate our current courses and to stimulate increasingly computer literate students. Distance learning in the broad sense (so, including enhancing current courses with internet-based activities), therefore, seems an inevitable and desirable step in the evolution of education. Heck, the many articles in prestigious publications, the aggressive support from computer companies and interest by our policy makers suggest that there is no stopping this train anyhow. Let's just make sure that this educational revolution will be headed by instructors and students, so get on board and be heard.

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CHARLES RICHTER AND THE NORTHRIDGE EARTHQUAKE

Here's an interesting and ironic vignette of science history. It concerns the famed Cal Tech seismologist Charles Richter and is taken from an article by Michael Forrest entitled "Charles Richter, Part Two", 1998, Southern California Earthquake Center Quarterly Newsletter, v. 4, no. 1, p. 26-29.

"In a little-known jest of fate, Richter became a victim of the Northridge earthquake. After he died, his nephew inherited many of Richter's personal belongings. They included rare books of science, art, and literature; a beautiful cherrywood desk; and irreplaceable objects like home movies and a diary that described Richter's meeting with Einstein.

Richter's nephew thought he was prepared for an earthquake, his awareness heightened by many interactions with his uncle. The house was stocked with emergency food and water and covered by earthquake insurance. After the 1994 Northridge earthquake, a quake-related fire burned down the nephew's Granada Hills home. The family escaped, but Richter's belongings were destroyed."

ANNOUNCEMENTS

"Precambrian Terrane Boundaries A Symposium in Honour of Jack Henderson"

The Structure and Tectonics and Precambrian Divisions of the Geological Association of Canada are organizing this symposium for the Sudbury '99 GAC-MAC meeting. Contact Alexander Cruden, Dept. of Geology, University of Toronto, Erindale College, Mississaauga, Ontario L5L 1C6, Canada, for more information. His phone: (416) 828-3971; email: cruden@erin.utoronto.ca

RESOURCE BIN

*** Interested in publishing your geologic map?**
Doug Walker, Dept. of Geology, University of Kansas, has a web site for geologic maps: http://geomaps.geo.ukans.edu The web site is part of an effort to publish geologic maps both electronically and as paper copies. Almost any map can be published digitally for low cost and no overhead. If you are interested in learning more, contact Walker @ jdwalker@KUHUB.CC.UKANS.EDU; phone: (785) 864-2735; fax: (785) 864-5276. Walker solicits inquiries from professional societies who might be willing to take this effort over (GSA?).

*** Internet catalog of maps**
OMNI Resources invites visits to its Internet catalog "for the state-of-the-art in U.S. and foreign mapping." Call for free geological supply catalog. OMNI Resources, P.O. Box 2096, Burlington, NC 27216; phone: (800) 742-2677; fax: (800) 449-OMNI; http://www.omnimap.com

*** U. California Davis Active Tectonics Course on the Web**
Check out HTTP://WWW-GEOLOGY.UCDAVIS.EDU/~GEL214/
Contents include: Lecture notes, problem sets, WWW links of interest to students and researchers, and references.

*** Neotectonic Map of Northern Eurasia (1:150,000)**
The Institute of Physics of the Earth Russian Academy of Sciences recently has published a 1:150,000 neotectonic map of Northern Eurasia. More information athttp://www.scgis.ru/hot_line/index.html#nm.

YOUR DIVISION AND THE 1998 ANNUAL GSA MEETING, TORONTO, OCTOBER 26-29

Once again, the Division of Structural Geology and Tectonics will play a major role in our Society's annual meeting. For the upcoming Toronto meeting with its theme of "Assembly of a Continent" (cosponsored by the University of Toronto and a number of Canadian organizations including the GAC and GSC), the Division is a sponsor or cosponsor of a number of exciting symposia, theme sessions, and short courses. These are listed below in abbreviated form.

Division members should refer to the June issue of "GSA TODAY" for complete information on content of these sessions and courses, registration and housing information, etc. *By means of this Newsletter announcement, the co-editors invite organizers for the Division sponsored or co-sponsored symposia and theme sessions to submit reviews of their sessions to us for inclusion in the March, 1999, Newsletter. Submittals in Mac Word 5.1 (as email attachments or by diskette) are most helpful to us, but other options for electronic transfer are available (confer with Scott W); contributions of 800 words or less are most desirable.*

DIVISION SPONSORED OR CO-SPONSORED SESSIONS

The Division is a cosponsor of two of the four meeting "Keynote Symposia." These are:

*** Tectonic evolution of Precambrian North America I A synthesis of recent results.**
Organizers: Ron M. Clowes, John A. Percival, and Kark Karlstrom.

