At the close of summer and the beginning of a new school year, we bring you the third Newsletter from the Physics and Astronomy Department of the University of Nebraska. We are pleased with the response from our alumni to last year's Newsletter, whose responses appear later in the Newsletter. As part of our upgrading processes we are adding post-docs and former faculty members to our mailing list. Enclosed with this Newsletter is a postcard for you to add what you might think is worthwhile for publication in next year's edition of the Newsletter. We would hope that you would pay particular attention to the list of lost friends and try to help us locate them. In the next year or two when we write off our lost friends as irretrievably lost, we will include as part of the Newsletter a list with addresses of everybody so please help us locate our lost friends this year.

External Review Team Visitiation

A distinguished team of physicists reviewed the department's research, teaching and service programs in a two-day visit on March 29 and 30, 1982. The members of the group were Professor Eugen Merzbacher, Chair of Physics at North Carolina, Professor Robert V. Coleman, Chair of Physics at Virginia, and Professor C. N. Yang, Nobel Laureate and Director of the Institute for Theoretical Physics at S.U.N.Y. - Stony Brook. The Team was generally most supportive of the quality of the department, calling it a leader among physics and astronomy departments in the Plains States. The Team made a vigorous plea to the UNL administration to provide additional support to the department, especially in the areas of teaching assistant support and operating budget.

At the conclusion of the formal review, Professor Yang gave a colloquium entitled "Einstein and Contemporary Physics." The auditorium in Brace was packed to overflowing to hear this outstanding speaker.

Graduate Student Teaching Awards

A considerable number of our graduate teaching assistants were honored this year for outstanding teaching. In a College-wide competition, Mr. Siamak Shahabi won the Outstanding Teaching Assistant Award, and Dave Billesbach was honored for superior teaching. The Department presented awards for 1980-81 to Michael Day and Swapan Chakrabarti and for 1981-82 to Siamak Shahabi and Thomas Stephen. We congratulate all of these students for their fine work on behalf of the Department.

Scholarship Awards

The Department announced its undergraduate scholarship winners for the 1982/83 academic year. The awards of $500 to physics majors were based on superior academic achievement. The students and their hometowns are:

U. S. Harkson Scholarships:

- Thomas F. Hall - Bellevue
- David A. Rose - Lincoln
- Charles E. Judge - Grand Island
- Rebecca Richards - Grand Island

Stebbins Scholarship:

- Bruce Waggoner - Norfolk
- *David Debrestian - Lincoln*

John E. Almy Scholarship:
Robert J. Bass - Elkhorn
David E. James - Lincoln

H. H. Marvin Scholarship:
Scott D. Allen - Grand Island
David W. Dunning - Lincoln

Alumni who would like to contribute to these or other scholarship funds are cordially invited to contact Professor David Sellmyer, Chairman of the Department.

Kudos this year go to Dr. John Hardy and Dr. Edward Schmidt. Dr. Hardy was named outstanding research professor by the local Sigma Xi chapter and Dr. Schmidt was promoted to Professor. Dr. Sitaram Jaswal returned from a semester on leave doing research in Lincoln and at the University of Missouri, Kansas City. Dr. Kam Leung spent the fall semester 1981 in China consulting and doing research. Dr. M. Eugene Rudd returned from a semester's leave of absence doing research at Battelle Laboratories in Hanford, Washington. An interesting note: while there by coincidence Dr. Robert DuBois started to work at Batelle and a fruitful collaboration resulted. Dr. Leo Sartori returned from several years leave of absence with the Disarmament Agency in Washington.

This year with the start of production of liquid helium and its use by Chemistry and our condensed matter group, we asked the condensed matter group to relate their work to you.

FROM PROFESSOR EDGAR PEARLSTEIN

LIQUID HELIUM PROGRESS

The helium liquefier has been operating since last fall. In March we got the purifier, so that now we save the boiloff helium, purify it, and reliquefy it. The machine operates for four or five days, about every three weeks. It produces approximately 5 liters per hour which is sold for $3 per liter if helium gas is recovered and $4 per liter if the helium gas is lost.

For those who are interested, here is a description of the physics of the liquefier and purifier: Helium gas, with less than 50 ppm impurities, is compressed to about 240 PSI by a 25 HP compressor. The energy of compression is carried away by water cooling. The gas goes to two piston engines in series, where it is cooled by expansion against the pistons. The work done on the pistons is used to run an electrical generator, which sends power back into the electric lines. Gas coming from the second engine is at 5 to 6° K. This is below the "Joule-Thomson inversion temperature" (go back to your thermo book!). It then goes through an orifice ("J-T valve") where it is cooled further by the Joule-Thomson effect and liquefies. The liquid goes to a 500-liter storage container where it awaits transfer to portable containers used by experimenters.

