notre dame report

contents

87-88

September 11, 1987

number 1

the university

inauguration announcements

All classes at the University will be suspended and the Theodore M. Hesburgh Library will be closed from 2 p.m. to 7 p.m. on Wednesday, Sept. 23 for the inauguration of Rev. Edward A. Malloy, C.S.C., as the University's 16th President. Ceremonies will include a Mass at 10 a.m. in the Edmund P. Joyce Athletic and Convocation Center, an academic procession beginning at 2:15 p.m. in the Hesburgh Library Mall, and an academic convocation at 3 p.m. in the Joyce Athletic and Convocation Center.

president's address to the faculty

The Inaugural Address of Father Edward A. Malloy, C.S.C., the new President of the University, which is scheduled for Sept. 23, will this year take the place of the Presidential Address to the Faculty usually scheduled for early October.

two alumni elected to board of trustees

Dr. Nancy M. Haegel and Tracy C. Jackson, two 1981 graduates of the University, have been elected to the Board of Trustees.

They will replace Dr. Terrence R. Keeley and Dr. Kathleen M. Sullivan, who were the first to occupy three-year positions set aside by the board for two recent graduates under 30 years of age at the time of their election.

w-4 form information

University employees who have not filed new W-4 Forms (Employee's Withholding Allowance Certificate), are reminded that the federal income tax currently being withheld could be in error. This error could result in the IRS assessing a penalty when filing the 1987 tax return.

The law requires all employees to file a new withholding allowance certificate with their employer by Oct. 1, 1987. If employees fail to do so, the University will be required to change the withholding as if the employee were single claiming one withholding allowance or married claiming two withholding allowances. W-4 Forms and new W-4A Forms can be obtained by contacting the Payroll Department at Ext. 7575.

Vol. 17, No. 1 September 11, 1987

Notre Dame Report (USPS 7070-8000) is an official publication published fortnightly during the school year, monthly in the summer, by the University of Notre Dame, Department of Public Relations and Information. Second-class postage paid at Notre Dame, Ind. Postmaster: Please send address corrections to: Editor, **Notre Dame Report,** c/o Rm. 212, Administration Building, Notre Dame, IN 46556

two endowed chairs announced

Mrs. Paula Koch of Fort Lauderdale, Fla., has endowed a chair in memory of her husband, Carl E. Koch, in the College of Arts and Letters at the University.

Carl Koch and his family have been longtime benefactors of the University. Mr. Koch was a successful Chicago businessman who established the Koch Foundation to aid the evangelization efforts of the Catholic Church. Mr. Koch also established the Koch Scholarship at the University.

An endowed professorship in Notre Dame's College of Business Administration will honor the memory of the late Mr. and Mrs. John W. Clarke of Chicago.

The John and Maude Clarke Chair has been funded by a trust created by Mr. Clarke, an investment banker who died on Dec. 4, 1983. He was a longtime member of the business school's advisory council. Mrs. Clarke, who died Sept. 11, 1985, was the principal donor of a campus fountain honoring Notre Dame alumni who gave their lives in World War II, Korea, and Vietnam.

A faculty search committee will convene soon to seek a distinguished business educator for the Clark Chair, Provost Timothy O'Meara said.

telephone directory addition

The short list of names that was not included in the preliminary telephone directory can be found on the first page of the documentation section in this issue.

telephone directory notice

The Department of Publications and Graphic Services is currently compiling information from staff, faculty, and departments for the 1987-88 University of Notre Dame/Saint Mary's College permanent telephone directory, scheduled for distribution sometime in October. There are four different cards for your use and instructions are included on each. If you have any questions, or if you would like to request telephone directory listing cards, please contact Jacki Callender in their office at 239-5337.

As always, this refers only to Notre Dame faculty and staff. Saint Mary's staff and faculty should contact Dorothy Peters in the Saint Mary's Purchasing Department at 284-4544. Notre Dame and Saint Mary's students should contact their respective Registrar or Housing Offices.

Please Note: The deadline for receipt of all cards at the Publications and Graphic Services Office for inclusion in the permanent directory is Thursday, September 10, 1987. A correctly completed card must be on file there in order for necessary changes to be made. Cards received after this date will not be used. All information must be on a card (no other form of written changes or telephone calls will be accepted) and should be typed or printed legibly.

faculty notes

appointments

Robert W. Williamson, professor of accountancy, has been named associate dean of the College of Business Administration, succeeding Yusaku Furuhashi, who is now dean of the College.

Williams is a specialist in financial and managerial accounting and has contributed articles to several scholarly publications. His doctoral studies at the University of Chicago included research on the accounting rate of return as an estimate of the internal rate.

A South Bend native, Williamson attended Notre Dame and received a bachelor's degree in business administration in 1961. He received a master's degree in finance and economics at the University of Chicago in 1963 and his doctoral degree in accounting there in 1971.

Twenty persons have been appointed to six University advisory councils by Rev. Edward A. Malloy, C.S.C., President. They are: College of Business Administration: Richard T. Doermer, president of the Summit Bank in Fort Wayne, Ind., and a 1944 Notre Dame graduate; James L. Hesburgh, president of James L. Hesburgh International, Inc., Pacific Palisades, Calif., a brother of the University's president emeritus and a 1955 graduate of Notre Dame; John R. Loftus, president of the Chapple Co., Elmhurst, Ill., and a 1949 graduate of the University; Vincent J. Naimoli, president, chairman of the board, and chief executive officer of Anchor Glass Container, Tampa, Fla., and a 1959 alumnus; Jack D. Sparks, chairman, president, and chief executive officer of Whirlpool Corporation, Benton Harbor, Mich.; and William K. Warren, Jr., president of Warren American Oil Company, Tulsa, Okla., and a 1956 graduate.

College of Arts and Letters: Robert M. Conway, managing director of Goldman Sachs International Corporation, London, England, and a 1966 graduate; Earl L. Linehan, president of Meridian, Inc., Towson, Md., and a 1963 alumnus; and Paul E. Tierney, Jr., chairman, Gollust, Tierney & Oliver, Inc., New York City.

College of Science: John E. Hughes, chief executive officer of Fannie May Candy Shops, Inc., Chicago, Ill., and Dr. Rudolph M. Navari, a 1966 graduate of Notre Dame and an oncologist at the Simon-Williamson Clinic in Birmingham, Ala.

Law School: Thomas A. Demetrio, a 1969 alumnus and a partner in Corboy & Demetrio, Chicago; Louis A. Smith, a partner in Smith, Johnson, Brandt & Heintz, Traverse City, Mich., and Robert J. Welsh, Jr., president of Welsh Oil Company, Merrillville, Ind., and a 1956 alumnus.

Institute for Pastoral and Social Ministry: Mr. and Mrs. Patrick W. Bartholomy, Long Beach, Calif. He is an investor who formerly operated life insurance, real estate development, and savings and loan firms, and his wife, Anne, is a former mathematics teacher. Robert and Rickey Leander, Paradise Valley, Ariz. A 1949 Notre Dame graduate, he is president of Town and Country Condominiums in Phoenix. Mr. and Mrs. Thomas McGuire of Greenwich, Conn. He is a 1947 Notre Dame graduate and a retired vice president of Richardson-Vicks, Inc. His wife, Elvira, collects art. Mr. and Mrs. William B. Smith. He is a 1965 alumnus and managing director of Dean Witter Realty, Inc., in New York City. His wife, Mary Ann, is a former teacher.

The Snite Museum of Art: Mrs. John F. Donnelly, Holland, Mich., widow of the late chairman of Donnelly Mirrors, Inc., and Mrs. James L. Hesburgh, Pacific Palisades, Calif.

honors

Harvey Bender, professor of biological sciences, has been appointed to a four-year term on the Sickle Cell Anemia Advisory Commission.

Alfred J. Freddoso, associate professor of philosophy, has been appointed to the board of editorial consultants of Faith and Philosophy, the journal of the Society of Christian Philosophers.

Charles K. Kulpa, Jr., associate professor of biological sciences, has been elected vice-president of the Indiana Branch of the American Society for Microbiology.

John R. Malone, professor emeritus of marketing, was awarded a plaque by the Michiana Chapter of the National Association of Business Economists for his leadership and service in the founding of the chapter in 1977.

Roger A. Schmitz, vice president, associate provost, and Keating-Crawford professor of chemical engineering, has been appointed to the National Research Council's Board of Chemical Sciences and Technology for a three-year term.

Donald E. Sporleder, professor of architecture, has been appointed to the National Council of Architectural Registration Boards, Examination Planning Council Adjunct Committee, which was established at the NCARB annual meeting in Seattle, Wash., in June 1987.

Anthony M. Trozzolo, Huisking professor of chemistry, has been appointed to the editorial board for the seventh edition of the Encyclopedia of Science and Technology.

Thomas L. Whitman, professor of psychology, has been appointed to the editorial boards of the Journal of Applied Behavior Analysis and Research on Developmental Disabilities. He has also been appointed to the executive board for the Gatlinburg Conference on Mental Retardation.

activities

Harvey A. Bender, professor of biological sciences, chaired the meetings of the Sigma Xi Committee on Science and Society, Washington, D.C., June 25-28. He participated in the board of directors meeting of Sigma Xi, the Scientific Research Society, Toronto, Ontario, Canada, July 20. He also chaired the sessions of the special planning meeting of AAAS, Sigma Xi, and the National Academy for Development of International Program on Science and Society, Washington, D.C., July 25-27. Prof. Bender chaired the session on "Science, Technology and Values" at the annual fellows meeting of the Society for Values in Higher Education held at Evergreen State College, Olympia, Wash., Aug. 8-17.

Cristina Bicchieri-Woodford, assistant professor of philosophy, presented a paper titled "Progress without Growth? The Case of the Marginalist Revolution in Economics," at a conference on economic rhetoric at Wellesley College, Wellesley, Mass., June 17-19. She also presented the same paper at a conference of the History of Economics Society at Harvard University, Cambridge, Mass., June 19-21.

Victor J. Bierman, Jr., associate professor of civil engineering, presented an invited paper titled "Bioaccumulation of Organic Chemicals in Great Lakes Benthic Food Chains" at the "Aquatic Food Chain Modelling" workshop, Ontario Ministry of the Environment, Seneca College, King City, Ontario, Canada, July 9-10.

Maria Bohorquez, research associate in the Radiation Laboratory, presented a paper titled "Photophysics in Spread Monolayers. The Use of Time-Resolved Fluorescence Techniques to Determine Pyrene-Lipid Diffusion and Eximer Kinetics" at the Third International Conference on Langmuir-Blodgett Films, Gottingen, West Germany, July 26-31.

John G. Borkowski, professor of psychology, presented a paper on "The Differential Development of Memory Strategies in EMR and Non-Retarded Children" at the Gatlinburg Conference on Research and Theory in Mental Retardation, March 26-28. He gave an invited address at Purdue University on "Spontaneous' Strategy Use: Perspectives from Metacognitive Theory," West Lafayette, Ind., April 3. He also attended meetings of the American Educational Research Association in Washington, D.C., April 20-22 and presented papers on "Attributional Beliefs and the Training of Memory and Comprehension Strategies" and "Underachievement: The Importance of Attributional Retraining for the Generalization of Reading Strategies." He also presented papers on "Attributional Beliefs and Strategy Use: Video Games as a Training Device" and "Adolescent Mothers and Their Children: Enhancing Cognitive Readiness for Parenting" (coauthored with Thomas Whitman, professor of psychology, and Cynthia Schellenbach, assistant professor of psychology) for the Society for Research in Child Development in Baltimore, Md., April 23-26. Prof. Borkowski participated in a symposium at the University of Minnesota on Motivation and Empowerment and delivered the keynote address titled "Motivation and its Implications for Transition Processes," Minneapolis, Minn., May 20.

Ian Carmichael, assistant professional specialist in the Radiation Laboratory, delivered a paper titled "Correlated Calculations of the Spin Density Distribution in Some Silicon-Containing Radicals" at the 1987 American Conference on Theoretical Chemistry, Brainerd, Minn., July 27-31.

Stephen R. Carpenter, associate professor of biological sciences, gave a presentation titled "Whole-Lake Manipulations: Fish Affect Plankton Dynamics" for the American Society of Limnology and Oceanography, Madison, Wis., June 16.

Daniel M. Chipman, associate professional specialist in the Radiation Laboratory, delivered a paper titled "Spin Density Calculations on Free Atoms" at the 1987 American Conference on Theoretical Chemistry, Brainerd, Minn., July 27-31.

Daniel J. Costello, Jr., professor of electrical and computer engineering, presented a seminar titled "Multi-Dimensional Trellis Coded Phase Modulation" at the IBM Communications Research Laboratory in Zurich, Switzerland, June 15. He also presented a paper titled "Concatenated Coding Schemes Employing TCM Inner Codes for Satellite Transmission" at the IEEE International Information Theory Workshop in Bellagio, Italy, June 24.

George B. Craig, Jr., Clark professor of biological sciences, participated in the initiation of U.S. Public Health Services Survey on Aedes albopictus, Indianapolis, Ind., July 19-21.

James T. Cushing, professor of physics, delivered an invited paper, "The Relation of S-Matrix Theory to Quantum Field Theory," at the conference on the history of gauge field theory held at Utah State University in Logan, July 19-25.

Paritosh Kumar Das, associate professional specialist in the Radiation Laboratory, gave an invited seminar titled "1, 3-Dipolar Intermediates in the Photochemistry of Small-Ring Heterocycles" at the Research and Development Center, Phillips Petroleum Co., Bartlesville, Okla., July 23.

JoAnn DellaNeva, assistant professor of modern and classical languages, presented a paper titled "The Celebration of Seduction: An Aspect of Ronsard's Use of Mythology" at the National Conference of the American Association of Teachers of French, San Francisco, Calif., July 1.

Stephen M. Fallon, assistant professor in the Program of Liberal Studies, presented a paper on "Strategies of Unorthodoxy in 17th Century Prose" at the 1987 annual meeting of the Northeast Modern Language Association, Boston, Mass., April 2-4.

Richard W. Fessenden, professor of chemistry and associate director of the Radiation Laboratory, presented a paper titled "^{13}C Hyperfine Constants in Some Simple Radicals" at the 29th Rocky Mountain Conference, Denver, Colo., Aug. 2-6.

Mohamed Gad-el-Hak, professor of aerospace and mechanical engineering, presented a lecture titled, "The Art and Science of Turbulent Flow Control" at the NASA-Lewis Research Center in Cleveland, Ohio, July 7. He also delivered an invited lecture titled "What Did We Learn Since the Last Workshop?" at the second AFOSR workshop on unsteady flows held at the U.S. Air Force Academy in Colorado Springs, Colo., July 29-30.

Paul E. Gargan, assistant professional specialist in the Lobund Laboratory, presented a paper titled "Identification and Purification of an Inhibitor to Plasminogen Activators From Prostate Carcinoma Cells" at the 11th International Congress on Thrombosis and Haemostasis held in Brussels, Belgium, July 4-11.

John J. Gilligan, director of the Institute for Peace Studies, Shuster University professor,

special assistant to the president for public policy, and professor of law, delivered an address titled "Ethical and Moral Issues of the Arms Race" at the 1987 Summer Seminar on Global Security and Arms Control sponsored by the Institute on Global Conflict and Cooperation of the University of California, San Diego at LaJolla, Calif., July 1. He also gave an address "The Bishops' Pastoral Letter on War and Peace" at a meeting of the Rockford chapter of Pax Christi at Rockford, Ill., May 12.

Ronald A. Hellenthal, associate professor of biological sciences, gave a computer demonstration on the "Microcomputer-based Management of Taxonomic Invertebrate Collections" at the annual meeting of the North American Benthological Society, Orono, Maine, May 30-June 8.

Jeffrey C. Kantor, associate professor of chemical engineering, presented a lecture titled "Reasoning in Time about Discrete-Event Systems" at the Advanced Control Systems User Group Meeting, Purdue University, Lafayette, Ind., July 14. He also presented a workshop titled "Some Ideas for Teaching Process Control" (with Bradley Holt and Costas Kravaris) at the American Society for Engineering Education summer school for chemical engineering faculty held at Southeastern Massachusetts University, North Dartmouth, Aug. 10-14.

Ingemar P.E. Kinnmark, assistant professor of civil engineering, gave a presentation titled "High Stability Spatial Discretization for Hyperbolic Problems" at the conference "Computational Hydrology '87" held in Anaheim, Calif., July 14. He also gave a presentation titled "Elementary Proof of a Routh-Hurwitz Like Criterion" at MAXIMA IV, Tie Siding, Wyoming, Aug. 4.

Charles F. Kulpa, Jr., associate professor of biological sciences, gave a seminar presentation titled "Microbial Studies with the Sequencing Batch Reactor: Microbial Selection during Waste Degradation" at Miles Laboratories, Elkhart, Ind., June 9. He gave another presentation titled "Identification of a Unique Outer Membrane Protein Required for Iron Oxidation in Thiobacillus ferrooxidans" at the University of Warwick, Warwick, England, July 10-26. He presented a paper titled "Microbial Degradation of Chlorinated Compounds" at Biotechnical Limited, Cardiff, Wales, United Kingdom, July 22.

Jay A. LaVerne, associate professional specialist in the Radiation Laboratory, presented a paper titled "An Overview of the Oxidation of Ferrous Ions in the Fricke Dosimeter by Heavy Ions" at the 8th International Congress of Radiation Research, Edinburgh, Scotland, July 19-23.

Haim Levanon, visiting scholar in the Radiation Laboratory, gave an invited seminar titled "Porphycenes, Novel Isomers of Porphin" at the Argonne National Laboratory, Argonne, Ill., July 28.

George Lopez, associate profesor of government and international studies and fellow in the Institute for International Peace Studies, served on the faculty of the 10th annual workshop on the liberal arts sponsored by the Lilly Foundation at Colorado College, June 14-28. He also taught a seminar on "International Education and International Studies in the 1980s." He served on a panel on "Minorities in Higher Education" during the workshop. Prof. Lopez taught a mini-course "Citizenship in a Changing Global Community" at the annual conference of Global Education Associates hosted by the National College of Education, Evanston, Ill., July 6-9.