*** Deep crustal processes.**
Organizers: Alan G. Jones, David Fountain, Walter D. Mooney, and Randall Parrish.

Other symposia sponsored or co-sponsored by the Division include:

*** Fault reactivations, neotectonics, and seismicity in the Great Lakes region.**
Organizers: Robert Jacobi, C. F. M. Lewis, and Joe Wallach.

*** Deformation mechanisms and microstructures.** Organizer: W. D. Means.

*** Role of partial melting during evolution of convergent orogenic belts.**
Organizers: Michael Edwards, Olivier Vanderhaeghe, and Christian Teyssier.

Theme sessions sponsored or co-sponsored by the Division include:

*** Geophysical studies of the crust and lithosphere.** Organizer: Walter D. Mooney.

*** Controls on the style, distribution, and intensity of deformation around faults and folds.**
Organizer: Mark P. Fischer.

*** From cracks to creep: Evolution, behavior, and processes within mature fault zones.**
Organizer: Joseph Clancy White.

*** What are we dating? Understanding the crystallogenesis of U-Pb geochronometers.**
Organizers: Desmond Moser and David Scott.

*** Tectonic evolution of Precambrian North America.**
Organizers: Ron M. Clowes, John A. Percival, and Karl Karlstrom.

Other theme sessions of potential interest to Division members include (not an all-inclusive list):

*** NAFTA: North American floating terrane accretion.**
Organizers: Jarda Dostal and J. Duncan Keppie.

*** Role of partial melting during evolution of convergent orogenic belts.**
Organizers: Michael Edwards, Christian Teyssier, and Olivier Vanderhaeghe.

*** Archean cratons: Evolution and assembly.**
Organizers: Tom Skulski, John Percival, and Wouter Bleeker.

*** Geological evolution of Mexico: Its relation to conterminous North America.**
Organizers: Jose´ F. Longoria, Dante Moran Centeno, and Rogelio Monreal.

DIVISION SHORT COURSES CO-SPONSORED WITH GSA

(Preregistration ends Sept. 18; On-site registration has a $30 fee)

*** Analysis of veins in low-temperature environments introduction for structural geologists.**
Saturday, Oct. 24 and Sunday, Oct. 25, 8:00 AM - 5:00 PM.
Faculty: David V. Wiltschko, John W. Morse, Zachary D. Sharp, and Will Lamb.

This course will introduce the participants to the integration of geochemical, fabric, and fluid-inclusion data in interpreting the formation and significance of veins. The format will be lectures, case histories, and exercises. Topics covered include: Overview of vein research; hydrology of veins; subsurface fluids and precipitation kinetics; applications of isotopes to veins; problems and potential of fluid inclusions in veins; case histories of the application of structural geology and geochemistry to understanding fluid composition; temperature and pressure during tectonism. Limit: 40; fee: $290. See "GSA TODAY," June, p. 13, for additional information.

*** Deformation mechanisms and microstructures.** Sat., 10/24, 8 to 5; Sun., 8 to 12.
Faculty: Jan Tullis, Christian Teyssier, and Holger Stunitz.

This is an introductory-level course dealing with grain-scale deformation mechanisms and microstructures. Lectures illustrated with slides will cover the deformation mechanisms of brittle faulting, cataclastic flow, semi-brittle flow, dislocation creep, pressure solution, and grain-sizesensitive creep, as well as the interactions of deformation and metamorphism. Laboratory session with hand samples and thin sections of experimentally and naturally deformed rocks will allow for practical experience and discussion. The course will illustrate how microstructural studies can contribute to a better understanding of lithospheric deformation, including the brittle-ductile transition, the strength profile and strain partitioning, the effects of partial melt, and seismic anisotropy. Limit: 30. Fee: $250. See "GSA TODAY," June, p. 13, for additional information.

FUTURE MEETINGS, CONFERENCES, AND COURSES

[Notices of future events of interest to Division members are welcomed by the editors]

1998

Sept. 26-27: Evolution of structures in deforming rocks: Canmore, Alberta, Canada. Sponsors: Geol. Assoc. of Canada and Canadian Tectonics Group. Contact: Shoufa Lin, c/o Geol. Survey of Canada, Ottawa; fax: (613) 995-7997; email: slin@gsc.nrcan.gc.ca; http://www.nrcan.gc.ca/ess/cgd/ctg98/

Oct. 4-8: The geologic record of natural disasters: Portland, OR. Contact: Judy Tarpley, SEPM; phone (918) 493-3361, ext. 22 (outside No. Am.); (918) 865-9765, ext. 22 (No. Am.); fax: (918) 493-2093; cemeet@galstar.com

Oct. 19-23: Precambrian-Paleozoic interactions between Laurentia and Gondwana: Oaxaca, Mexico. Contact: J. D. Keppie, Instituto de Geologia, Universidad Nacional Autonoma de Mexico; phone: 52-5-622-4303; fax: 52-5-622-4289; duncan@servidor.dgsca.unam.mx

Oct. 19-20: Meeting of the Eastern Section of the Seismological Society of America: Millersville, Pa. Contact: Charles Scharnberger; phone: (717) 872-3295; cscharnb@marauder.millersv.edu. Abst. deadline is Sept.18.