For recovery of gas, we have an extensive piping system through Behlen, the first floor of Brace, and some labs in Hamilton Hall (Chemistry). Boiloff gas from storage containers and apparatus goes to this system at slightly above one atmosphere pressure. In the liquefier room it is collected first in a 300 ft^3 plastic bag. When the bag is nearly full, a 10 HP compressor turns on and puts the gas into standard cylinders at high pressure, where of course it occupies a lot less volume. The recovered gas will have a little air in it, so it must be purified, or else the air will freeze in the liquifier. The purifier has two stages. The first is just a liquid-nitrogen-cooled pot, which will liquefy nitrogen, oxygen, and argon and get the helium down to about 2% impurity. Our experience so far has been that the returned helium is already better than that, so we don't use the first stage. The main purification is done by a charcoal trap, which is at liquid nitrogen temperature. The enormous amount of surface in the charcoal adsorbs just about everything except helium. The pure helium gas from the charcoal trap goes to the liquefier or cylinder-storage. Impurities collected in the trap must be removed occassionally by a "blow down," which is just a heating of the trap to room temperature and pumping out with a small vacuum pump. This is done automatically.

FROM PROFESSOR D. J. SELLMYER

ELECTRONS IN COMPLEX SOLIDS

The theme of our research is the investigation of electronic and magnetic states in relatively complex solids. These materials either exhibit new types of physical phenomena or require new theoretical models to describe their physical properties. We are pursuing work in the following three general areas:

(1) Electronic and magnetic states in d and f band metallic compounds. These compounds are of intermediate structural complexity and exhibit interesting magnetic, structural, or superconducting phase transitions. Of special interest is the relationship of the electronic structure to the phase transitions, which are thought to be electronically motivated. The compounds contain d or f conduction electrons and some of them are quasi-one- or two-dimensional conductors. This work is being carried out by Dr. David Liebowitz and graduate students Bill Burmester and Harun Rashid.

(2) Electronic structure and magnetism of metallic glasses: Amorphous alloys have provided a rich new area for studying the physics of disorder. In addition the materials may well have important technological applications because of certain favorable physical properties and processing advantages. Our recent work has been concerned with the anomalous electron transport properties of glasses, their electronic structure, and magnetic phase transitions in glasses based on the rare earths. The phenomena under investigation include local random anisotropy, exchange fluctuations, itinerant magnetism, and spin arrangements. Personnel involved in this work are Drs. M. J. O'Shea and J. G. Zhao and graduate students Akhter Ahmed and Mike Engelhardt.

(3) Hydrogen absorption by metallic glasses: In the future hydrogen could become important as a fuel and it will be necessary to store it and transport it safely and conveniently. Certain metals are capable of absorbing hydrogen to the extent that the hydrogen density is larger than that of liquid hydrogen. We have discovered that rare earth glasses are capable of absorbing large amounts of hydrogen, and a study of the physical properties of these new materials is underway. This work is being performed by Drs. Charles Robbins and Z. D. Chen, along with Mr. Jim Nabity.

We are employing a broad range of experimental measurements. These include ac and Faraday susceptibility, magnetization to 100 kOe, electron transport, Mossbauer effect, xray diffraction and fluorescence, and ultraviolet photoemission. For selected materials we perform measurements to 220 kOe at the MIT National Magnet Laboratory. Our research is supported by NSF and several industrial firms including 3M, Kollmorgen, and Dale Electronics.

FROM PROFESSOR JOHN WEYMOUTH

Professor John Weymouth continued his participation in archaeological programs by applying geophysical techniques to site surveying. Recent sites surveyed with magnetometers (a near-surface, non-invasive method) included two early 18th century French fort sites on the Mississippi below St. Louis (surveyed for the Illinois Department of Conservation), a 13th century Mississippian Indian site (Spiro Mounds) near Fort Smith, Arkansas (for the Oklahoma Archaeological Survey) and four historical or pre-historical sites in the Ozark National Scenic Riverways (for the National Park Service). Early this summer he supervised the magnetic surveying of three Indian sites in eastern Nebraska as part of the Anthropology Summer Field School program. In August he directed a six day survey on a Pawnee site near Red Cloud, Nebraska in conjunction with the State Historical Society.