Ralph McInerny, Grace professor of medieval studies, director of the Jacques Maritain Center, and professor of philosophy, presented "Roots of Modern Subjectivism" at the Bay Area Conference on the Ethics of Human Reproduction held in San Rafael, Calif., July 27-31.

Anthony N. Michel, chairman and Freimann professor of electrical and computer engineering, presented a paper titled "Application of Interval Analysis Techniques to Linear Dynamical Systems: The Parameter Tolerance Problem" at the 10th World Congress of the International Federation of Automatic Control, Munich, West Germany, July 27-31. He presented an invited lecture titled "Effects of Quantization and Overflow Nonlinearities in Digital Feedback Control Systems" at the University of Belgrade, Yugoslavia, Aug. 3.

Elizabeth Anne Moon, staff librarian, wrote a book review titled "A Manual of AACR2 Examples for Serials, second edition which appeared in Serials Review, vol. 13, no. 1 (spring 1987).

Asokendu Mozumder, faculty fellow in the Radiation Laboratory, delivered a paper titled "Theoretical Aspects of Heavy-Ion Tracks on Radiation Chemistry" at the 8th International Congress of Radiation Research, Edinburgh, Scotland, July 19-23. He presented another paper titled "Theoretical Analysis of Free-Ion Yield in Liquid Argon under Low-Let Irradiation" at the 9th International Conference on Conduction and Breakdown in Dielectric Liquids, Salford, England, July 27-31.

Leonard E. Munstermann, associate faculty fellow in biological sciences, served as chairman at the 8th Annual Insect Photo Salon: American Mosquito Control Association, 1987, Seattle, Wash., March 29-31.

John F. O'Malley, adjunct associate professor of biological sciences, presented a series of anatomical lectures to head and neck surgeons and otolaryngologists as part of the 72nd annual comprehensive course on histopathology and anatomy of the head and neck in Indianapolis, Ind., July 6-16.

Larry K. Patterson, faculty fellow and assistant director of the Radiation Laboratory, gave a paper titled "Transient pH Effects in Charged Surfactant Micelles. A Pulse Radiolysis Study" at the 8th International Congress of Radiation Research, Edinburgh, Scotland, July 19-24. He gave another paper "Time-Resolved Behavior of Pyrene Excited States in Lipid Monolayers at the Gas-Water Interface. A Structure and Kinetics Study," at the Third International Conference on Langmuir-Blodgett Films, Gottingen, W. Germany, July 26-31.

John A. Poirier, professor of physics, gave an invited talk titled "Method to Detect Gamma Ray Extensive Air Showers and Identify Muons" at the workshop on nonaccelerator physics at the University of Rochester, N.Y., June 2.

Wolfgang Porod, associate professor of electrical and computer engineering, participated in the SDIO/IST Contractor Review Meeting, organized by ONR, held in Washington, D.C., June 16-18. He gave a presentation titled "Transport in SiO_2" at the meeting. He also presented a paper titled "Effect of Continuum Resonance on Hot Carrier Transport in Quantum Wells" (with Craig S. Lent, assistant professor of electrical engineering) at the 5th International Conference on Hot Carriers in Semiconductors, Boston, Mass., July 20-24. He participated in the Third International Conference on Superlattices, Microstructures, and Microdevices, held in Chicago, Ill., Aug. 17-20. He presented a paper titled "Effect of Continuum Resonances on Electronic Transport in Quantum Wells" (with Craig S. Lent) at the same conference.

Irwin Press, professor of anthropology, presented an invited paper titled "Obtaining and Using Patient Satisfaction Data" at the annual meeting of the American Hospital Association, Atlanta, Ga., May 27.

Jonathan Sapirstein, assistant professor of physics, presented a seminar titled "Parity Violation in Cesium" for the Nuclear Theory Group at the University of Colorado at Boulder, Aug. 5. He gave the same seminar at the Joint Institute for Laboratory Astrophysics, Aug. 11.

Howard J. Saz, professor of biological sciences, delivered a paper titled "Acyl CoA Transferases from Ascaris Mitochondria" at the 62nd annual meeting of the American Society of Parasitologists held in Lincoln, Neb., Aug. 2-6.

Robert H. Schuler, Zahm professor of radiation chemistry and director of the Radiation Laboratory, presented the keynote lecture on "Modern Trends in Radiation Chemistry" at the 8th International Congress of Radiation Research, Edinburgh, Scotland, July 19-24. He also chaired a symposium on "Track Effects in Radiation Chemistry" at the same conference.

James H. Seckinger, director of the National Institute for Trail Advocacy and professor of law, spoke at the NITA Advanced Trial Advocacy Program at the University of Colorado School of Law in Boulder, June 28-July 3. He was a faculty member and program coordinator for the NITA/Oppenheimer, Wolff & Donnelly Law Firm Trial Advocacy Program in Minneapolis, Minn., July 13-18. He also spoke at the NITA National Session at the University of Colorado School of Law in Boulder, July 5-6, and July 22-24. He conducted an evaluation of the Cook County States Attorney Trial Advocacy Program in Chicago, Ill., July 28-Aug. 1.

Janet E. Smith, assistant professor in the Program of Liberal Studies, gave a talk "The Objective Reality of Marriage" at the Bay Area Conference on "The Ethics of Human Reproduction" at Dominican College, San Rafael, Calif., July 29.

Donald E. Sporleder, professor of architecture, presented the report of the Lateral Forces Task Force at the annual meeting of the National Council Architectural Registration Boards in Seattle, Wash., June 24-27. He discussed the development of the seismic exam, the preparation of the seismic course specifications, and the resultant preparation of a lateral forces-seismic home study course for architects by the AIA. Prof. Sporleder serves as chairman of NCARB.

Albin A. Szewczyk, professor and chairman of aerospace and mechanical engineering, presented a paper titled "The Effects of Upstream Shear and Endplates on the Pressure Distribution Around a Rectangular Cyclinder" (coauthored by S.J. Elsner) at the CANCAM '87 (Canadian Congress of Applied Mechanics) held in Edmonton, Alberta, Canada, May 30-June 8.

Lee A. Tavis, Smith professor of business administration, completed field research in Kenya on health care and the role of pharmaceuticals, June 11-July 4.

J. Kerry Thomas, Nieuwland professor of science, presented a paper on "Fast Reactions in Viscous Liquids" at the Micellar Gordon Conference, at Plymouth, N.H., July 4-10. He also presented an invited talk, "Diffusion Controlled Reactions?" at the Faraday Society meeting on Fast Reactions at Sackville, New Brunswick, Canada, July 12-16. He also presented an invited talk, "Models for Biological Systems," and organized a symposium "Energy and Electron Transfer in Membranes" at the Photo Biology Society meeting at Balhour, Fla., June 22-26.

Anthony M. Trozzolo, Huisking professor of chemistry, served as session chairman at the Gordon Research Conference on Photochemistry, Proctor Academy, Andover, N.H., July 13-17.

Rev. Joseph L. Walter, C.S.C., chairman of preprofessional studies and associate professor of chemistry, was recently appointed to membership on the committee for "Undergraduate Science Education Initiative" of the Howard Hughes Medical Institute, Bethesda, Md., and participated in the planning meeting, in Bethesda, July 24.

administrators' notes

appointments

Todd M. Bemenderfer has been named associate director of the College of Business Administration's Executive Program Division according to Yusaku Furuhashi, college dean. He replaces John Raster who left the college in May to pursue other interests.

A 1976 graduate of Purdue University and 1987 graduate of the Notre Dame Executive MBA program, Bemenderfer's background is in sales, marketing, and management. Before joining a Mishawaka firm as an industrial sales manager, he was president of his own construction company and has served as sales representative for Motorola, Inc.

honors

Donald E. Dedrick, director of the physical plant, was awarded a Certificate of Appreciation by the Association of Physical Plant Administrators of Universities and Colleges (APPA). The certificate is awarded to those individuals who have actively participated in the advancement of the association through service as an officer, committee member, or participant in a program of benefit to membership. Dedrick was recognized for his contribution as a member of the Professional Affairs Committee.

documen-tation

telephone directory addition

The following is the list of names that was inadvertently omitted from the preliminary telephone directory. They will be included, in the correct sequence, in the permanent directory scheduled for distribution in late October.

LINK, David T. (Barbara) Dean and Professor, Law, 203 Law Bldg. 7015
51734 Lilac Rd. 272-6614

LIU, Ruey-wen (Nancy) Professor, Electrical Engineering, 270 Fitzpatrick Engr. 6228
1929 Dorwood Drive 233-2914

LIVINGSTON, A. E. Gene (Sibylla) Assoc. Professor, Physics, 224 Nieuwland Science ..... 7554 / 7716
17663 Hansom Court 272-8004

LOCKHART, Robert B. (Jody) Asst. Professor, Mathematics, 354 Computing Ctr./Math Bldg. .. 5352

LODGE, David M. (Andrea Midgett) Asst. Professor, Biological Sciences, 240 Galvin Life Science ... 6094
116 E. Bronson 288-2959

LOEFFLER, Robert A. (Carol Beth) Manager of Operations, Joyce ACC, C116 Joyce ACC 6689
17357 Fleetwood Lane 272-6305

LOESCHER, Gilburt D. (Ann) Assoc. Professor, Gov't and Int'l Studies, 114 Decio 7096
844 Park Avenue 289-3668

LOMBARDO, Peter J., Asst. Director, Center for Continuing Education 7005
52126 Country Lane 277-5208

LONIE, C. Ann, Librarian, Head, Reference Dept., 108 Hesburgh Library 7665
26414 Brush Trail 272-9487

LONIE, Joseph C., Staff Engineer, Physics, 106 Nieuwland Science 7716
918 Napoleon 234-9669

LOPEZ, George (Cathy) Assoc. Professor, Government and Int'l Studies, Institute for Int'l Peace Studies 6972
1613 Enchanted Forest 277-4316

LORDI, Robert J. (Dorothy) Professor, English, 177 Decio 7550
52901 Winterberry Drive 272-7180

LORENZ, Edward H., Asst. Professor, Economics, 415 Decio 7590
915 N. Notre Dame Ave. 233-8672

LoSECCO, John M. (Lynne) Assoc. Professor, Physics, 412 Nieuwland Science 6044
128 North Shore East

LOUGHERY, C.S.C., Mr. Robert, Asst. Rector .....
239 Morrissey Hall 6272

LOUGHRAN, Thomas, Adjunct Asst. Professor, Philosophy, G-69 Hesburgh Library
809 E. Angela Blvd. 232-0723

LOUX, Michael J. (Ann) Dean, College of Arts and Letters, 137 O'Shaughnessy 6642
3520 Winding Wood Drive 233-1993

LOVATA, Linda M. (Kirk Philipich) Asst. Professor, Accountancy, 201E Hurley Bldg. 6261
52262 Farmington Square Rd., Granger, IN 272-9341

LOWE, Christopher R. Graphic Arts/Photography, Educational Media, Rm. 13 Center for Cont. Education 5465
1123 E. Calvert Street 289-7295

LUCAS, Log Sgt., Joseph P. (Elizabeth) Military Science (Army), ROTC Bldg. 5 6264
521 E. Grove St., Mishawaka, IN 259-2472

LUCEY, John W. (Nancy) Assoc. Professor, Aero. and Mech. Engr., 371 Fitzpatrick Engr. 7381
307 E. Pokagon 232-4481

LUCKERT, Phyllis H. (Herbert) Asst. Professional Specialist, Lobund Laboratory, 049 Galvin Life Science 7564
221 Marquette Ave. 282-1354

LUDWIG, Arnie F. (Jean) Director, Executive Programs Division, College of Business Administration, 134 Hayes-Healy 6396
51963 Shoreham Ct.

LUNDEEN, Stephen R. (Ann) Assoc. Professor, Physics, 219 Nieuwland Science 7398
928 Riverside Drive 233-3610

LUTE, John (Peggy) Stockroom Manager, 102 Radiation Research Bldg. 6204
126 N. Walton 288-9726

LUTHER, C.S.C., Bro. Edward, Rector, Fisher Hall, Student Affairs .....
100 Fisher Hall 6950

LYONS, Patricia L. (Michael A. Doellman) Asst. General Counsel, General Counsel's Office, 429 Administration Bldg. 6411
310 Peashway 232-0778

LYPHOUT, James J. (Rose) Asst. Vice President for Business Affairs, 307 Administration Bldg. 6646
50654 Birkdale Court, Granger, IN 277-5292

LYTLE, Julie, Media Consultant - Wake Up To Prayer (IPSM), Institute for Pastoral and Social Ministry, 1201 Hesburgh Library 6968
19573 N. Paxon Drive 272-0812

LYSY, Peter J., Asst. Archivist, University Archives, 607 Hesburgh Library 6448
523 L.W.W., 7-G, Mishawaka, IN 259-9158

report to the provost of the task force on computing at the university of notre dame

In the fall of 1985, I appointed a task force to conduct a comprehensive study of all aspects of computing at Notre Dame and to make recommendations for a University-wide strategy. The task force submitted a summary report in December 1986, and a full report in April 1987. The full report is printed below.

The recommendations of the task force call for major changes and significant increases in funding aimed at meeting the forseeable needs of the disparate community of users on our campus.

I believe that the University must move in the directions indicated by the task force. The starting and continuing costs are high and, quite frankly, rallying the necessary resources will be difficult. Nevertheless I am convinced that the plan should have a high University priority, and that strong efforts should be devoted to its execution.

I hope you will reflect on the report. If you have any comments or suggestions, please send them to Roger Schmitz.

I appreciate the substantial amount of time and effort that Roger and members of task force devoted to this important work.

Timothy O'Meara
Provost

FULL REPORT OF THE TASK FORCE ON COMPUTING AT THE UNIVERSITY OF NOTRE DAME

I. Introduction

Computers have become essential tools in all areas of today's university. Used by faculty, students, and administrators on all levels to create, store, analyze and disseminate information, computer-based technologies also have made possible new creative teaching and scholarly endeavors. For example, new computer-intensive areas of scholarly work in economics, quantitative literary analysis, artificial intelligence, and large-scale simulations are becoming part of the academic mainstream. Undoubtedly, countless academic enterprises will be significantly enhanced and productivity improved for most people if modern computer-based technology and support are made available in adequate quantity.

A university's computing environment is becoming one measure of the quality of its programs, even though the correlation may not be perfect, because it is a visible measure of support for teaching and research. Moreover, an institution which neglects computing will harm its ability to attract and retain top-quality students and faculty and to compete for external financial support. Top-rated institutions already have given careful attention to these matters; others see a once-in-a-generation opportunity to make a strategic upward move in educational circles.

However, the best strategy for any given institution is hard to determine. Simply acquiring the latest mainframe, providing periodic pulses of funding, and giving users a central resource for computing power and services is no longer adequate. Some technological advances are clearly predictable, but others are not, and the rapid changes demanded seem contrary to normal university culture. The tendency is to wait for the ultimate. However, the ultimate will never arrive, and institutions which choose to wait will fall even further behind. Computing capabilities will continue to grow, and the price of state-of-the-art systems is not likely to decline rapidly. In these circumstances, the best approach is to establish an organization and strategy for moving in the right direction which is flexible and open to rapid and often unpredictable technological changes.

A recent trend is to categorize institutions according to their status and enterprise in computing, communications, and other information technologies. Some have been classed as *leading-edge developers* (risk-takers, pioneers); others are *early followers* of available technology. Two other categories are *late followers* of these technologies and *resisters* to technological change. Probably no institution fits perfectly in any one category in all of its activities. Even leading-edge places bemoan some late-following units, and resisters are likely to have some leading-edge activities. They differ in their institutional goals for computing and how they pursue those goals. Those who engage in such categorizations imply that no institution will be able to gain or maintain status as a leading teaching and research institution through this century unless it places itself in one of the first two categories.

On the whole, Notre Dame can hardly be classed as a leading-edge institution with respect to computing, and becoming one certainly need not be an institutional goal. However, the University has been inappropriately late in advancing with computing and finds itself significantly below the early follower stage, especially in academic applications and the use of modern software. Considering the University's aspirations to move to the front ranks of research universities while

maintaining excellence in teaching, we assert that its current status as a late follower is not consistent with its academic goals and not appropriate for a university of its caliber. In some academic areas, the University is already in a weak competitive position in the attraction and retention of faculty and students, in research capability, and even in the provision of basic instruction.

The University's PACE (Priorities and Commitments for Excellence) report of 1982 recognized the need and pointed to the direction:

> ". . . long-range planning is essential to provide direction as computing continues to proliferate into all parts of the University. It is only through planning that the University can take advantage of new technologies in a cost-effective manner."

In the fall of 1985, Provost Timothy O'Meara instructed this Task Force to make a comprehensive study of computing at Notre Dame. We submit a report of our study in two forms: this full report and, separately, a summary version with less detail. We describe briefly the present situation and likely future developments, and give the rationale, guidelines and estimated costs for a recommended course of action for Notre Dame. We emphasize the conceptual strategy and general architecture, rather than such detail as equipment and software specifications. We acquired information, drew conclusions and drafted recommendations for this report through (1) reports submitted by the four colleges and the Law School, which were based on departmental reports, (2) oral presentations by the staff of the Library and of Information Systems, (3) visits by some members to other universities, (4) participation by some members in national conferences, (5) consultations with major campus users and the University Committee on Computing, (6) a meeting with a group of graduate and undergraduate students, (7) consultations with a private consulting firm which visited the campus, and (8) numerous Task Force meetings.

II. National Directions and Developments

The ideal developing at many research universities is a unified, evolving, networked campus-wide computing infrastructure which incorporates personal computers and workstations, gateways to national networks and remote supercomputers, access to on-campus academic, administrative and library computing systems, a distribution of support services, and a strategy for continual funding. Within a few years, typical computer users on a university campus will be able to: (1) use a desk-top computer (i.e. workstation; microcomputer) for much of their work, (2) communicate within their units through a local network, (3) communicate with others on the campus through a campus-wide network, (4) gain access through the network to minicomputers and mainframes for exchanging files, executing programs and searching library catalogs, (5) share the capabilities of many individual computers, and (6) use the campus network as a link to remote supercomputers as well as colleagues and resources throughout the world.