Oct. 26-29: Geological Society of America Annual Meeting, Toronto. Contact: Becky Martin, GSA Meetings Dept.: phone (303) 447-2020, ext. 164.

Nov. 8-11. American Association of Petroleum Geologists (international meeting), Rio de Janeiro. Contact: AAPG Conventions, P.O. Box 979, Tulsa, OK 74101-0979; phone: (918) 560-2679.

Nov. 9-12. Geology of the Middle East (international conference), Beirut, Lebanon. Sponsor: Arab Geological Union. Contact: Dr. Mustapha Mroueh, Lebanese National Geological Committee; phone: 961-1-862665; fax: 961-1-822639; email: ngc@cnrs.edu.lb

Dec. 1-3: Origin of the Earth and Moon (conference): Monterey, California. Sponsors: Geochemical Society, Lunar and Planetary Institute, NASA. Contact: LeBecca Simmons, Lunar and Planetary Institute, Houston, Texas; phone: (281) 486-2158; fax: (281)486-2160; simmons@lpi.jsc.nasa.gov. Deadline for hard-copy abstracts, Aug. 28; for electronic abstracts, Sept. 4; for preregistration, Oct. 30.

Dec. 6-10: American Geophysical Union (annual meeting), San Francisco. Contact: AGU Meetings Dept.; phone: (202) 462-6900; fax: (202) 328-0566; meetinginfo@kosmos.agu.org; http://www.agu.org

1999

Feb. 1-5: Shallow Tethys (international symposium), Chiang Mai, Thailand. Contact: Shallow Tethys 5 Symposium Secretary, Dept. of Geological Sciences, Chiang Mai University, Chiang Mai 50200, Thailand; fax: (66-53-892261.

Feb. 15-19: "The Last Conference of the Millennium", Halls Gap,Victoria, Australia. Sponsor: SGTSG. Contact: Sarah Vaughan; email: sarah@earth.monash.edu.au

Mar. 9-11: Pangea and the Paleozoic-Mesozoic Transition (international meeting), Wuhan, Hubei, The People's Republic of China, China University of Geoscience, Dr. Tong Jinnan and Peng Yuanqiao, Pangea Conference Secretariat, Faculty of Earth Science, China University of Geosciences, Wuhan, Hubei 430074, The People's Republic of China.

April 11-14: American Association of Petroleum Geologists (annual meeting), San Antonio, Texas. Contact: AAPG Conventions, P.O. Box 979, Tulsa, OK 74101-0979; phone: (918) 560-2679.

April 26-28: Thrust Tectonics 99, Royal Holloway University, London, Egham, Surrey. Contact: Dr. Ken McClay; email: ken@gl.rhbnc.ac.uk

June 6-9: 1999 Vail Rock '99 Symposium: Rock Mechanics for Industry, Vail, Colorado. Sponsor: American Rock Mechanics Assoc. Contact: Expomasters; phone: (303) 771- 2000; fax: (303) 843-6212; mcramer@expomasters.com

July 19-30: International Union of Geodesy and Geophysics (meeting), Birmingham, U. K. Contact: IUGG99, School of Earth Sciences, Univ. of Birmingham, Edgbaston, Birmingham B15 2TT, U.K.; fax: 44-121-414-4942; email: IUGG99@bham.ac.uk

Sept. 12-15: American Association of Petroleum Geologists (international meeting), Birmingham, U.K. Contact: AAPG Conventions, P.O. Box 979, Tulsa, OK 74101-0979; phone: (918) 560-2679.

Sept. 13-15: 2nd ESIS TC4 Conference on Fracture of Polymers, Composites, and Adhesives, Les Diablerets, Switzerland. Contact: Amy Richardson: Tel: +44 (0) 1865 843643, http://www.elsevier.nl/locate/esis99.

Oct. 25-28: Geological Society of America Annual Meeting, Denver, Colorado. Contact: Becky Martin, GSA Meetings Dept.: phone (303) 447-2020, ext. 164.

2000

Mar. 8-9: The Nature and Tectonic Significance of Fault Zone Weakening (international meeting), Geological Society, Burlington House, London. Contact: Dr Bob Holdsworth, Dept of Geological Sciences, University of Durham, Durham DH1 3LE. Fax: +44(0)191-374-2510, R.E.Holdsworth@durham.ac.uk.