FROM PROFESSOR ROGER KIRBY

My group's research program is largely concerned with "limited dimensionality" compounds, so-called because their physical properties can be described as quasi-one-dimensional or quasi-two-dimensional. We have concentrated on transition metal compounds like the layered structure (nearly two-dimensional) compounds like TaS_2, $TiSe_2$, and $NbSe_2$, and the linear (nearly one-dimensional) compounds like TaS_3, $NbSe_3$, and TiS_3. These materials are especially interesting because many of them undergo phase transitions to structurally distorted states at low temperatures.

We are actively investigating two problems:

1. The nature of the changes which occur at the phase transitions. As the temperature is lowered through the phase transition the crystal structure becomes considerably more complicated, and the electronic properties are strongly modified. We are studying the changes which take place at the phase transition using laser Raman scattering, with the goal of understanding the fundamental mechanisms involved. This investigation is aided considerably by our well-developed crystal growth laboratory, which allows us to "tailor-make" crystals with the desired properties.

2. Mixed crystal lattice dynamics. The lattice dynamics of mixed crystals are only poorly understood. We have grown single crystals of mixed layer compounds (for example, $TiSe_{2-x}S_x$ for $0 \leq x \leq 2$ and $Hf_xTi_{1-x}Se_2$ for $0 \leq x \leq 1$) and have measured the frequency spectrum of the atomic vibrations using laser Raman scattering. We have been interpreting our results using several different theoretical models. The theoretical work of Professor Jaswal has been very helpful in the interpretation of our results.

FROM PROFESSORS J. R. HARDY and F. G. ULLMAN

THEORETICAL AND EXPERIMENTAL STUDIES OF STRUCTURAL PHASE TRANSITIONS IN COMPLEX SYSTEMS

This program of work represents the current phase of a long-standing collaboration between solid state theory (J. R. Hardy) and materials science in both the Electrical Engineering and Physics Departments (F. G. Ullman). The general area at present under study is that of transitions in certain insulating materials having relatively complex structures, which transform from normal periodic lattices at high temperatures to so-called "incommensurate" phases at lower temperatures. These latter structures can be viewed as arising from the high-temperature structures by the "freezing-in" of a static displacement wave whose wavelength is not a rational multiple of the basic lattice spacing. This leads to systems which have unique physical properties and are currently the subject of great interest in the international scientific community, particularly in the U.S.S.R. and Japan.

Our principal experimental tool for these studies is the inelastic scattering of laser light which enables us to probe lattice excitation spectra in normal and incommensurate phases. The aim of the theoretical work is to understand the nature of the force-balance in these systems which is responsible for their unusual behavior. To this end we have built on past lattice-dynamical experience to develop a capability to study the dynamics of complex systems which is unique to Nebraska and ties in closely with the experimental program. Our first major success was an unravelling of the force balance responsible for the incommensurate phase transition in potassium selenate (K SeO) which represents the oldest and most-studied of these systems. Moreover we were able to explain the unique sensitivity to uniaxial stress of the observed transition temperature which we discovered during our experimental studies. These studies were and are carried out in the Physics Department's Light Scattering Laboratory which is under the overall charge of Professor R. D. Kirby.

The combined program on structural transitions is funded under a U. S. Army Research Contract on which J. R. Hardy and F. G. Ullman are co-Principal Investigators.

THEORETICAL STUDIES OF LONG-WAVELENGTH ABSORPTION IN INSULATORS
J. R. Hardy

This program, which is funded under an Office of Naval Research Contract, is directed at understanding the processes which limit the transmission of long-wavelength electromagnetic radiation by materials which are optically transparent. In the far-infrared the limiting processes involve the simultaneous creation and destruction of quanta of lattice vibrational energy. It has proved possible to account theoretically for the known experimental data for alkali halide crystals to a high degree of accuracy. This work is continuing in order to examine other problems raised by these results and to attempt an extension to other materials of the same level of theoretical understanding.

MOLECULAR DYNAMICS STUDIES OF SHOCKS IN ENERGETIC MATERIALS
A. M. Karo, F. E. Walker and J. R. Hardy

This represents a collaboration with Dr. A. M. Karo and F. E. Walker of the Lawrence Livermore National Laboratory (LLNL) in California: the work is carried out primarily at Livermore using the LLNL computer system. The aim is to examine by computer integration the classical equations of motion how various assemblies of atoms behave under impulsive (shock) loading. We are particularly concerned with the manner in which bond rupture can be caused by shock loading.

We have carried out, over the past six years, many simulations on many systems. These have been described in an ongoing sequence of publications and have led to a general understanding of how bond rupture occurs at, or near, surfaces or defects. The emphasis on bond rupture stems from Dr. Walker's initial hypothesis, some ten years ago, that this was the crucial step in the shock initiation of exothermic chemistry (burning, detonation) in energetic materials. The essential point was that ruptured bonds could imply the presence of free radicals, and free-radical chemistry that have characteristically low activation energies. Thus, once formed in sufficient numbers, these free radicals could initiate the rapid chain reactions necessary to build to detonation. This work continues with the overall aim of bridging the gap between microscopic and macroscopic descriptions of the initiation process.