Such capabilities already exist on many campuses. Rapid computing developments at universities across the country are based on certain common realizations: (1) The demand for computer use pervades all corners of the campus. (2) The most important need is to provide convenient access to a variety of computing resources, including supercomputers -- at remote (i.e. off-campus) locations for most universities -- as well as microcomputers throughout the campus.

Universities are allocating large amounts of money to implement their computing plans, and dramatically increasing annual budgets for computing operations. The following examples of commitments to computing by some of Notre Dame's academic peers are from a long and growing list. These are not leading-edge institutions in computing.

The University of Pennsylvania has allocated about $8 million to AT&T to set up the spine of a campus-wide network, called Penn-Net, linking its 117 buildings together. Another $11 million will be spent to create internal networks within each building linking workstations in individual offices and departments together and to the campus network.

The University of Virginia has announced a $30 million five-year plan to network its campus and to replace its so-called dumb terminals with intelligent workstations.

Networks

Technological advances having the greatest impact on universities are those regarding networks, supercomputers and microcomputers. With current technology, the overall campus picture is one of many networked workstations which have stand-alone capabilities for certain tasks, and are connected to shared central or remote computers for others. The increasing number of networked microcomputers, particularly those that are connected to local shared files and software on micronetworks, will reduce certain types of demand on central systems; however, overall computing on the central system is likely to increase as the population becomes more computer literate.

Until recently, networking developments at universities were fragmented and uncoordinated. However, many universities have realized that a unified approach to networking is required, that good use can be made of current technology, and that networking is the single most important unifying step that can be taken to enhance the computational environment at this time. Many, in fact, have campus-wide networks in place. At Brown University, for example, the system consists of a campus-wide broadband network, an IBM 3081 mainframe computer, several distributed minicomputers, and workstations of Apple and IBM microcomputers, and further major developments are underway.

Others have networking projects in progress. Cornell University is constructing a network that will transmit voice, data and video and link all academic, administrative, laboratory and residential buildings on the Ithaca campus. The hardware at Cornell includes 137 terminals and 543 microcomputers, mostly Macintoshes and IBM PCs, in a combination of publicly accessible and restricted facilities. The central mainframe facility has an IBM 4381, used mainly for instructional computing, and an IBM 3081, for research and administrative computing. There is a central software lending service for microcomputer users.

The details of how campus networks are being developed vary widely, but indeed they are being developed in large numbers. The usual procedure is to build a network of networks by installing a backbone which interconnects the departmental networks on a centrally supported system. The actual connections are in various configurations and architectures. A variety of communications procedures (protocols) are in use, but a common standard is evolving. Many universities have adopted as the campus standard TCP/IP, the set of protocols developed and used with the Department of Defense Advanced Research Projects (DARPA) and recommended by the National Science Foundation in its networking initiative, NSFnet.

Supercomputers

Along with these developments, universities are hastily gaining access to national networks for supercomputing power. Increasing use of supercomputers, machines at the highest end of current computational technology, clearly will be a way of research life in certain disciplines for the foreseeable future. Prices beyond the $20 million level prohibit most institutions from obtaining

their own system, and current use of externally supported supercomputers by Notre Dame researchers is not sufficiently large to justify the local acquisition of so large a resource. The important development is the establishment of national networks which give all universities an opportunity to use supercomputing facilities elsewhere. Most noteworthy has been the National Science Foundation (NSF) program, begun in 1984, from the Office of Advanced Scientific Computing to provide immediate access to six existing supercomputer facilities and the establishment of five national supercomputing centers to serve the academic research community. The five national centers are linked together through a national network called NSFnet. NSF also has funded regional and state networks which link to NSFnet and provide supercomputer access to the member institutions. Recent NSF targets have been the need for high-function graphics workstations to be used in conjunction with supercomputers and connections of outlying universities to the regional networks. In order for a university to receive NSF support for a network connection, it must have a campus backbone for access by all users in science and engineering, at least, and it must provide a gateway from the backbone to the national network. Users are charged for time on these supercomputers, but grants are readily available for science and engineering applications.

Microcomputers and Workstations*

Developments with microcomputers are increasingly rapid, and each new product has greater memory, faster speeds and improved user friendliness than the previous one. At all institutions, the common usage of microcomputers is word processing, and that usage alone justifies computing capability for most students, faculty members and administrators.

A system currently under development at Carnegie-Mellon University jointly with IBM, called the Andrew workstation system, is a user interface that adapts powerful desk-top computers to specific needs in higher education. Judging from recent trends such as this, we can expect that within a few years the workstation environment will be more fully integrated, with superior graphics, microcomputer speeds of 0.3 million floating-point operations per second (mflops) and active memories of 2 megabytes. These capabilities are superior to those of current machines by an order of magnitude. The costs now are in the $7,000 to $10,000 range, but with quantity educational discounts, they are expected to be as low as $3,000.

The user need is quite varied, however, and it will be sometime beyond their development that such capable workstations are wanted or needed by the majority of campus users. Meanwhile, universities are putting currently available microcomputer clusters in place to provide computing access to the general user while experimenting with these more advanced technologies.

Having uniformity at the workstation level, to the extent of having a common operating system and a common workstation structure, would solve many problems standing in the way of truly effective workstation use in higher education, not the least of which are problems of maintenance, support and software exchange. However, there is promise but little progress toward standardization of personal computers among various vendors. Different models use different operating systems. Therefore, software developed for one vendor's machine will not run on another's. An exception, to some extent at least, is the family of so-called IBM compatibles, which use MS-DOS or PC-DOS operating systems. An operating system called UNIX, widely used currently on minicomputers and mainframes, has been proposed as the standard for the next generation of microcomputers. Even now, however, some versions of UNIX are not fully compatible with each other, but a standard seems to be emerging gradually.

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* The term *workstation* is used generically in this report to mean an access station for an individual user. The vast majority of workstations would be microcomputers, but some could be simple terminals.

Another factor working against uniformity on university campuses, in addition to the competitive, rapid and unpredictable changes in technology, is the difficulty in getting faculty in various disciplines to agree on the appropriate standard. One vendor's products may be more suitable to a certain discipline, for example, because established trends in the discipline may have already led to extensive development of useful software.

How many workstations are needed? The University of Wisconsin's goal is to have one for every 10 students within three years. Their present ratio is 1 to 26. The ratio at Cornell, counting graduate and undergraduate students, also is about 1 to 26. These ratios reflect a growing demand by students for regular and convenient access to computing technology. (The current ratio at Notre Dame, by comparison, is about 1 to 40.)

Some institutions, which tend to be heavily technically oriented, require their students to purchase microcomputers. Included among them are Clarkson University, Drexel University, and Stevens Institute of Technology. At Dartmouth, 70 to 80% of the entering class purchase Apple Macintoshes, and they have access from their dormitory rooms, through a campus-wide network, to a central computing facility and an on-line library catalog.

Bradley University has developed what it calls "tomorrow's residential living quarters" for students. In one dormitory, each room is equipped with an AT&T microcomputer, a printer and an assortment of software. Some of the rooms are connected to a campus network. Students must apply for residence in that dorm, and they are charged an extra fee of $200 per semester to cover the cost.

The computer literacy of entering freshmen is changing dramatically. According to surveys reported in the Chronicle of Higher Education, the proportion of entering college freshmen reporting that they frequently or occasionally wrote a computer program increased from about one-fourth to about one-half between 1982 and 1984. Two-thirds of incoming Notre Dame freshmen have taken one or more courses in which the computer was integrally involved. (See the College of Arts and Letters Freshman Computing Survey in the Appendix.) Another survey showed that university students are less than satisfied with college computing facilities generally, complaining of slow mainframe response, shortage of terminals, microcomputers, and printers. It showed further that students strongly oppose the idea of schools requiring entering students to purchase their own microcomputers. Most say that they would not have been able to afford them.

III. History and Current Status of Computing at Notre Dame

The history of computing at Notre Dame until the middle 1970s is similar to that at most universities. Through the 1960s, the central system consisted of a mainframe housed in the Computing Center and run in batch operation. An IBM 1620 was followed by a Univac 1107, both then state-of-the-art machines. By the late 1960s other machines, IBMs and the smaller PDPs, were appearing in individual colleges and departments. In 1970 an IBM 360/50 was installed and one year later, an IBM 370/155 -- which introduced TSO (time-sharing operation) to the University.

By the end of 1973, computing operations at Notre Dame were a model for other institutions, especially in Indiana. Notre Dame was the first in the state to install the latest mainframe, an IBM 370/158 which supported up to 60 TSO users, a heavy load of batch work and the full range of administrative work. The annual operating budget was approaching $1.5 million, with a staff of 48 full-time employees plus secretaries.

That same year, however, the report of the Committee on University Priorities (COUP) expressed concern:

> "Computer people say the computers are to be as available as the libraries. The analogy has much merit, but it is far from perfect. Every student and every faculty member is personally dependent on the library, but that is not true of the computer. Some people use computers much but most not at all. . . .
>
> "We have found a general uneasiness and concern for the total cost of all computing on campus, for the proper configuration and capacity of machines in relation to instructional, research and administrative needs and, not least, for the apparently unplanned and uncontrolled growth of computer use."

Falling Behind

Since then, computing resources at Notre Dame have steadily declined. Relatively little substantial change has been made in central computing facilities. Old IBM 370 equipment is still being used for the current campus mainframe, an IBM 370/3033, and much of the software is antiquated. Notre Dame was not alone, however, in standing still during this decade of rapid but somewhat chaotic changes in computing technology, affecting not only mainframes but also smaller machines. The overall picture for future developments was not in sharp focus, even for the experts.

Meanwhile, at Notre Dame individual colleges and departments handled their own computing needs as best they could. Researchers were able to obtain funds from granting agencies to purchase and maintain dedicated minicomputers. Computer areas consisting of terminals to the mainframe or to a local minicomputer were set up for students and faculty. More recently, such areas also contain microcomputers. In the absence of a comprehensive central strategy, most developments have been undirected and fragmented. Some units are in a better position regarding computing equipment than others.

Current Networks and Equipment

Notre Dame now has five major local area networks in addition to several microcomputer networks such as AppleTalk and Corvus Omninet. The major ones include three DECNETs, one in the Radiation Laboratory and two in the College of Science. The College of Engineering has installed a HYPERbus network which connects microcomputers and minicomputers in the College to a Prime 9955 minicomputer and to the campus mainframes, the IBM 3033 and 4381. The fifth, also in Engineering, is an Ethernet system, using the TCP/IP protocol, which connects four Sun workstations and will be extended to two MicroVAX machines and an AppleTalk network. Notre Dame is a subscriber to BITNET, a national network which supports file transfers such as mail and remote job entries over telephone lines at 9600 baud. The University also has an interactive link via Telenet throughout the world.

In the present configuration, the IBM 3033 mainframe is accessible by three types of time-sharing terminals. There are 120 locally attached full-screen devices of the IBM 3270 variety connected by coaxial cable and operating at the channel speed of the mainframe (1.2 million baud). Full-screen asynchronous ASCII terminal access is available to another 48 units, 32 of which are directly connected at 9600 baud and 16 of which connect through ordinary dial-up telephone lines at up to 2400 baud. Finally, access is provided for 71 asynchronous devices operating in line-at-a-time mode, 60 of which may be connected over dial-up telephone lines at 1200 baud. Any of the devices connected may be generic terminals or may be a personal computer emulating a terminal of the appropriate type. In total, 239 time sharing sessions could be active at one time on the 3033 if all access paths were simultaneously in use.

The various types of systems in use at Notre Dame involve several different operating systems, including MVS/SP (on the IBM 3033 and 4381), VM/SP (on IBM 4341 in Electrical and Computer Engineering), MPE (on the HP 3000/70), PC DOS (on IBM PCs), UNIX (on Sun and MicroVAX workstations, VMS (on VAX systems), PRIMOS (on Engineering's PRIME 9955), and the Macintosh operating system.

Table I in the Appendix, composed from college reports, lists most, but not all, computing equipment on the campus as of November 1986. It does not seem possible or necessary to obtain a complete list. The intention is to give an impression of the amounts and types of equipment in use at Notre Dame. As the table shows, computing developments within colleges and departments have led to an assortment of micro- and mini-level computing equipment for teaching and research.

We can give no estimate of the number of computers owned by students, but clearly the number is increasing. We would expect it to increase further if guidance and encouragement were to come from announced University standards and from more extensive integration of computing in curricula. As it now stands, students use available computing resources for their work quite widely even when such use is not required, and they often wait in long lines at all hours to find an open terminal or microcomputer. The student interest is not surprising in view of the fact that 60% of entering freshmen in the fall of 1985 reported completing at least one-half year of computer science in high school and nearly one-fourth of them reported that they used a personal computer frequently during the year prior to entering college. (See the Freshman Computing Survey in the Appendix.) These percentages are certain to increase as computing in high schools becomes more and more common.

Developments in Central Computing

While there has been no major change in the IBM mainframe system itself in recent years, there have been important developments in central computing. The Notre Dame Administrative Computing System, for example, is in a state of transition. Formerly run in time-sharing and batch modes on a single IBM mainframe, in competition with academic usage, the administrative computing demand gradually grew to a point where it consumed about one-third of the University's central computing resources. Also, the programs had become inefficient and, although many applications used the same data, there was no integration or common database.

In 1982, detailed plans were made to develop an entirely new set of administrative systems to be run on a Hewlett Packard system (currently the HP 3000 computer) and share common University databases. Both the present and planned Administrative Systems are described in a later section.

Another noteworthy development is the 1986 acquisition of an IBM 4381 (model 13) computer for automation of the University Libraries which, with the Law Library, are in the process of implementing library automation software called NOTIS, the Northwestern On-line Total Integrated System. This project also is described later in this report. All 168 access paths to the IBM 3033, which is connected to the IBM 4381, also may be used to access the NOTIS system. For now, the IBM 4381 has more than sufficient capacity for the Library System. It is temporarily running those administrative programs which have not yet been reprogrammed for the HP system. Therefore, the IBM 3033 central mainframe is now totally available for academic use.

For most users, the IBM 3033 has adequate computing power to continue their current level of activity. However, these users generally find the software inadequate, modern accessories lacking, and the system difficult to use. Ordinarily if more than 50 or 60 intensive users are on the time-sharing system at one time, response is very sluggish. In addition, access is difficult and the operating system is obsolete and unfriendly. Newer, more functional software would strain the

capacity of the system, which is practically saturated. Researchers involved in leading-edge computational work find the present mainframe capacity inadequate, and a small but very important number of researchers say that they must deliberately limit the scope of their research because adequate computer power is not available.

Need for Major Development

Computer uses vary from one discipline to another, but the common base of use is word or text processing for both academic and administrative purposes. If there were a campus network, computer-based technologies would likely be used extensively for various communication purposes, including sending and receiving text and electronic mail generally. Quite common also are needs for information acquisition and graphics capability. If provided convenient access, faculty and students could make advantageous use of library automation, initially for searching the card catalog and later as a source and window into larger information resources.

Students and faculty in the Colleges of Science and Engineering are most strongly involved with so-called "number-crunching" work, which means that they are carrying out numerical solutions and simulations based on mathematical models of physical systems. Many undergraduate needs (for example, most homework assignments and computer-aided design (CAD) work) can be met by advanced microcomputers or minicomputers, but applications at the graduate student and faculty research end require the most capable mainframes and supercomputers. Typically they demand extensive CPU (central processing unit) time rather than large quantities of input and output. For example, only about 10% of the jobs processed by the campus mainframe are from engineering faculty, but these consume up to two-thirds of the CPU time. Also, the most demanding research computing task in the Physics Department currently may run on the IBM 3033 for several hours per day to produce a single point on a graph per week. Other science and engineering applications include on-line laboratory data acquisition and control by micro- or minicomputers interfaced to experimental equipment. The computers frequently are dedicated to the laboratory.

A typical use of computers in the College of Business Administration is for data manipulation and analysis and file management. Student homework assignments require computer usage, sometimes through the execution of user-written code and sometimes through the use of applications software packages. Tasks usually are not CPU demanding but frequently have large input/output requirements and data banks.

The College of Arts and Letters and the Law School place greatest importance on text processing and library information acquisition. In addition, social scientists require computers for statistical data analysis and mathematical modelling, and artists and architects need computer-aided-design capabilities. The English Department pioneered instructional use of the computer in the freshman writing program.

Notre Dame can point to some leading-edge activities. One is Professor David Cohn's IBM-sponsored microcomputer communications project in the Department of Electrical and Computer Engineering. Others include software development for laboratory management and experimental control in the Department of Biological Sciences and the fully-integrated entity relationship model proposed for the University's Administrative System. Notre Dame also has participated in Educom's Planning Council for Higher Education and currently participates on Educom's Networking and Telecommunications Task Force.

Some good computing facilities have been developed within individual units on the campus. Examples include minicomputers and local networks, generally obtained through gifts and external grant support, currently in use for teaching and research in the Colleges of Science and Engineering.

For the most part, though, these and other developments have been fragmented and uncoordinated. In addition, one can find many computer uses elsewhere that have not been introduced at Notre Dame. Most likely the lack of, and/or limitations of, computing resources has been a deterrent. Examples include work in the arts -- such as the computer construction and analysis of art forms and the composition and analysis of music -- and the interactive electronic exchange of text materials between students and faculty, particularly for the submission, correction and revision of assigned papers. With some notable exceptions, there has been little interest in -- or support for -- courseware development.

Frustration best describes the general feeling on campus about academic computing. Faculty recite a list of obstacles to the more effective use of computers. Some departments are unable to integrate computing into their teaching and research programs, even though an obvious need exists to do so, because central facilities and services are insufficient. Faculty need user support, including education or training, and assistance in developing courseware. Funds are not available for obtaining and maintaining personal computers and other equipment. Researchers in science and engineering find the CPU power of the mainframe inadequate for many applications, and the software out-of-date.

IV. Task Force Conclusions and Recommendations

The Task Force concludes that the University must change its posture toward computer-based technologies and services if it is to achieve the goal, stated in the PACE report, of becoming a great university, excelling in teaching and research. The 11 recommendations which follow, in short, urge the University to move from the category of a late or casual follower of proven computing developments to an early or aggressive follower -- still not a pioneer or risk-taker. Such a move calls for the installation and support, with a full range of services, of an integrated computing system and an environment which provides convenient, even inviting and pleasant, access for faculty, student and staff users to the latest proven computing technology, to an automated library system, and, with appropriate limitations, to an administrative database.

At the same time, we emphasize that a University-wide commitment to being an early follower should not be interpreted as discouraging to those individuals or groups who would engage in pioneering computing endeavors. Indeed we should expect that a great research university would encourage pioneering work in computing as it would in all other important areas.

In making the following recommendations, we envision a computing infrastructure consisting of a campus-wide network on which there are three major computing systems -- Academic, Administrative, and Library -- and a link to remote supercomputers and national networks. Other components of the infrastructure include several clusters of *workstations* for general access, primarily by undergraduate students, and some classrooms equipped for interactive access to network resources by an instructor during class. In addition to this infrastructure, other important parts of the total system are *Unit Specific Requisites (USRs)*, the computing requirements within departments, colleges, and other units. USRs include, for example, workstations in faculty and administrative offices and graduate student areas, microcomputer networks with servers and gateways, and computing equipment in laboratories and studios. The recommended system would be managed and coordinated by an Office of University Computing (OUC) under an Assistant Provost for Computing who would be generally responsible for a range of support services, including educational programs for users at all levels.

We urge prompt action by the University, emphasizing that the recommendations which follow are for the necessities, not luxuries, of today's teaching, research and service functions of a major university. This expansion and enhancement of the University's computing capabilities must be based on careful and continuous planning and must include both adequate financial resources, initially and continually, and adequate support services for users.

The following subsections contain the specific recommendations with brief descriptions, and a later discussion section calls attention to other important considerations. The recommendations are simply listed in Section VI.

A. The Network

An effective university computing system must provide easy access to local and remote information and computing resources. Notre Dame faculty, students, administrators and staff in every part of the campus use computers, and their number is growing. Granting that the sharing of resources and the enhancement of campus-wide communications are highly desirable qualities, we conclude readily that a campus-wide network should be developed.

RECOMMENDATION 1: *The Task Force recommends that a campus network, herein called NDnet, be put in place. NDnet, extending to nearly all buildings on the campus and consisting of a fiber optic backbone with connections to local and microcomputer networks, would facilitate campus-wide communications and provide access from workstations (i.e., microcomputers or terminals) and by telephone connection to the University's computing resources, including the Administrative, Library, and Academic Systems and local servers. We recommend further that NDnet be linked to national networks and remote supercomputers.*

Figure 1 in the Appendix gives a schematic diagram of the recommended system.

With all of these components connected, the user at any station could gain access to any other point on the campus network for purposes of computing, transmitting, storing and sharing files and information. The user also could exchange information with colleagues around the world and gain access to a remote supercomputer. Furthermore, most of the workstations themselves would have stand-alone capabilities for modest computing needs, including word processing.

The recommended system should include the capabilities current technology can provide. Proven systems of this general type already operate at other universities. The major obstacles, which are being removed rapidly by advancing technology, pertain to incompatibility of products, both hardware and software, from various vendors.

Two matters to address regarding networks are *connectivity*, which deals with the physical connections of components and describes accessibility and communicability, and *compatibility*, which deals principally with difficulties in communicating between dissimilar systems and describes the limits of functionality.

Regarding connectivity, current and foreseeable technological developments dictate the appropriate overall architecture, and institutions seem to be following very similar paths. First, relatively small networks connect workstations or microcomputers (described in a later section) to such locally shared resources as file servers, printers and possibly minicomputers. (We call these

micronetworks hereafter.) We envision such micronetworks at Notre Dame to span departments, or groups of offices, or a single cluster of workstations. With this level of connectivity, a user at a workstation would be able not only to use the stand-alone capabilities of the station, but also to communicate with nearby colleagues, share files and software and use high-quality printers. Thus micronetworks would serve the frequent local computing and communications needs without taxing any central resource, and we suspect that most of the computing needs of the majority of campus users, particularly undergraduate students, would be met at this time with this arrangement alone. Examples of micronetworks are the Corvus Omninet, AppleTalk and the IBM Token Ring -- all of which are already in use on the Notre Dame campus.

For most areas of the campus, the micronetworks should be connected to what we call *local networks*. Usually spanning entire buildings, these networks would provide access to such college level resources as minicomputers, and they would facilitate interdepartmental communications and sharing, again all without adding load to central campus facilities. Examples of networks which would serve this purpose are Excelan's Ethernet and Proteon's ProNet.

At the campus level an interbuilding backbone should be connected to the central Academic, Administrative and Library Computing Systems. All local networks and some micronetworks would be connected to the backbone. In addition, the backbone should be linked to a remote supercomputer, which is discussed later, and there should be a telephone access system. The latter feature is important as it would permit off-campus or off-network access to the network resources from locations not directly connected, such as most dormitory rooms and off-campus sites. The interbuilding backbone should have a high bandwidth to support graphics workstations driven from mainframe software and be able to handle large file transfers, support queries to a library catalog, operate a campus-wide mail system and provide for off-campus access.

There is some question about the best choice of backbone material. In most of the recent installations, universities have favored the latest technology of fiber optic cable, which transmits at a higher rate and greater bandwith and supports voice, data and video. Earlier installations used coaxial cable, which at the time was much less expensive than fiber. Although fiber optic cable may be slightly more expensive to install, its high bandwidth, immunity to electrical interference, and environmental stability make it the optimum choice. Considering that there certainly will be increasing demands on transmission rates, particularly for graphics, that future applications may call for video transmission, and that we should hope for at least a couple of decades of use before replacing the backbone, the Task Force felt that fiber optic cable, with its expected long technical life, would be the appropriate choice. The installation of the backbone apparently will be able to use at least parts of the campus steam tunnel system and reduce the amount of necessary new tunneling around the campus.

The matter of compatibility arises because a multi-vendor equipment environment makes the use of a network less than ideal. Connecting one network to another -- for example, an IBM Token Ring functioning as a micronetwork to an Ethernet local network -- is accomplished by means of devices called gateways and bridges. (A gateway is a protocol-translating device which connects one network to another when they use different protocols. A bridge passes information between similar networks. The network protocol is the means or strategy by which signals are sent and received by that particular network.) Second is the question of the ability of one vendor's machine to function effectively on a network with another's. Fortunately, hardware and software developments have made it feasible to conduct effective operations in a multi-vendor environment, but this is not yet a trouble-free matter. The following description elaborates on this point by depicting an ideal situation and a more realistic one.

In ideal circumstances, a workstation would have local processing capability, memory, graphics and printing, and access to other network resources as if they were part of the workstation environment itself. The Andrew project at Carnegie-Mellon University, mentioned earlier, and Project Athena at MIT, are prototypes of this concept. The user would be able to transfer files, i.e. text messages, documents, electronic mail and the like, to any other points on the network and have them duplicated there exactly in the form that they were prepared. The user would have to learn only one environment -- that of the workstation itself. At least he/she could retrieve and store files, execute commands and run programs without regard for the network servers used.

Unfortunately, limitations in current technology make such ideal functions of workstations on networks impossible in a multi-vendor computer environment. As a minimum, current technology allows the workstation, with the appropriate software, to emulate a terminal in gaining access to a host computer. For example, a Macintosh computer, with appropriate software, could emulate a terminal for the administrative computer (the HP 3000) or, with other software, an IBM terminal. In that sort of emulation mode, a user could combine the capabilities of the workstation and the network servers to accomplish a number of tasks. The difficulty is that the operation requires the user's knowledge of the server computer and of the various commands pertaining to it. The user would have to learn several environments to take advantage of all resources on the network.

B. Academic Computing System

1. Mainframe. For the near future, as in the recent past, the best descriptor of a university's computing capability will be its mainframe system along with the mode of access or type of network. A mainframe computer usually is a central facility with large memory capabilities, a high-speed processor, large input/output capabilities, and a wide assortment of peripheral devices and software -- all in a multi-user shared environment, supporting perhaps thousands of users. Notre Dame's present mainframe, the IBM 3033, is obsolete and, by today's standards, slow and awkward to use.

In light of the facts that mainframes embrace a wide range of capabilities and prices and that off-loading of many tasks to microcomputers or to remote supercomputers will occur, selecting an appropriate mainframe will not be straightforward. A prudent approach would be to install a significantly better new system that could be upgraded. As a minimum, the new system would possess state-of-the-art mainframe technology and vector processing capability. Some advantages might be gained by having more than one computer in the mainframe system. For example, some users want a machine on campus which uses software compatible with supercomputers so that programs could be developed and tested locally before their execution at remote sites.

RECOMMENDATION 2: *The Task Force recommends that the University replace the IBM 3033 with a state-of-the-art mainframe system with vector-processing capability and possibly more than one computer.*

Computation speeds of mainframes usually are in the range of 1 to 10 mflops, but can be considerably higher when vector processing capabilities are applied to large problems. Generally, with vectoring, the larger the problem gets, the more effectively the machine processes. The current IBM 3033 mainframe has an approximate speed of 1.7 mflops. One modern mainframe, the IBM 3090/VF, operates at about 8 mflops. Such a mainframe with vector processing operates at about 12 mflops when solving 100 simultaneous equations but achieves a speed on the order of 70 mflops when the problem size is increased to 1000 equations.

Speed and memory space are important considerations for the user who is involved in numerical techniques, but they are not the only performance considerations. A mainframe also must handle many users. Thus it must have good input/output management so that bottlenecks are not created when several users try to gain access to or retrieve information from the mainframe at the same time.

With most of these features and descriptions, the capabilities of a mainframe computer lie below those of supercomputers, described in the next subsection, and above those of minicomputers. Typically, minicomputers are in multi-user environments, but often with only a handful of users, usually at the department or college level. Because of its architecture, a minicomputer is likely to get bogged down if input/output requirements are large. It might serve well those tasks which are CPU intensive, but its computation speed usually is considerably less, by an order of magnitude, than a mainframe. Examples of minicomputers include the Prime, VAX, and PDP systems currently in use at Notre Dame. A recent introduction is the superminicomputer, which falls between the usual mini and the mainframe in capability and price.

At some universities, clusters of connected minicomputers, or superminis, actually form the mainframe system. The University of Wisconsin, for example, is proposing such a system. This configuration has some obvious advantages. For example, a cluster can be expanded in capability and versatility, even updated, by adding more or replacing some of the old units with little or no disruption to services and minimal incremental costs. Increasing the size of a single-unit mainframe, on the other hand, requires greater effort, more disruption and a sizeable incremental cost. In addition, a cluster can provide the versatility often needed with a wide variety of user tasks.

Given the increasing capabilities of workstations, particularly when networked with access to network servers, and the likely future convenient access to supercomputers on national networks, the long-range future of mainframes on university campuses is uncertain. For the next several years, however, a high-powered central computing facility of some type will be needed to handle computing tasks that are beyond the capability of micros and minis and do not justify use of a supercomputer.

The exact mainframe need at Notre Dame cannot be determined yet. The computing demand of an increasingly active research environment certainly will increase, and experience has taught us that the most powerful obtainable mainframe will be well-used soon after installation. We can safely predict that researchers at Notre Dame will make use of computer power when it is provided.

The mainframe system should be chosen on the basis of the functions it is expected to perform. These range from heavy "number-crunching" tasks from a relatively small (but not to be neglected) number of users to more modest applications use by a larger segment of the user population for numeric and non-numeric processing (for example, analyses of large verbal databases as in linguistics and literary stylistic studies). In the former case, vector processing capabilities and compatibility with supercomputers are important issues; in the latter, the ability to handle several users, the operating system, and the ability to host applications software are the major concerns. The ease of linking the mainframe to the campus network must be considered. Also, codes developed locally could be easily ported if the local mainframe system were compatible with the supercomputers.

2. Supercomputing. Faculty in all disciplines need access to databases which are not available on the Notre Dame campus but can be provided by linking NDnet to national networks. Certain researchers, primarily in science and engineering, must have access to supercomputers (machines at the highest end of current computational technology, which now means speeds on the

order of 100 mflops). Since convenient access to remote supercomputers is available, meeting this relatively limited need by purchasing a supercomputer is not reasonable. (Current list prices for supercomputers exceed $10 million. Actually, the total investment in the computer and necessary associated hardware would be about $20 million.) Recommendation 1 provides that NDnet be linked to national networks and remote supercomputers.

Applications demanding supercomputing power generally include numerical solutions of systems of coupled nonlinear partial differential equations (PDEs), particularly those involving two or three spatial dimensions and time. Examples in current research activities at Notre Dame include:

- simulations of higher dimensional fluid flow, including turbulence, in conjunction with wind tunnel work in Aerospace and Mechanical Engineering,
- numerical solutions of reaction-diffusion equations, sometimes coupled with fluid flow, in Chemical Engineering, in environmental applications in Civil Engineering, and in solar energy conversion studies in Chemistry,
- multi-dimensional simulations in solid-state semiconductor research in Physics and Electrical and Computer Engineering,
- problems in relativistic atomic physics.

Linking to ARPANET or NSFnet, a national network of supercomputer centers supported by the National Science Foundation, would provide access to remote supercomputer sites. However, an ARPANET link is restricted to researchers associated with the ARPANET link grant. Another possibility is a direct link to the Cray X-MP supercomputer at the University of Illinois at Urbana-Champaign.

While it is not necessary to purchase a supercomputer, special user services are required for programming assistance. Supercomputing offers its greatest advantage only if the user knows how to structure an algorithm to take advantage of the vector processing capability of the machine.

3. Workstation Clusters. We envision publicly accessible clusters of workstations located in academic buildings and residence halls to be the primary mode of access to computing resources for most undergraduate students. There seems to be little or no support here at this time for requiring students in any discipline to purchase their own microcomputer, as a few universities have done in recent years. It is reasonable to expect, however, that increasing numbers of students will want to own them, especially as microcomputers become more integrated into courses and some campus standards are promoted.

Typically, a workstation would be connected to a local network or a micronetwork to provide local communications and resource sharing. These local networks would be part of NDnet so that a user at a workstation would have access to various computing resources on and off campus. This system is far more responsive than time-sharing use of a central system through hard-wired terminals or through dial-up ports.

We use "workstation" as a generic term for single-user environment. So defined, workstations range from simple terminals to high-powered stand-alone microcomputers which themselves could support a few terminal users. For the discussion here, we have in mind single-user microcomputers such as Apple Macintoshes and IBM PCs.

Microcomputers, characterized by the fact that the processor is on a single chip, typically have computational speeds up to 0.02 mflops. Particularly user-friendly, they are well-suited for computations, word processing and graphics, but not for applications involving large quantities of input and output. In addition, the common programming languages and an extensive set of application software, including graphics, are readily available for the most common models. Storage on floppy or hard disks is convenient and relatively inexpensive. Therefore, combining microcomputers with print and file servers on a local network would provide full capabilities for many, if not most, student users. The file server would act as a repository for and supplier of software needed by the users. Cluster areas should be staffed, managed and serviced centrally. Services provided at each cluster site would include software assistance, document checkout and general consulting.

Developments at other universities suggest that a ratio of 20 students per workstation is a reasonable target. At Notre Dame, we should provide 350 workstations for use primarily by undergraduate students and be prepared to adjust that number as the need changes. (The special workstation needs of faculty and graduate students, presumably in offices or restricted areas, are addressed in the section on Unit Specific Requisites.)

For functional and economic reasons, a cluster should have no more than 50 stations and no fewer than 15. Twelve clusters averaging about 30 workstations may suffice, but finding space for them may be a formidable problem. Certain areas now used for computing access could be expanded and upgraded. These include rooms in the Colleges of Engineering, Arts and Letters and Business Administration, the Freshman Learning Resource Center, and the Computing Center. In addition, the University Libraries could provide up to 2800 square feet (for two clusters of 35 or more stations in each) on the second floor of Memorial Library, and a new classroom building also must eventually provide a large area. Some clusters should be located in residence halls.

Having many different types of microcomputers on a campus frustrates their advantageous integration into academic programs. Having a single type, however, is neither feasible nor advisable. In order to use and support microcomputers effectively, we should narrow the vendor base as much as possible and encourage or enforce system standards. Also, trained technicians on campus for repair, maintenance and upgrades is a high-priority service which can be provided only for a very limited vendor base. Fortunately, most microcomputers at Notre Dame are IBM, Apple or Digital products, and only a few local networks are in place. At this time, all public workstations should be either Apple or IBM microcomputers, plus perhaps a few types of carefully selected IBM-compatible machines. Developments in this area are rapid, and this decision should be reviewed frequently.

Standards can be readily enforced for workstation clusters which are centrally procured and served. Purchases by a unit through its own budget resources are not so easily controlled, but presumably such units would find incentives to follow the cluster standards, especially if there were such inducements as discount purchases, campus-wide maintenance and institutional software licensing available only for cluster-type hardware.

Public workstation cluster areas should be arranged so that a few, or perhaps sections of a few, could be restricted to classroom use at certain hours. Such an arrangement would be essential for regular courses involving computer applications and hands-on instruction in computing and computer applications. In addition, such areas could be used for short tutorial sessions on using the campus computing system.

Workstations undoubtedly will be the fastest changing technological aspect of university computing. Accordingly we should envision an ongoing program to upgrade or replace 20 to 25% of the workstation facilities each year.

RECOMMENDATION 3: *The Task Force recommends that clusters of workstations be provided and maintained. The number of stations required to meet an anticipated increasing demand probably will reach 350 over the next two or three years. These should be provided at about 12 cluster sites and consist of Apple and IBM products and perhaps a few types of carefully selected IBM-compatible microcomputers at this time. The clusters would*

- *be the primary means of access to computing by undergraduate students.*
- *have their local or micronetworks with file and print servers and be a part of NDnet.*
- *be staffed at some locations to provide user consultation and checkout of materials.*
- *serve dual functions as user access sites and as classrooms of workstations for instructional use in certain courses or training programs.*

4. Classrooms. Classrooms equipped so that an instructor can obtain and display computer output interactively during class are becoming necessary for the effective teaching of various courses which involve graphic displays, computer simulations, data manipulation and analysis, and the like. For example, the faculty in the College of Business Administration use IBM PCs and video projection in some classrooms and say they need most of their classrooms to be so equipped. Faculty in all of the colleges say that they could present course material more effectively if they could incorporate in-class interactive dynamic demonstrations of computer solutions or simulations of interesting and realistic problems. Other areas which are not specifically classrooms, such as rooms in the Center for Continuing Education, also require such equipment for extracurricular educational programs.