FROM PROFESSOR S. S. JASWAL

ATOMIC AND ELECTRONIC STRUCTURE OF AMORPHOUS METALS

Amorphous materials figure prominently in the search for new materials in all areas of technology. I started doing theoretical work in this area about two years ago with some overlap with the experimental research in Sellmyer's Laboratory. Since amorphous materials lack periodicity, one must consider a very large number of atoms, compared to only a few atoms per unit cell in a crystal, to study their properties. This makes the theory of amorphous materials extremely difficult and the calculations time consuming. X-ray and other scattering techniques give limited but useful information that is used to determine the atomic arrangements. The electronic structure calculations are based on the method of orthogonalized linear combination of atomic orbitals. We have done the electronic structure calculations with the most realistic model of metallic glasses so far and the results are in very good agreement with the photoemission data. Efforts are underway to improve upon the various aspects of the theory.

FROM PROFESSOR ROBERT J. HARDY

After some neglect my research on the "uncorrelated-pairs approximation" (UPA) for the equilibrium properties of anharmonic solids is moving forward. The problem, of course, is to predict the equilibrium properties (macroscopic and otherwise) of crystals from the force laws that govern the microscopic interactions. For his dissertation Mike Day is investigating the possibility of using an Einstein Hamiltonian (which connects each particle to its lattice site by a spring) for the harmonic part of the approximation. At first this appears to be a step backwards from the lattice dynamical type of harmonic Hamiltonian used by Bruce Jones in his work on the UPA. The advantage of an Einstein Hamiltonian is that it allows complex solids (including alloys) to be studied without having to do the lattice dynamics of complex solids. Our initial comparisons with Monte Carlo results show that very accurate predictions can be obtained. Hopefully in the near future we will have a powerful new theoretical tool for studying materials of technological importance.

I still consult regularly at Lawrence Livermore National Laboratory. The group with which I work is using molecular-dynamics methods to study molecule-surface collisions and shock-wave propagation in condensed matter.

WE HEARD FROM THESE ALUMNI:

ACKERMAN, Charles B., 6720 E. Bluebird Lane, Paradise Valley, AZ 85253

Senior Staff Scientist for Motorola, Inc. Working in solar energy program which is a joint venture between Motorola and Shell Oil. Says Richard Sill was killed in a small plane crash.

ANDERSON, Milo V., Pacific Union College, Angwin, CA 94508

Is Professor at Pacific Union College. Had sabbatical leave summer 1981. Participated in Summer Faculty Research Participation Programs at IBM, San Jose, CA. Collaborated with Wayne Imaino on contact electrification of insulators.

ANDERSON, Richard D., 5046 Park West Avenue, San Diego, CA 92117

Is Senior Physicist at Naval Ocean Systems Center, working in applications of blue/green systems and in the further development of the associated technology. Initiated the concept of communicating with submarines using pulse coded blue-green energy and performed initial experimental verification. Presently working in Submarine Laser Communication project, surveillance systems, physical oceanography, bioluminescence, and development of birefringent filters.

BIJANKI, Sudhir, 6 Wheaton Center, #213, Wheaton, IL 60187

Title is MTS at Bell Labs.

BRANDLI, Allan E., 2014 Williamsburg Court North, League City, TX 77573

Is Avionics Verification Manager at NASA. Has been with NASA at Johnson Space Center since July, 1967, is currently responsible for managing the avionics verification of the Space Shuttle. Is an Associate Fellow of the American Institute of Aeronautics and Astronautics and also a Commander in the Naval Reserve. Wife, Connie, works part-time. Six children.

CACAK, Robert K., (C-278), University of Colorado Heath Sciences Center, 4200 E. 9th Avenue, Denver, CO 80262

Is Assistant Professor at University of Colorado Health Sciences Center. Enjoys applying physics to health sciences, particularly medicine. Is currently supported by National Cancer Institute grant developing dosimetric model for high energy electron beam radiation therapy. Working on various aspects of radiographic imaging technology. Wife, Roxie, manages floral shop in Aurora, CO. Two children.

CHASSON, Robert, Department of Physics, University of Denver, Denver, CO 80208

CRANDALL, David H., Bldg. 6003, Oak Ridge National Laboratory, Oak Ridge, TN 37830

Program Manager and Research Physicist for Union Carbide Corporation, Oak Ridge National Lab. Still active in atomic collisions research which was his thesis topic. Sees Nebraska professors and students regularly. Keeps contact with R. H. McKnight and F. D. Schowengerdt who are active in other areas related to atomic collisions.