RECOMMENDATION 4: *The Task Force recommends that a number of classrooms, perhaps 12 at first, be equipped with a workstation and output projector and be connected to NDnet for the instructor's use.*

5. Unit Specific Requisites (USRs). The computing system previously described would be part of the University's computing infrastructure. As such, it should be under central management. The college reports submitted to the Task Force, however, reveal other computing needs of equal importance. Most of these other computing systems would be connected to the University system, but they might be restricted in use within a single unit. Examples include workstations in faculty, staff and administrative offices and graduate student areas, microcomputer networks, and special equipment and software for laboratory and studio computerization.

The trend toward a personal computer in the office of every faculty member will become increasingly strong at Notre Dame as the campus computing resources and support improve. Presumably, all faculty would find it advantageous to have access at least to word processing, for preparing written materials and for sending and receiving text materials and messages electronically on and off campus. The work of all faculty surely would benefit from access from their offices to the Library System and to certain parts of the Administrative System, such as transcript information on their advisees and research grant accounts. More and more faculty will want to enhance their

teaching function by sending instructional and informational materials to file servers for students to receive via NDnet. They also might want to prepare and store instructional matter which they would display interactively later in the classroom. Some faculty would use their personal computer to enter code and to call local or remote computers to execute problem solutions.

In many cases, the public access workstation clusters will not serve well the needs of graduate students, who might need to work in the proximity of their laboratories and their advisors. Further, they might need special workstation capabilities that would not be available in general areas designed mainly for undergraduate use.

Notre Dame also needs more computing resources which are dedicated to laboratories and studios. Use of computer-assisted laboratory instruction has increased in science and engineering curricula around the country. In some cases, computer-simulated experiments are used advantageously and economically in place of actual laboratory tests. Such experiments are used in undergraduate chemistry and biology (viz. physiology, aquatic biology) courses at Notre Dame. In some undergraduate laboratories in Biological Sciences and in Engineering, computers are interfaced to experimental equipment for on-line data processing, displaying results and controlling experiments. (Biological Sciences, in fact, presents a good case in point. That department two years ago submitted a proposal requesting a special University allocation of $215,000 to upgrade and expand its computing equipment in undergraduate laboratory courses, a request which could not be funded at the college level. Without a university-wide strategy, it is difficult to evaluate and act on such requests.) Microcomputers in most instances, minicomputers in a few, with analog-to-digital and digital-to-analog converters, suffice for such purposes, and access to campus computing resources from the laboratory may be nonessential.

Some faculty in the College of Business Administration see a need for a dedicated minicomputer to model a business firm for the College's teaching and research purposes. Studios for art and architecture instruction also require special consideration. The need is for workstations with enhanced color graphic capabilities and software for computer-aided design. Further, the workstations would have to be dedicated to studio courses in areas of restricted access, at least most of the time, functioning in much the same way as do drawing and drafting tables.

Obviously, researchers have similar needs. The usual expectation is that these will be taken care of through external support of research projects. But not all of them can be so handled, and even when they are, substantial institutional cost sharing is required.

Such facilities usually cannot be procured or maintained through grants from external sources or within a unit's budget. Furthermore, increasing a unit's annual operating budget base will not insure that funds are directed to computing needs or that they are aligned with the University's priorities, goals and standards for computing. We recommend that the Assistant Provost for Computing have a regular budget from the University annually for USRs. Individual units would set priorities for USRs through their usual administrative channels, and the Assistant Provost would maintain inventory records of equipment procured. Through this mechanism the Assistant Provost and the divisions of the central computing operation could provide any associated user service and continuing maintenance for all equipment on its inventory list.

Effective integration of computers into courses and curricula requires considerable faculty time and effort. Released faculty time and summer faculty support for course development or other important computing endeavors are legitimate uses of USR funds. Individual colleges may decide to give faculty development priority in the USR funding procedure described above.

RECOMMENDATION 5: *The Task Force recommends that in addition to providing and supporting the computing infrastructure (NDnet, the Academic, Administrative and Library Systems, workstation clusters, and classroom equipment), the University provide sufficient funds to support the computing requirements of colleges, departments and other units. Called* Unit Specific Requisites, *or* USRs, *these requirements would be supported by an allocation of those funds by the Assistant Provost for Computing. Equipment and software so obtained ordinarily would connect to the infrastructure and allow for its effective use. Examples are workstations in faculty and administrative offices and graduate student areas, microcomputer networks (as part of NDnet) with appropriate servers and software for local workstations, and special equipment and software for laboratory and studio computerization.*

C. Administrative Computing System

The Task Force was briefed on, but did not study in detail, the existing plan for the development of software and hardware for the Administrative System. Originally presented in 1982 and now partially finished, the plan calls for the full integration of University databases and would serve a number of administrative subsystems. Principal among the subsystems are those for:

- Budgeting
- Facilities
- Research and Sponsored Programs
- Personnel/Payroll
- Development
- Security
- Student Information (including Admissions, Registrar, Financial Aid, Student Accounts, Housing)
- Financial (including Accounting and Purchasing)

The first four subsystems have been completed and are being run on the Hewlett Packard 3000 (HP 3000, Series 70), the current administrative computer. Two parts of the Development subsystem are in test stages; a third part has yet to be delivered by American Management Systems (AMS), the firm employed to program this subsystem. The Security subsystem, recently completed, is ready for acceptance testing. Two major subsystems, Student Information and Financial, remain to be developed.

A *conceptual design phase* was completed recently for the Student Information subsystem. which is intended to integrate and improve the record-keeping processes of the various offices which deal with student matters. Among the suggested new features is on-line student registration.

For the subsystems which are not complete, existing versions are being run on the IBM 4381, the library computer. They have only recently been transferred from the IBM 3033, the academic mainframe. In the present configuration, users of the Administrative System have access via hard-wired terminals or dial-up access to either the new systems on the HP 3000 or the old on the IBM 4381.

According to the 1982 plan, all administrative programs eventually will be run on the Hewlett Packard system. Hardware improvements through the development phases will necessitate the

purchase of the recently announced HP Spectrum 950, as either a replacement for or an addition to the present HP 3000.

Our recommendation, contained in Recommendation 1, that the Administrative System be accessible through the campus-wide network would lead to obvious benefits, including:

- faculty access to transcript information on their advisees and course information, such as class lists,
- account administrator access to current account data,
- departmental and college office access to current official statistics and information on student enrollments, faculty and staff, budgets, and research grants,
- students' ability to register for classes remotely by touch-tone telephone or by workstation access on campus.

Obviously, appropriate restrictions and security measures would have to be enforced to insure the protection of confidential information.

Not all operations on the business side of the University will use the Administrative System for their computing services. Some niches are best served by obtaining available software packages and the necessary dedicated hardware to run them. Examples are the Bookstore, Athletic Ticket Office, and Laundry, all of which have obtained, or are in the process of obtaining, their own stand-alone systems. The Morris Inn and Center for Continuing Education might eventually do the same. Even though the intersection of such niches with the University database may be minimal, there would be some advantage to connecting them to the campus network.

Task Force discussions on Administrative Computing centered on concerns about the level of estimated costs and the advisability of reviewing all of these plans, particularly those for the Student Information subsystem. We concluded that such a review should be undertaken as soon as possible.

RECOMMENDATION 6: *The Task Force recommends that a review of the existing plans for the development of the Administrative System, particularly the Student Information subsystem, be undertaken without delay and completed quickly. The review should involve outside consultants.*

D. Library Automation System

The University Libraries and the Law Library are in the process of implementing library automation software called NOTIS, the Northwestern On-line Total Integrated System, a system now used by about 50 university libraries in the United States.

Initially, the system will have 68 terminals distributed among Memorial Library, Law Library and the various campus branch libraries, and that number probably will be doubled by the fall of 1987. By the late spring of 1987, users throughout the campus will have on-line access to the library database through those terminals. Subsequently, access will be available through other campus terminals and dial-in from PCs with modems. Once it is in place, users will be able to access NOTIS using existing computing facilities -- that is, even without the installation of the campus network. In addition to the traditional query of the library catalog by known author, title and subject, keyword and boolean searching also will be available, thereby permitting searching on all elements in bibliographic records, and combining these elements using the boolean operator's "and, or, and not."

A goal for the fall of 1987 is to automate the circulation activities in the Library System, based on barcoding of both material and patron IDs. This will greatly streamline the current system for both staff and patrons. Subsequently, plans call for implementing acquisitions, fund accounting and serials control during 1988.

Further developmental work on the system will be done by both the main NOTIS office in Evanston, Illinois, and the Notre Dame staff. Expected enhancements include downloading capabilities, gateways to other local and remote databases, and messaging systems to communicate electronically between users and the library.

As mentioned in a previous section, the administrative programs slated for redesign on the HP system are temporarily being run on the same computer as the Library System. The IBM 4381, when totally dedicated to library services, will be ample to handle the need for the foreseeable future. Budget adjustments have already been made for the development and support of the system; the only additional costs necessary at this time are for terminal network maintenance and replacement/ upgrade. The immediate need is to provide convenient access to all users.

Finally, it must be noted that library uses of computing extend far beyond the NOTIS system itself -- that is, beyond merely computerizing the variety of clerical operations which are part of library processing. Other kinds of bibliographic databases will be integral parts of future library systems, as will access to both bibliographic and textual/numeric databases, both local and remote. Indeed, while print media will continue to be very important, the essence of the library of the future will be the electronic linking of users and machine readable data. The library database must be enlarged to include information on other campus resources. For example, catalog records are being added for machine-readable data files. Other possibilities include adding resources of the Snite Museum, the University Archives, and Educational Media. The present preliminary planning for continued growth should be pursued.

RECOMMENDATION 7: *Noting that the University's primary database of shared campus resources is its library catalog, and that the long-range effectiveness of teaching and research at the University depends on these resources, the Task Force emphasizes the importance of enlarging that database and making access to the Library Computing System convenient for all users through the campus network.*

E. General Support Services

Hardware is the visible part of a university computing system, but services are critical for its effective implementation and integration into the various university activities. The installation of a new computing system and the expected wave of new users on campus should mean greater productivity and more effective teaching and research programs, but they also might mean more user frustration unless adequate support services, including instructional programs, are provided.

In addition to a general consulting service for users, the support structure should provide the following services:

- instructional programs, more focused than presently offered and aimed particularly at those who are nonexperts and/or newcomers to the Notre Dame system or to computing generally. The program should include (1) documentation which describes the procedures, policies and services in printed form and on disks, and (2) short seminars or workshops and training

sessions on the use of hardware and software. For maximum effectiveness, some of these should be aimed at specific groups. For example, an on-site workshop might be coordinated with all or some faculty within a specific college and designed to meet their specific needs.

- staffing and user assistance at some of the workstation cluster sites, including software and document check-out services.

- technician services that would handle repair, maintenance and regular upgrading tasks for microcomputer systems, at least. Hiring full-time technicians who are trained in the repair of these products would be not only a convenience, but also probably an economic advantage.

- a microcomputer store, similar to that currently offering mainly Macintosh hardware in the Computing Center but expanded to offer the range of hardware and software supported in the recommended workstation clusters.

- assistance for faculty interested in developing courseware for computer-aided instruction and generally in applying the latest methods of computer-based educational technology. For example, the need might be for assistance with developing interactive courseware or producing videodiscs for classroom or laboratory demonstrations and self-paced instruction. (Some expertise has already been developed along these lines at Notre Dame in an interdisciplinary Educational Technology Laboratory now operating in Cushing Hall. In fact, faculty -- Charles Crowell, Psychology; James Johnson, Chemistry; Al Miller, Materials Science and Engineering -- involved in that laboratory have proposed that such a facility perform a University-wide service which would include training programs, workshops, and general consulting.)

Many of these services are provided now, but their scope must be expanded significantly and, in some cases, reoriented and reorganized. All of this calls for additional support staff.

RECOMMENDATION 8: *The Task Force recommends that support services be expanded to provide a wide range of services for all centrally supported systems, including educational programs and materials, consulting services, general technical support, and assistance to faculty in developing courseware and applying educational computing technology. These functions should be organized and managed by a new central User Services division. It would replace user service groups in the present Computing Center and Information Systems divisions (recommended hereafter to be called Academic Computing and Administrative Computing divisions, respectively) of the University's central computing operations.*

F. Administrative Structure

In order for a computing environment of the type recommended to operate in the best interests of the University, there must be effective management and organization. A basic administrative structure, consisting of an Assistant Provost for Computing and directors of the two present divisions, already is provided. An existing University Committee on Computing is composed of elected faculty members and others appointed by the Vice President for Business Affairs. Only minor modifications are needed -- in the short run, at least. Central operations would be better served if an Office of University Computing (OUC) were established and headed by the Assistant Provost. Recommendation 8 calls for a change in the division structure to form a User Services division. Further, formal channels of communication should be established between OUC and the

University Libraries, owing to the latter's increasing use of computer-based technologies and the need for general user access to the Library Automation System.

In addition, the existing University Committee on Computing should be restructured -- specifically to include appointed as well as elected faculty members. The Committee would function as an advisory group to the Assistant Provost to review and update the University's computing strategy annually. An executive committee of the advisory group would advise the Assistant Provost on decisions involved in implementing the strategy, such as budget allocations for USRs.

RECOMMENDATION 9: *The Task Force recommends the establishment of an* Office of University Computing (OUC), *headed by the Assistant Provost for Computing. OUC would coordinate and facilitate University developments with computing equipment, software and support services, including both the infrastructure and USRs. The divisions of User Services, Administrative Computing, and Academic Computing would function under OUC with the three directors reporting to the Assistant Provost. A restructured University Committee on Computing and its Executive Committee would advise the Assistant Provost on planning and implementation of the University's computing strategy.*

G. Implementation

We recommend implementation of the plan over a four-year period starting in 1987-88. Determination of a priority ordering for sequential implementation of the various elements of the plan seems unnecessary because many of them should be in progress simultaneously, if possible, and developed gradually. For example, projects aimed at the highest-priority USRs, setting up some of the workstation clusters, developing NDnet with a link to supercomputers, obtaining some classroom equipment, replacing the academic mainframe, and expanding user services all can be initiated at the same time. Such a broadly based gradual implementation makes practical sense because it would allow for a periodic analysis of the impact and further need, especially for those elements of the plan for which quantitative needs are not easily foreseen. A more formal and precise agenda of actions should be determined annually by OUC to match each year's available funds, but our recommendation is simply that the implementation be as broadly based as possible with early visible improvements of equipment, software and services, and that developments of the Library and Administrative Systems continue simultaneously with those of the Academic System.

RECOMMENDATION 10: *The Task Force recommends that implementation begin with a broadly based response to needs and with a goal of completing the plan over a four-year period. The University should begin to expand and enhance user services, to make plans to replace the academic mainframe, and to install, at the same time, some workstation clusters, some USRs (including workstations in faculty offices), some classroom equipment, and a portion of the campus backbone so that a link can be made to supercomputers and national networks.*

H. Costs and Financial Considerations

Our estimates of costs are only approximate, and they should not be taken too literally. Actual costs could be less than the estimates, but they also could be more. These figures will serve to call attention to the anticipated level of financial need, and to the necessity of continual funding at a much higher level than presently budgeted. Our recommendation is to put the system in place, not to

spend a certain number of dollars, and to provide the intensive follow-up required to use, maintain and upgrade it.

The initial cost of putting the recommended system in place is estimated to be about $26.6 million, including the cost ($6.2 million) of completing the Administrative System as it is currently planned. This cost may be reduced by special discounts and gifts-in-kind. Once in place, the recommended system would necessitate an annual budget increase of about $7 million, the sum of estimated annual costs of replacements, upgrades, maintenance, and increased salaries due to staff expansions. Table II lists the estimated costs of the various items, and Figure 2 shows a graphic representation of an expenditure plan for the implementation period. That plan is based on the realization that the recurring costs associated with the recommendations would increase gradually through the implementation process as shown. That being the case, an annual funding level of about $9.67 million above current budgets for a four-year period would provide sufficient funds to cover these gradually increasing costs and also the initial cost of about $26.6 million. As the figure and table show, once the implementation phase has passed, the continuing costs of the system would be at a *pseudo-steady* level of about $10.5 million per year beginning with the fifth year -- $7 million above the present level, or triple the present budget of $3.5 million.

While we feel that all estimates in Table II are in a realistic range, not all of them can be projected rigorously at this time. Even if all of the costs were accurate, changes in computing technologies are taking place too rapidly to allow precise planning for a four-year period. Therefore, we emphasize the need to review the suggested strategy annually and to adopt a rolling four-year plan for University computing.

The initial cost shown for the academic mainframe system is near the middle of a wide realistic range of about $4-8 million, and it is based on an estimated 25% discount from the list price. The annual mainframe costs are in addition to some $650,000 which would apply to the new system from current budgets for the maintenance and lease of mainframe equipment. The following examples show list prices. An IBM 3090 costs about $5 million. Vector processing would increase the prices by about $0.5 million, and subsystems such as disk and tape drives also would have to be purchased as well as software. A Control Data 990E costs about $3.8 million and is comparable with the 3090, though it is incompatible with the existing system in use at Notre Dame. CDC's Piper is fully compatible with a new ETA supercomputer and is expected to cost $2.6 million - $2.8 million for a system which includes software and disk subsystems. The SCS-40 which runs the Cray supercomputer software is made by a relatively new company which has just received a commitment from the Boeing Company to provide technical support in keeping the software up-to-date with Cray's. This system (including subsystems) lists at $0.9 million. However, it must be "front-ended" by a VAX computer at about $80,000.

Some comments are in order here while other cost considerations are dealt with in a later discussion section.

- Replacements and upgrades are shown as annual costs in Table II and Figure 2. While many expenditures in this category could follow an annual plan, others -- such as mainframe components and the network backbone -- could not. Some means other than annual budgeting might be preferred to account for the amortization of such items and planning for their replacements, but clearly those costs cannot be ignored.

- Workstations in the USR category would represent a range of capabilities depending on local needs. Prices range from several hundred dollars, for simple terminals, to several thousand for such high-function stations as Sun, MicroVAX and IBM PC-RT varieties.

- Required staff expansions are difficult to estimate, but undoubtedly appreciable expansions will be necessary. For example, full-time technicians should be employed to install, service and upgrade microcomputer equipment. The entries shown for salaries are based on expansions from 25 to 34, 25 to 40 and 10 to 20 full-time staff in the Academic, Administrative, and User Services divisions, respectively, and on an increase from 7 to 70 in the number of undergraduate aides in the User Services division, principally for cluster management and monitoring. Furthermore, the present salaries in some areas of technical expertise appear low for computing staff and have made it difficult at times to recruit and retain top-quality people. The salary structure should be reviewed.

- No allowance is made for cost recoveries through externally sponsored programs. Some such recoveries are justified and should be realized, but since only a very small percentage of users would be able to provide them, we favor continuing the present policy of free and open access with no forced charge to users.

- Completion of the Library automation project requires no new allocation for initial or recurring maintenance costs.

Budgeting and Allocation

After lengthy discussion, the Task Force agreed that simply enlarging the present lines for maintenance and capital in existing budgets would not be an effective way to move toward meeting the goals for campus computing developments, even if such enlargements originally were earmarked for computing developments. A budgeting and allocation process for computing, running parallel to existing budgeting practices, should be implemented to insure appropriate progress and necessary maintenance and support. This annual allocation process, as well as the support and service structure to be offered by OUC, would insure appropriate concern for compatibility of systems campus wide and that developments are in the best interests of the University.

We need not spell out all details of the budgeting and allocation practices of the Assistant Provost for Computing, but it is worthwhile to describe a workable scenario, for the sake of definiteness, and to provide some illustrations.

The Office of University Computing would receive funds annually of the order shown in Figure 2 to be budgeted to meet needs in the two major components of the University's system. One would be to meet the costs of building, maintaining, upgrading and servicing the *infrastructure* and the inventory of OUC equipment. The other would be to distribute funds according to prioritized requests for *USRs*, including local replacements and upgrades. Such distribution presumably would take the form of setting up a budgeted annual computing account for the use of the individual units.

The starting point for USRs should be proposals and requests at the local level. Such requests would progress through the appropriate channels, e.g. departments and colleges, where priorities would be set. Requests ordinarily would be presented annually to the Assistant Provost for Computing, who would determine the allocation of funds, with approval from the Provost.

All equipment purchased through this mechanism would become part of the inventory of OUC, which then would assume responsibility for continuing service and maintenance. If possible, the OUC should keep an inventory of all computing equipment on campus, not just the equipment it supports.

None of this would preclude the possibility that local initiatives for computing developments take place independently of OUC. For example, a department may decide to use some of its discretionary funds, or even its budgeted capital funds, to move toward its computing goals at a faster pace than OUC could support -- or some cost-sharing with OUC could be accommodated. In such cases, the department may simply request that continuing maintenance be provided through OUC funds, perhaps justified on the basis that the equipment is compatible with campus computing developments and might be an asset to the campus network.

As an example situation, a researcher might obtain computing equipment from external research support -- dedicated equipment used in stand-alone fashion in his/her research lab. If it is independent of the campus system, we see no need to exert central control over the type of equipment obtained or to be concerned about its compatibility unless the researcher makes a request to OUC for its maintenance.

Charges for Use

Use of the campus mainframe has been free; as a general practice, accounts have not been charged for computer time. Nearly all users have strong feelings that this practice should continue. They point out that it is a strong positive factor in the recruiting and retention of faculty. An analogy is often made to the library system, an analogy which makes more and more sense because as computing use now permeates the entire campus, it assumes a role that is essential for participation in the academic life of the University.

The Task Force discussions on this subject attest to some of the difficult questions which would surround the development of a charge or allocation plan. The general agreement was that an allocation system might serve to make users aware that this resource, like nearly any other, has a limit, regardless of the magnitude of the system. However, the management of an allocation strategy which would cover faculty and students and attempt to determine priorities could lead to a bureaucratic operation with little benefit. We came to the conclusion that since nearly everyone will be a user, a charging policy should not be adopted for anyone. Therefore, an allocation system should not be formulated unless and until it becomes necessary. An exception would be charges for supercomputer use, and even then some funds might be provided from OUC for seed grants and special purposes.

RECOMMENDATION 11:*Regarding financial concerns, the Task Force recommends that*

- *the campus computing system, including the infrastructure, USRs, and services, be fully implemented over a period of four years beginning in 1987-88.*
- *funding be provided at a sufficient level over the implementation period to cover the initial costs of the recommended system plus the associated recurring costs which would gradually increase during that period. (The Task Force estimates the initial cost to be about $26.6 million, and the necessary funding level to be about $9.67 million per year for four years -- in addition to the present budgets for central computing operations.)*
- *the University be prepared to provide a substantially increased budget base for central computing operations for continuing support of the complete system after its implementation. Such support would cover replacements, upgrades, maintenance, licenses, salaries, and an allowance for continued growth and enhancement (The Task Force estimates the costs to be about a $7 million increase annually above the present level, or triple the present budget.)*
- *for now, the University computing system be free and open. An allocation system should be formulated if and when experiences demand one.*
- *the suggested strategy be reviewed annually.*

V. Discussion

If the recommended computing system were in place today, Notre Dame would be an early follower of university computing developments, not a pioneer. We acknowledge that by the end of the recommended four-year implementation period, most of the currently available hardware and software will no longer be state-of-the-art, owing to rapid developments in computing technologies.

Some directions are clear and the eventual consequences predictable. For example, microprocessor workstations in a networked environment soon will be the national mode. On many university campuses, access to networked resources from a personal computing environment soon will be provided from all offices and residence hall rooms -- with access as extensive as today's telephone system. Further, many universities already are finding it advantageous to integrate all computer-based technologies on the campus, including voice, video and data communications, into one grand strategy.

All signs indicate that these developments will occur in a matter of years, not decades. The obvious need, therefore, is for a strategy which is sufficiently flexible to accommodate future developments and to provide the funding mechanism and necessary services for them. We feel that implementation of the preceding set of recommendations will meet that need.

The costs are high, and the obvious questions are: What are the benefits? Why should the University of Notre Dame make a commitment of this type? What are the alternatives?

Many benefits are obvious to a university community and hardly need stating. Others are difficult to describe. Regarding the former, we can say that the functions of teaching, learning, research and service can all be carried out more effectively for most people, and productivity should be improved, in a modern computing environment. Perhaps more important, however, are the stimulation and motivation provided along with the opportunities for people to engage in creative teaching and scholarly pursuits that would be impossible without up-to-date computing capabilities. These and others add up to the principal benefit of advancing Notre Dame toward its objective of being a great university in the true sense.

To address further the question of why the University should make such a commitment, we give the following seven-point excerpt from the report submitted by the College of Arts and Letters.

1. Modernization: To prepare our students, faculty and staff to understand and function in a society undergoing widespread and rapid change in the collection, analysis, and dissemination of information, we must move ahead decisively in computing and state-of-the-art information technology.

2. Competition: For Notre Dame to attract and retain quality students, faculty and staff, it must offer the facilities, user support and programs commensurate with its academic aspirations and the expectations of these constituencies.

3. Efficiency: The power of computing technology can help Notre Dame employ its limited resources more efficiently. Sometimes the result will be a direct cost savings; in other cases, the savings are unseen and unrecorded, but nonetheless are very real. In still other situations, current methods may appear to be the least costly while, in fact, lost opportunities mean they are not. Many times the result will not be more work or less cost but better work.

4. Communication: Effective communication internally and externally by the most appropriate and efficient methods available is important for the time saving it will make possible. Equally important, it will contribute to the realization of the major educational goals of the University.

5. Status: If Notre Dame wants to be considered among the best universities in the country, it must catch up with our peer institutions as well as others which are far ahead of us in this area.

6. Quality: Recent and continuing technological changes in computing and information processing broaden the possibilities for the kind and quality of education we can offer our students and of research we can expect from our faculty as well as the quality of all the various support services for these endeavors.

7. Goal Achievement: Computing, like the faculty and the library, is one of the key ingredients necessary today for Notre Dame to reach its objective of moving to the front ranks of research universities while maintaining its record of excellence in teaching and its special character. However, computing and information technology are not themselves the end but the means to help Notre Dame achieve its own higher academic goals.

The alternatives are few. We contend that no element of the plan can be eliminated without negative consequences, and our sense is that the academic community here and elsewhere would agree. The possible reductions are quantitative -- that is, in the number of workstations, the extent of the network, the number of additional staff, etc. We believe our quantitative estimates are realistic (although they should be re-evaluated regularly during the implementation period), but even greater amounts of some items *must* be provided inevitably. Therefore, in our view, this alternative amounts to extending the implementation period for some elements of the plan. We did not develop any alternative implementation plans, feeling that the four-year period is already a "catch-up" period and any lengthening of it may mean that catching up will be impossible in this fast-moving field.

Opinions differ about the best way to provide computing access to the masses of undergraduate students. Some feel that the residence halls should be wired for direct network connections from individual rooms. The Task Force did not favor that approach at this time, preferring instead a plan which would put clusters of workstations in some residence hall areas. The access from individually-owned computers in residence hall rooms, then, would be by telephone dial-up, as it is now. We feel that all new residence halls and other campus buildings, hereafter, should have network cables installed at the time of construction.

The following matters also were discussed by, or brought to the attention of, the Task Force.

- Severe space problems will hamper some of the proposed developments. Information Systems and the Computing Center both are crowded now and do not have space for additional staff and equipment. The space problem for workstation clusters was mentioned in an earlier section.

- Some researchers and groups will continue to seek external grant funds for independent computing developments. Such activity should be encouraged, and USR funds may be used for cost-sharing purposes or to cover continuing maintenance for those proposals that are compatible with the University-wide plan. OUC should assume responsibility for responding to, or notifying others of, opportunities for external funding of computing proposals.

In Summary, we repeat our strong recommendation that Notre Dame begin immediately to implement the plan described in this report, realizing that many details not addressed by the Task Force will have to be resolved as progress is made. Experiences have shown that computer usage and demand increase beyond expectations when resources are increased, and therefore, plans should not be regarded as rigid. The important step for the University now is to make a start and then to proceed sensibly, responding to needs and constant re-evaluation.

VI. List of Recommendations

RECOMMENDATION 1: The Task Force recommends that a campus network, herein called NDnet, be put in place. NDnet, extending to nearly all buildings on the campus and consisting of a fiber optic backbone with connections to local and microcomputer networks, would facilitate campus-wide communications and provide access from workstations (i.e., microcomputers or terminals) and by telephone connection to the University's computing resources, including the Administrative, Library, and Academic Systems and local servers. We recommend further that NDnet be linked to national networks and remote supercomputers.

RECOMMENDATION 2: The Task Force recommends that the University replace the IBM 3033 with a state-of-the-art mainframe system with vector-processing capability and possibly more than one computer.

RECOMMENDATION 3: The Task Force recommends that clusters of workstations be provided and maintained. The number of stations required to meet an anticipated increasing demand probably will reach 350 over the next two or three years. These should be provided at about 12 cluster sites and consist of Apple and IBM products and perhaps a few types of carefully selected IBM-compatible microcomputers at this time. The clusters would

- be the primary means of access to computing by undergraduate students.
- have their local or micronetworks with file and print servers and be a part of NDnet.
- be staffed at some locations to provide user consultation and checkout of materials.
- serve dual functions as user access sites and as classrooms of workstations for instructional use in certain courses or training programs.

RECOMMENDATION 4: The Task Force recommends that a number of classrooms, perhaps 12 at first, be equipped with a workstation and output projector and be connected to NDnet for the instructor's use.

RECOMMENDATION 5: The Task Force recommends that in addition to providing and supporting the computing infrastructure (NDnet, the Academic, Administrative and Library Systems, workstation clusters, and classroom equipment), the University provide sufficient funds to support the computing requirements of colleges, departments and other units. Called Unit Specific Requisites, or USRs, these requirements would be supported by an allocation of those funds by the Assistant Provost for Computing. Equipment and software so obtained ordinarily would connect to the infrastructure and allow for its effective use. Examples are workstations in faculty and administrative offices and graduate student areas, microcomputer networks (as part of NDnet) with appropriate servers and software for local workstations, and special equipment and software for laboratory and studio computerization.

RECOMMENDATION 6: The Task Force recommends that a review of the existing plans for the development of the Administrative System, particularly the Student Information subsystem, be undertaken without delay and completed quickly. The review should involve outside consultants.

RECOMMENDATION 7: Noting that the University's primary database of shared campus resources is its library catalog, and that the long-range effectiveness of teaching and research at the University depends on these resources, the Task Force emphasizes the importance of enlarging that database and making access to the Library Computing System convenient for all users through the campus network.

RECOMMENDATION 8: The Task Force recommends that support services be expanded to provide a wide range of services for all centrally supported systems, including educational programs and materials, consulting services, general technical support, and assistance to faculty in developing courseware and applying educational computing technology. These functions should be organized and managed by a new central User Services division. It would replace user service groups in the present Computing Center and Information Systems divisions (recommended hereafter to be called Academic Computing and Administrative Computing divisions, respectively) of the University's central computing operations.

RECOMMENDATION 9: The Task Force recommends the establishment of an Office of University Computing (OUC), headed by the Assistant Provost for Computing. OUC would coordinate and facilitate University developments with computing equipment, software and support services, including both the infrastructure and USRs. The divisions of User Services, Administrative Computing, and Academic Computing would function under OUC with the three directors reporting to the Assistant Provost. A restructured University Committee on Computing and its Executive Committee would advise the Assistant Provost on planning and implementation of the University's computing strategy.

RECOMMENDATION 10: The Task Force recommends that implementation begin with a broadly based response to needs and with a goal of completing the plan over a four-year period. The University should begin to expand and enhance user services, to make plans to replace the academic mainframe, and to install, at the same time, some workstation clusters, some USRs (including workstations in faculty offices), some classroom equipment, and a portion of the campus backbone so that a link can be made to supercomputers and national networks.

RECOMMENDATION 11: Regarding financial considerations, the Task Force recommends that

- the campus computing system, including the infrastructure, USRs, and services, be fully implemented over a period of four years beginning in 1987-88.
- funding be provided at a sufficient level over the implementation period to cover the initial costs of the recommended system plus the associated recurring costs which would gradually increase during that period. (The Task Force estimates the initial cost to be about $26.6 million, and the necessary funding level to be about $9.67 million per year for four years -- in addition to the present budgets for central computing operations.)
- the University be prepared to provide a substantially increased budget base for central computing operations for continuing support of the complete system after its implementation. Such support would cover replacements, upgrades, maintenance, licenses, salaries, and an allowance for continued growth and enhancement. (The Task Force estimates the costs to be about a $7 million increase annually above the present level, or triple the present budget.)
- for now, the University computing system be free and open. An allocation system should be formulated if and when experiences demand one.
- the suggested strategy be reviewed annually.

Respectfully submitted by the Task Force on University Computing

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Table I
COMPUTING HARDWARE AT NOTRE DAME

(From available information, not necessarily complete, as of November 1986)

	Mainframes	Superminis	Minis	Microcomputers				Word Processors
				IBM	Apple	Work-stations	Others	
ARTS & LETTERS	--	--	--	12	83	--	9	10
BUSINESS ADMINISTRATION	--	--	--	42	31	--	--	--
ENGINEERING	--	2	12	27	38	6	37	15
SCIENCE	--	--	10	4	20	4	48	2
RADIATION LAB	--	--	5	3	1	1	13	1
ADMINISTRATION	--	1	--	21	6	--	12	52
LAW SCHOOL	--	--	--	7	6	--	5	7
LIBRARY	--	--	--	5	--	--	28	--
COMPUTING CENTER	2	--	--	24	20	--	2	3
TOTALS	**2**	**3**	**28**	**145**	**205**	**11**	**154**	**90**

MAINFRAMES: IBM 3033 and IBM 4381.
SUPERMINIS: IBM 4341, Prime 9955 and Hewlett Packard 3000.
MINIS: PDP 11, LSI 11, HP 9000, DEC 1124, VAX, Perkin Elmer and Ridge.
WORKSTATIONS: Sun, MicroVAX and Alpha Micro.

Additional microcomputers and word processors are in the Bookstore, Laundry, ACC, Observer, and other locations. The Observer and the Laundry each have an Alpha Micro system.