DAHNKE, John E., 25526 Redlands Boulevard, Loma Linda, CA 92354

Is Senior Project Engineer for TRW.

DuBOIS, Robert, 7721 W13, Kennewick, WA 99336

Joined Battelle as Senior Scientist in January 1981. Is associated with Radiological Sciences Department.

EDDY, Steve, Rt. #7, Box #34, Houma, LA 70360

Is General Field Engineer for Schlumberger Well Services. It's rumored that Joe St. Lucas is trapped inside an "Asteroids" machine in a bistro on Bourbon Street in New Orleans. Remember: Mud is good food!

FREEMAN, J. Reuben, Tekoah, Jerusalem Mountains, Israel

Senior Lecturer at Jerusalem College of Technology.

JAFAREY, Sohail, 5015 Forth Bridge Drive, Houston, TX 77084

Geophysicist at Shell Oil Company. Wife, Gaity. They have their first child, a son.

KELTON, Phillip W., 5713 Marilyn Drive, Austin, TX 78731

Systems Analyst IV at University of Texas at Austin, McDonald Observatory. 1973-79: Graduate student and systems programmer at University of Texas, Ph.D. 1979 in Computer Science and Astronomy. 1979-80: Jet Propulsion Lab, Pasadena, CA. 1980-present: Supervisor, Computing Group, McDonald Observatory, University of Texas, primarily involved with real time control of astronomical observations involving solid state imaging detectors.

KUMAR, Satyendra, 13-2025, Massachusetts Institute of Technology, Cambridge, MA 02139

Research Associate at MIT. Made high-resolution x-ray and AC calorimetric measurements on liquid crystals at University of Illinois, Urbana. Obtained Ph.D. in June, 1981, is at MIT as post doc. Doing Laser light scattering spectroscopy on liquid crystals. Has not found a more homey place than Lincoln.

LARSSON, Leif, Strangnas, Sweden S-15201

Is Manager of R & D at Ceaverken. Among other things is making special films e.g. for autoradiography with H and for x-ray diffraction studies. Model by Katz for interaction between radiation and matter has been useful also in non-academic career.

MAURER, Christopher, 417-251 S.W. 20th Avenue, Gainesville, FL 32601

Post doc at University of Florida. Received Ph.D. (Ceramic Engineering) from University of Illinois in 1979. Since 1980, has been Post-doctoral Fellow in Materials Science at the University of Florida working on corrosion of glass encapsulants for nuclear waste.

POVEDA, Arcadio, Apartado Portal 70-204, Mexico 20 D.F., Mexico

Professor at Universidad Nacional Autonoma de Mexico.

STUTZ, Conley, 5809 N. Machnac, Peoria, IL 61614

Professor of Physics, Bradley University. Really enjoyed receiving the Newsletter. Enjoyed news of graduate students of mid-60's that he knew.

SULLIVAN, Dr. George A., 4204 Kota Avenue, Harrisburg, PA 17110

Statistical Analyst III for Pennsylvania Board of Probation and Parole. Wife, Virginia, is Capitol Police Corporal for State of Pennsylvania, 2 children.

THORNTON, Melvin C., 3405 M, Lincoln, NE 68510

Associate Professor, Math Department, UN-L.

YEH, Mrs. Anthony (Fang-Mei Linn), 3738 Claudine Street, Honolulu, Hawaii 96816

We are still trying to locate the following lost friends:

Mr. Donald Anderson	(B.S.-54)	Mr. Robert Matulka	(B.S.-73)
Ms. Jean Davis	(B.S.-54)	Ms. Carol McKinley	(B.S.-64)
Mr. Timothy D. Evans	(B.S.-75)	Mr. John C. Meyers	(B.S.-75)
Mr. William G. Garner	(B.S.-68 or 69)	Mr. Terry L. Ochsner	(B.S.-72)
Mr. Paul Hiltenson	(B.S.-54)	Mr. Robert L. Phillips	(B.S.-73)
Mr. Randy R. Hinze	(B.A.-75)	Mr. Edward E. Moreland	(M.A.-54)
Mr. Henry J. Lenhoff	(B.A.-72)	Mr. Kenneth B. Scow	(M.A.-55)
Mr. Michael T. Marsh	(B.S.-70)	Mr. Kuo Kuang Wang	(B.S.-58)
Mr. Edward Mathieson	(B.S.-7])	Mr. Ronald E. Whitney	(B.S.-73)