TABLE II
ESTIMATED COSTS

	Costs in Thousands of Dollars			
	Initial Cost of Recommended System	Annual Continuing Costs		
		Equipment Replacements & Upgrades	Equipment & Software Maintenance & Licenses	Salaries
Infrastructure (costs of purchasing and installing hardware & software)				
Academic Mainframe System	$6,500	$ 1,000	$ 500	
Administrative System	6,200	150	150	
Network Backbone	1,070	110	110	
Gateway & Link to Supercomputer (at the Univ. of Illinois, Urbana-Champaign)	130	15	15	
Local (building) Networks	1,890	380	190	
Workstation Clusters with Network Components	1,920	380	140	
Classroom Equipment	60	15	5	
	$17,770	$ 2,050	$ 1,110	
Unit Specific Requisites				
Workstations & Software in Faculty & Administrative Offices & Graduate Student Areas	4,000	700	400	
Microcomputer Networks with Servers, Gateways & Software	2,790	450	280	
Computing Equipment & Software in Laboratories & Studios	1,500	300	150	
	$ 8,290	$ 1,450	$ 830	
Staff Expansions				
Administrative Computing				450
Academic Computing				270
User Services				400
				$1,120
Others				
Space Renovations and Furnishings	500			
Consulting Fees and Expenses	60			
Continued Growth & Enhancements		400	40	
TOTAL Initial Cost	$26,620			
		$3,900	$1,980	$1,120
TOTAL Annual Continuing Costs			$7,000	

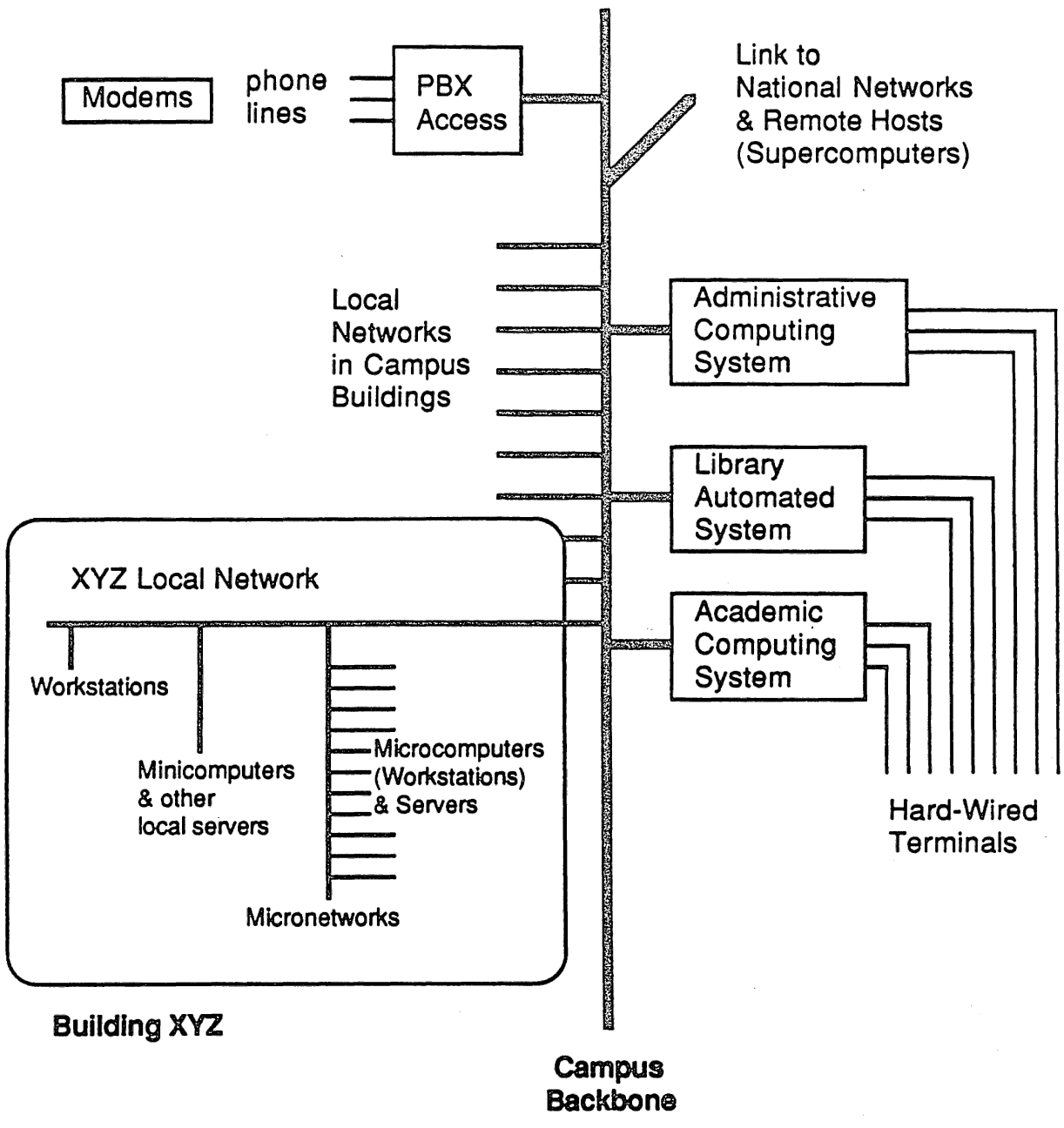

Figure 1
Schematic Diagram of Recommended System

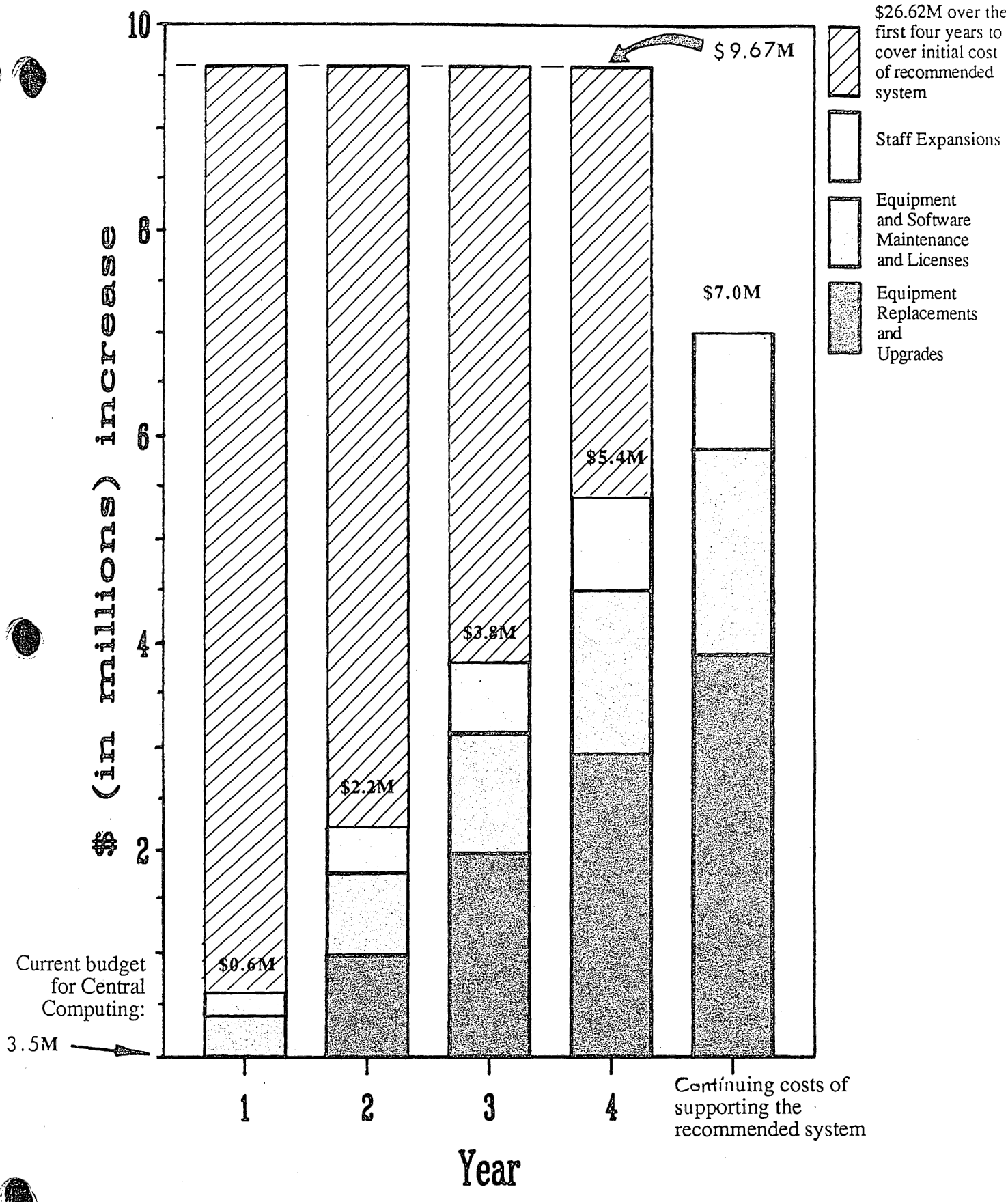

Figure 2
Suggested Expenditure Plan

Freshman Computing Survey: Discussion

The Computer Experience of Entering Notre Dame Students

Who were Freshman in the Fall of 1985

As an outgrowth of our discussions in the Arts and Letters Computer Policy Committee, it became clear that no one really had much of an idea as to the extent of prior computer experience among entering students at the University of Notre Dame. Two of us decided that we would do a survey of entering Freshman students to try to determine some of their experiences with computers, their exposure to certain kinds of programming languages and the kind of expectations they had regarding the use of computers while at Notre Dame.

Computer Exposure: The entering Notre Dame freshman is much more likely to have a personal computer in their own home than families in the general population. One newspaper article reported a national survey that indicated 8% of families in the United States owned a personal computer (Chicago Tribune, October 1, 1985). In marked contrast 44.3% of the incoming freshman indicate that their family owns a personal computer.

Of the approximately 1,714 valid responses to our survey, 78% indicated that they had used a personal computer while in high school; 44% indicated that they had used a personal computer in their home; 12% indicated that they had used a personal computer in the context of special programs; and almost 11% indicate they had used a personal computer in jobs which they have held while in high school. Only 8.8% indicated that they have not used a personal computer in any capacity whatsoever.

We attempted to get an indication of the kind of software packages that students might have used on a personal computer. Almost 60% indicated that they had used various wordprocessing software packages and 36.5% indicated that they had experience with various graphics packages. Twelve percent indicated experience with data base programs, 11.6% indicated experience with spreadsheet programs and 11.1% indicated that they had experience with statistical packages to be used on personal computers. Over four percent of the students had used their personal computers for telecommunications and 69% had indicated that they had used gaming software.

Knowledge of different languages: We asked student's whether or not they had taken any courses in computer programming without trying to evaluate the level of sophistication that may have been involved. It is clear that a large number of students have been exposed to formal programming in relation to their computer experience. Almost 61% indicate that they had taken a course which included programming in Basic, while 10.6% had taken a course in Pascal programming and approximately 6.3% had taken a course which involved Fortran programming.

Approximately 18% of the incoming Freshman indicated that they had taken no courses in which a computer was used in some fashion as a part of class or as part of homework assignments. Thirty-five percent indicated that they had one course in which a computer was used in some fashion. Another 18.8% indicated that they had taken two courses in which the computer was used either as a part of class or as a homework assignment. An additional 8% indicated that they had taken at least three courses which included

substantial use of computers as a part of the course work. Other students indicated even larger number of courses which involved computer work or computer assignments. The import of this descriptive data is that over 66% of incoming freshman have taken one or more courses in which the computer was integrally involved.

Anticipated use of Computers at Notre Dame: Almost 59% of the student's indicated that they would like to take a course in computer programming at Notre Dame. Twenty-eight percent were undecided and the remainder indicated that they were not interested in taking a computer programming course. The general thrust of student's interest in computers is that the students are interested primarily in learning how to use computers and learning how to work with computers. Approximately 26% indicated a lot of interest in learning how the computer works, a computer science emphasis, and a significant minority (12.7%) indicated a strong interest in becoming a computer "expert". Students tended to view computer use essentially as technical and functional while a substantial portion also viewed computer use as emancipating and creative. Only a small percentage (approximately 1.2%) had strong feelings that personal computer was unwholesome or addictive.

Approximately 11% of the incoming freshman indicated that they would be bringing a personal computer to Notre Dame while an additional 11.8% indicated that they definitely planned to buy a personal computer while they were at Notre Dame.

We asked students what kind of personal computers they had experience with. Among the leaders in the list was the Commodore 64 (18.5%), the IBM Personal Computer (41%), the TRS Radio Shack series of computers (23%) and the Apple MacIntosh (7.7%). Seventeen percent indicated other computers than those listed. Students who anticipated bringing computers to Notre Dame were most likely to be bringing a Macintosh, an Apple computer, an IBM PC or a TRS series computer.

Kathleen Biddick
and
C. Lincoln Johnson

***Numbers represent percentages

COMPUTER EXPERIENCE & INTEREST SURVEY - CLASS OF 1989

We are interested in knowing the kinds of computer experiences incoming N.D. freshman have had and what your current interest in computing is. Please answer each question as best as you can.

I. Background Information

1. I am 28.7 (1) Female 68.2 (2) Male NA = 3.1%

2. While I may change my mind, I think that I will enroll in the college of

33.2	A. Arts & Letters	26.6	C. Engineering
22.3	B. Business	14.9	D. Science

3. While I may change my mind, the following are areas I am thinking of majoring in. List no more than two.

1. _____
2. _____

II. Computer Background

1. Have you used a personal computer before? Check all that apply.

78.0	Yes, in high school	10.5	Yes, on a job
44.2	Yes, at home	11.4	Yes, other
11.8	Yes, in special programs	8.8	No

2. Does your family own a personal computer?

44.3 Yes ____ No

3. If you have used a personal computer before, what kind (brand) did you use. List as many as you are familiar with.

_____
_____
_____
_____
_____

4. Indicate the software packages that you have used on a personal computer.

58.4	Word Processing	11.1	Statistics
11.6	Spread Sheet	4.4	Telecommunication
36.5	Graphics	69.0	Games
12.0	Data Base Management		

5. Have you taken any courses in computer programming? ____ Yes ____ No
If yes, what Languages do you know? (List all that apply)

Basic	60.9
Pascal	10.6
Cobol	1.6
Fortran	6.3

6. How many courses have you taken in which a computer was used in some fashion as a part of class or homework assignments: _____

One course = 35.2 Two courses = 18.8 Three courses = 8.1

III. Anticipated Experience with Computers at N.D.

1. Would you like to take a course in computer programming at N.D.?

58.8 Yes 5.7 No 27.5 Don't know

2. Do you presently plan to bring a personal computer to N.D.?

10.7 Yes: Kind _____ ____ No

3. If you are not bringing a personal computer to N.D., do you think you will buy one before you graduate?

11.8 Yes, definitely 20.1 No 50.1 Don't Know

4. Please rate your interest in the following:

	A Lot	A Little	None	NA
Learning how the computer works	25.7	51.3	14.9	8.8
Learning how to use computers	67.2	22.5	2.3	8.1
Learning how to work with computers	64.3	25.0	2.7	8.0
Becoming a computer "expert"	12.7	39.0	40.0	8.4

5. Do you anticipate that N.D. will provide you with access to a personal computer?

59.6 Yes 1.9 No 30.0 Don't Know

6. Rate the potential of personal computers in your life as a student.

	very	a Little	not at all	NA
emancipating and creative	23.2	54.5	13.2	9.0
technical and functional	59.4	29.1	2.6	8.9
unwholesome and addictive	1.2	18.1	71.1	9.5

1987-88 notre dame report publication schedule

The following is the publication schedule for Volume 17 of the 1987-88 NOTRE DAME REPORT. Please note that all copy deadlines are on Wednesdays, except for Tuesday, Dec. 22, 1987. We suggest that you retain this schedule and the guidelines that follow for future reference.

Number	Copy Deadline	Publication Date
1	Aug. 19, 1987	Sept. 4, 1987
2	Sept. 2, 1987	Sept. 18, 1987
3	Sept. 16, 1987	Oct. 2, 1987
*4	Sept. 30, 1987	Oct. 23, 1987
5	Oct. 21, 1987	Nov. 6, 1987
6	Nov. 4, 1987	Nov. 20, 1987
7	Nov. 18, 1987	Dec. 4, 1987
8	Dec. 2, 1987	Dec. 18, 1987
9	Dec. 22, 1987	Jan. 15, 1988
10	Jan. 13, 1988	Jan. 29, 1988
11	Jan. 27, 1988	Feb. 12, 1988
12	Feb. 10, 1988	Feb. 26, 1988
13	Feb. 24, 1988	March 11, 1988
14	March 16, 1988	April 1, 1988
15	March 30, 1988	April 15, 1988
16	April 13, 1988	April 29, 1988
17	April 27, 1988	May 13, 1988
18	May 18, 1988	June 10, 1988
19	June 15, 1988	July 8, 1988
20	July 13, 1988	Aug. 5, 1988
Index		Aug. 19, 1988

Volume 18, Number 1 of the 1988-89 NOTRE DAME REPORT will have a copy deadline of Aug. 17, 1988 and a publication date of Sept. 2, 1988.

*No. 4 will be an updated version of the annual listing of University administrators, committees, and the official faculty roster.

notre dame report submission information

Items for the NDR Faculty Notes section are accepted from: faculty (all classes); professional specialists, and postdoctoral research candidates who teach at Notre Dame.

Appointments include only those University appointments such as deans, department heads, heads of committees, public relations and development professionals, and advisory council members. This does not include appointments to faculty positions.

Honors is comprised of non-University appointments in one's field and outright honors. It does not include fellowships, grants, etc. Any grants not published in the Awards Received section (listed at the end of NDR) should be noted in the Activities section.

Activities must be of a professional and public nature (such as invited lectures and papers read) and should be related to the person's work at the University. Lectures given on campus are only acceptable if they are of a special nature and/or if they are presented to a broader audience than the Notre Dame community. Merely attending a meeting is unacceptable. Information required for each activity submitted includes: name, rank, title of presentation, title of meeting, place, and date. Standardized cards must be used for submissions and are available by contacting Notre Dame Report (239-5337). No activities are printed ahead of the date, only after the fact. Also, activities will not be printed over six months out of date.

Items for NDR Administrators' Notes section are accepted from administrative staff and follow the same guidelines as Faculty Notes.

All Appointments, Honors, and Activities should be sent to Notre Dame Report, 415 Administration Building.

Current Publications and Other Scholarly Works should be sent to the Office of Advanced Studies, 314 Administration Building, c/o Janine Andrysiak. Submissions of current publications are due on the Friday prior to the copy deadlines stated on the preceding page. Standardized cards must be used for submissions and are available by contacting Research and Sponsored Programs (239-7432).

The only meeting minutes printed in the Documentation section are from the Academic Council, Faculty Committee on University Libraries, Faculty Senate, Graduate Council, Board of Trustees and Committee on Research and Sponsored Programs.

official university academic calendar for 1988-89

Aug.	19	Friday	Orientation, registration, and enrollment for all new upperclass and graduate students.
Aug.	19-21	Fri thru Sun	Orientation and counseling for freshmen.
Aug.	22	Monday	Enrollment for all continuing students and freshmen.
Aug.	23	Tuesday	Classes begin at 8 a.m.
Aug.	31	Wednesday	Last date for all class changes.
Sept.	11	Sunday	Mass. Formal opening of school year (subject to change).
Oct.	13	Thursday	Midsemester Deficiency Reports due in Registrar's Office.
Oct.	15-23	Sat thru Sun	Midsemester Break.
Oct.	24	Monday	Classes resume at 8 a.m.
Oct.	27	Thursday	Last day for course discontinuance.
Nov.	10-17	Th thru Th	Advance registration for Spring Semester 1989.
Nov.	23-27	Wed thru Sun	Thanksgiving holiday.
Nov.	28	Monday	Classes resume at 8 a.m.
Dec.	9	Friday	Last class day.
Dec.	10-11	Sat & Sun	Study days (no examinations).
Dec.	12-16	Mon thru Fri	Final exmainations.
Dec.	23	Friday	Absolute deadline for delivery of all grades to Registrar.

CLASS MEETINGS

MWF	42	MTuF	43
MW	28	MThF	42
MF	28	TT	29
MTuW	43	TWT	43
MTT	43	TTF	43
MWTh	42	TuF	29
MTh	28	TWF	43

NUMBER OF CLASS DAYS

	Mon	Tues	Wed	Thurs	Fri	Total
Aug	1	2	2	1	1	7
Sept	4	4	4	5	5	22
Oct	4	3	3	3	3	16
Nov	4	5	4	3	3	19
Dec	1	1	1	2	2	7
Total	14	15	14	14	14	71

Home games: Michigan - Sept. 10; Purdue - Sept. 24; Stanford - Oct. 1; Miami - Oct. 15; Air Force - Oct. 22; Rice - Nov. 5; Penn State - Nov. 19.

Jan.	16	Monday	Orientation, registration, and enrollment for all new students.
Jan.	17	Tuesday	Enrollment for all continuing students.
Jan.	18	Wednesday	Classes begin at 8 a.m.
Jan.	26	Thursday	Last date for all class changes.
Feb.	2	Thursday	Last date for return of housing contracts.
Feb.	22-Mar. 1	Wed thru Wed	Enrollment reservations for the Fall Semester 1989-90.
Mar.	2	Thursday	Midsemester Deficiency Reports due in Registrar's Office.
Mar.	4-12	Sat thru Sun	Midsemester Break.
Mar.	13	Monday	Classes resume at 8 a.m.
Mar.	16	Thursday	Last day for course discontinuance.
Mar.	24-27	Fri thru Mon	Easter holiday begins at 4 p.m. Thursday, March 23.
Mar.	28	Tuesday	Classes resume at 8 a.m.
Apr.	20-27	Th thru Th	Advance registration for Fall Semester 1989-90 and for the Summer Session 1989.
Apr.	26-28	Wed thru Fri	Room reservations for the Fall Semester 1989-90
May	5	Friday	Last class day.
May	6-7	Sat & Sun	Study days (no examinations).
May	8-12	Mon thru Fri	Final exmainations.
May	16	Tuesday	Absolute deadline for delivery of all grades to the Registrar for students who are graduating.
May	19-21	Fri thru Sun	Commencement weekend.
May	19	Friday	Absolute deadline for delivery of all grades to the Registrar.

CLASS MEETINGS

MWF	42	MTuF	42
MW	28	MThF	42
MF	27	TT	30
MTuW	43	TWT	44
MTT	43	TTF	44
MWTh	43	TuF	29
MTh	28	TWF	44

NUMBER OF CLASS DAYS

	Mon	Tues	Wed	Thurs	Fri	Total
Jan	2	3	2	2	2	10
Feb	4	4	4	4	4	20
Mar	2	3	4	4	3	17
Apr	4	4	4	4	4	20
May	1	1	1	1	1	5
Total	13	15	15	15	14	72

U.N.D. SUMMER SESSION CALENDAR DATES

	1989
Registration	June 19 (tentative)
Commencement	Aug. 4 (tentative)

summary annual report for tiaa-cref tax deferred annuity

This is a summary of the annual report for TIAA/CREF Tax Deferred Annuity Plan, employer number, 35-0868188, for Jan. 1, 1986 through Dec. 31, 1986. The annual report has been filed with the Internal Revenue Service, as required under the Employee Retirement Income Security Act of 1974 (ERISA).

BASIC FINANCIAL STATEMENT

Benefits under the plan are provided by individually owned, fully vested annuity contracts issued by Teachers Insurance and Annuity Association and College Retirement Equities Fund. The total payments paid for the plan year ending Dec. 31, 1986 were $870,110. A total of 175 persons were participants in or beneficiaries of the plan at the end of the plan year, although not all of these persons had yet earned the right to receive benefits.

YOUR RIGHT TO ADDITIONAL INFORMATION

You have the right to receive a copy of the full annual report or any part thereof, including insurance information, on request. To obtain a copy of the full annual report, or any part thereof, write or call the office of the Director of Personnel, Personnel Department, Notre Dame, IN (219) 239-5900.

You also have the legally protected right to examine the annual report at the main office of the plan which is the Personnel Department, Notre Dame, Ind., and at the U.S. Department of Labor in Washington, D.C., or to obtain a copy from the U.S. Department of Labor upon payment of copying costs. Requests to the Department should be addressed to: Public Disclosure Room, N4677, Pension and Welfare Benefit Programs, Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C., 20216.

summary annual report for tiaa/cref retirement annuity for faculty and administrators

This is a summary of the annual report for TIAA/CREF Tax Deferred Annuity Plan, employer number, 35-0868188, for Jan. 1, 1986 through Dec. 31, 1986. The annual report has been filed with the Internal Revenue Service, as required under the Employee Retirement Income Security Act of 1974 (ERISA).

BASIC FINANCIAL STATEMENT

Benefits under the plan are provided by individually owned, fully vested annuity contracts issued by Teachers Insurance and Annuity Association and College Retirement Equities Fund. The total payments paid for the plan year ending Dec. 31, 1986 were $4,283,847. A total of 858 persons were participants in or beneficiaries of the plan at the end of the plan year, although not all of these persons had yet earned the right to receive benefits.

YOUR RIGHT TO ADDITIONAL INFORMATION

You have the right to receive a copy of the full annual report or any part thereof, including insurance information, on request. To obtain a copy of the full annual report, or any part thereof, write or call the office of the Director of Personnel, Personnel Department, Notre Dame, IN (219) 239-5900.

You also have the legally protected right to examine the annual report at the main office of the plan which is the Personnel Department, Notre Dame, Ind., and at the U.S. Department of Labor in Washington, D.C., or to obtain a copy from the U.S. Department of Labor upon payment of copying costs. Requests to the Department should be addressed to: Public Disclosure Room, N4677, Pension and Welfare Benefit Programs, Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C., 20216.

summary report: health plus, hmo

This is a summary annual report of the Health Plus, HMO plan for the University of Notre Dame (employer #35-0868188) for the plan year ending Dec. 31, 1986. The annual report has been filed with the Internal Revenue Service, as required under the Employee Retirement Income Security Act of 1974 (ERISA).

INSURANCE INFORMATION

The plan has a contract with Health Plus, HMO, Inc., to pay all claims incurred under the terms of the plan. The total premiums paid for the year ending Dec. 31, 1986 was $170,826.

YOUR RIGHT TO ADDITIONAL INFORMATION

If you want a copy of the annual report, or any part of it, write or call the office of the plan administrator: Roger V. Mullins, Director of Personnel, University of Notre Dame, Notre Dame, IN 46556.

Under the providisons of ERISA you have the right to receive from the plan administrator upon request, and at no charge, a statement of the assets and liabilities of the plan and accompanying notes. If you request a copy of the full annual report, these statements and notes will be included with it. You may also examine a copy of the full annual report in the office of the plan administrator.

Copies of the annual report can also be obtained from the U.S. Department of Labor upon payment of copying costs. You should address your request to: Public Disclosure Room, N4677, Pension and Welfare Programs, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20216.

summary report: key health, hmo

This is a summary annual report of the Key Health, HMO plan for the University of Notre Dame (employer #35-0868188) for the plan year ending Dec. 31, 1986. The annual report has been filed with the Internal Revenue Service, as required under the Employee Retirement Income Security Act of 1974 (ERISA).

INSURANCE INFORMATION

The plan has a contract with Health Maintenance of Indiana, Inc., to pay all claims incurred under the terms of the plan. The total premiums paid for the year ending Dec. 31, 1986 was $179,016.

YOUR RIGHT TO ADDITIONAL INFORMATION

If you want a copy of the annual report, or any part of it, write or call the office of the plan administrator: Roger V. Mullins, Director of Personnel, University of Notre Dame, Notre Dame, IN 46556.

Under the providisons of ERISA you have the right to receive from the plan administrator upon request, and at no charge, a statement of the assets and liabilities of the plan and accompanying notes. If you request a copy of the full annual report, these statements and notes will be included with it. You may also examine a copy of the full annual report in the office of the plan administrator.

Copies of the annual report can also be obtained from the U.S. Department of Labor upon payment of copying costs. You should address your request to: Public Disclosure Room, N4677, Pension and Welfare Programs, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20216.

summary report: maxicare

This is a summary annual report of the Maxicare, Indiana Plan for the University of Notre Dame (employer #35-0868188) for the plan year ending Dec. 31, 1986. The annual report has been filed with the Internal Revenue Service, as required under the Employee Retirement Income Security Act of 1974 (ERISA).

Maxicare, Indiana provides benefits for medical care as a federally qualified Health Maintenance Organization. During the plan year the University and the employees choosing this optional health coverage paid $459,574 in premiums. Maxicare's premiums are community rated.

YOUR RIGHT TO ADDITIONAL INFORMATION

If you want a copy of the annual report, or any part of it, write or call the office of the plan administrator: Roger V. Mullins, Director of Personnel, University of Notre Dame, Notre Dame, IN 46556.

Under the providisons of ERISA you have the right to receive from the plan administrator upon request, and at no charge, a statement of the assets and liabilities of the plan and accompanying notes. If you request a copy of the full annual report, these statements and notes will be included with it. You may also examine a copy of the full annual report in the office of the plan administrator.

Copies of the annual report can also be obtained from the U.S. Department of Labor upon payment of copying costs. You should address your request to: Public Disclosure Room, N4677, Pension and Welfare Programs, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20216.

summary report: group life insurance

This is a summary of the annual report of the group life insurance plan for the University of Notre Dame (employer #35-0868188) for the period July 1, 1986 through Dec. 31, 1986. The annual report has been filed with the Internal Revenue Service, as required under the Employee Retirement Income Security Act of 1974 (ERISA).

INSURANCE INFORMATION

The plan has a contract with Great West Life Assurance Company to pay all claims incurred under the terms of the plan. The total premiums paid for the plan year ending Dec. 31, 1986 was $162,738.

YOUR RIGHT TO ADDITIONAL INFORMATION

You have the right to receive a copy of the full annual report, or any part thereof, on request. Direct your request to the office of the plan administrator: Roger V. Mullins, Director of Personnel, University of Notre Dame, Notre Dame, IN 46556.

You may also receive from the plan administrator on request and at no charge a statement of the assets and liabilities of the plan and accompanying notes. These are automatically included with copies of the full annual report.

You have the legally protected right to examine the annual report at the Personnel Office of the University of Notre Dame and at the U.S. Department of Labor upon payment of copying costs. Send your request to: Public Disclosure Room, N4677, Pension and Welfare Programs, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20216.

advanced studies

special notices

The National Institutes of Health Biomedical Research Support Grants for 1986-87

The Office of Advanced Studies announces the NIH Biomedical Research Support Grants made for 1986-87.

* Prof. John G. Duman, Department of Biological Sciences. Studies on Hemolymph Proteins Involved in Insect Cold Tolerance. $185.

* Prof. David A. Cole, Department of Phychology. Data Analysis for Depression Research. $1,154.

* Prof. Phillip E. Klebba, Department of Biological Sciences. Flow Cytometry in Biomedical and Immunological Studies. $139,362.65.

* Prof. Thomas L. Whitman, Department of Phychology. Predicting Parenting in Adolescent Mothers. $2,181.54.

* Prof. Francis J. Castellino, Department of Chemistry. Peptides Containing Sequences Present in Human Tissue Plasminogen Activator. $4,000.

* Prof. Thomas P. Fehlner, Department of Chemistry. Infrared Spectrometer. $1,500.

* Prof. Subhash C. Basu, Department of Chemistry. Freezing of Cultured Cells Before Long-term Storage. $5,500.

* Profs. Joan Aldous and David M. Klein, Department of Sociology. Multiple Projects on Family Studies. $540.

* Profs. Jennifer L. Glass and David M. Klein, Department of Sociology. Multiple Projects on the Elderly. $1,868.

awards received

IN THE PERIOD JULY 1, 1987 THROUGH JULY 31, 1987

Department or Office	Principal	Short Title	Sponsor	Dollars / Months
		AWARDS FOR RESEARCH		
Aerospace Mech. Eng.	Nelson, Batill	Flow Field Measurements of Stranded Cables	Dept. Navy	50,000 7
Chemistry	Basu, Basu	Glycolipid Metabolism in Tumor and Transformed Cells	Natl. Inst. Health	132,251 12
Economics	Ghilarducci	"Labor's Capital"	M.I. Bunting Inst.	0* 12
Elect. Comp. Eng.	Lent	Simulation of Superlattice Devices	Natl. Sci. Fdtn.	70,000 24
Philosophy	Manier	Cognitive and Cell Biological Analyses of Assoc. Learning	Natl. Sci. Fdtn.	9,000 18
Philosophy	Bicchieri-Wood	Strategic Behavior and Counterfactuals	Natl. Sci. Fdtn.	30,000 12
Physics	Johnson	Multiphoton Ionization	Natl. Sci. Fdtn.	5,650 36
Physics	Lundeen	Fast Beam Atomic Physics	Natl. Sci. Fdtn.	90,928 6
Physics	Poirier	Research in Elementary Particle Physics	Natl. Sci. Fdtn.	90,000 18
Physics	Tomasch, Blackstead	Microwave Measurements for High Temperature Superconductors	Amoco Chemical Research Cent.	50,000 12
Physics	Cushing	The Construction, Selection and Content of Scientific Theories	Natl. Sci. Fdtn.	25,000 12
Physics	Ruchti	Fiber-Optic Detector Development for the SSC	Dept. Energy	68,781 12
So. Bend Cent. Med. Educ.	Olson	Gill Metabolism	Natl. Sci. Fdtn.	3,044 6
So. Bend Cent. Med. Educ.	Olson	Gill Metabolism	Natl. Sci. Fdtn.	8,000 6
Civil Eng.	Gray	REU Civil Engineering	Natl. Sci. Fdtn.	39,936 15
Chemistry	Bretthauer	Lung Glycoprotein Synthesis	Natl. Inst. Health	142,260 12
College Eng.	Wolf	FTIR Studies of Catalytic Oxidation Reactions	Natl. Sci. Fdtn.	52,965 12
Physics	Johnson, Sapirstein	Weak Interactions in Heavy Atoms	Natl. Sci. Fdtn.	90,000 12
Physics	LoSecco	Non Accelerator High Energy Physics	Dept. Energy	45,000 8
Psychology	Borkowski, Whitman, Schellenbach	Predicting and Modifying Parenting in Adolescent Mothers	Natl. Inst. Health	145,086 12
		AWARDS FOR FACILITIES AND EQUIPMENT		
Physics	Ruchti, Cason, Shephard	Proposal for Equipment for Fermilab Experiment E687	Natl. Sci. Fdtn.	45,000 12
Physics	Biswas, LoSecco	Supplemental Equipment for E735	Natl. Sci. Fdtn.	30,000 12

AWARDS FOR INSTRUCTIONAL PROGRAMS

Cushwa Cent. Amer. Cath	Dolan	Colloquium on the History of Women Religious	Lilly Endow., Inc.	19,387 4
Management	Raymond	The Jesse H. Jones Professorship in Management	Houston Endow., Inc.	100,000 9
Medieval Inst.	Van Engen	Curriculum Development in Medieval Civilization	Lilly Endow., Inc.	23,250 35

AWARDS FOR SERVICE PROGRAMS

Inst. Past. Soc. Min.	McNeill	Center for Social Concerns	Various Others	40 1
Inst. Past. Soc. Min.	Bernstein	Center for Pastoral Liturgy	Various Others	1,992 1
Inst. Past. Soc. Min.	Pelton	Shaheen Bishops' Leadership	Various Others	279 1
Inst. Past. Soc. Min.	Pelton	IPSM Parish Study - Phase III	Various Others	3,796 1
Inst. Past. Soc. Min.	Pelton	Notre Dame Center for Continuing Formation in Ministry	Various Others	33,208 1
Inst. Past. Soc. Min.	Bernstein	Center for Pastoral Liturgy - Publications	Various Others	1,859 1
Inst. Past. Soc. Min.	Pelton	Latin and North American Church Concerns	Various Others	1,250 1
Inst. Past. Soc. Min.	Pelton	Third Age Workshop	Various Others	65 1

AWARDS FOR OTHER PROGRAMS

English	Kucich	Dryden's Annotations of Spenser's Poetry	Natl. Endow. Humanities	750 1
Graduate School	Le	Jacob Javits Fellows Program	Dept. Education	17,964 12
Snite Museum Art	Larkin, Porter	Institute for Museum Services, General Operating Support	Inst. Museum Serv.	75,000 12

*Use of Facilities.

proposals submitted

IN THE PERIOD JULY 1, 1987 THROUGH JULY 31, 1987

Department or Office	Principal	Short Title	Sponsor	Dollars Months
		PROPOSALS FOR RESEARCH		
Chemical Eng.	Wolf, Varma	Center for Chemical and Catalytic Reaction Engineering	Natl. Sci. Fdtn.	10,316,198 60
Elect. Comp. Eng.	Antsaklis	Artificial Intelligence/Control Theory Relationships	McDonnell Douglas Corp.	10,589 3
Materials Sci. Eng.	McGinn	Thick Film Processing of High Tc Superconductors	Dept. Navy	844,710 30
Physics	Poirier	Research in Elementary Particle Physics	Natl. Sci. Fdtn.	98,555 18
Aerospace Mech. Eng.	Yang, Szewczyk, Gad-el-Hak	National Center for Electronic Cooling	Michigan State Univ.	1,052,632 60

Biological Sciences	Kulpa	Pathways for Fine Acid Degradation	Amoco Chemical Research Cent.	48,809 12
Elect. Comp. Eng.	Liu, Cohn, Costello, Huang, Michel, Porod	Center for SIPMA	Natl. Sci. Fdtn.	5,180,785 60
Materials Sci. Eng.	McGinn, Pelton	Thick Film Processing of High TC Superconductors	Ind. Corp. Sci. & Tech.	447,612 24
Philosophy	O'Connor	Aristotelian Approaches to Justice and Friendship	Natl. Endow. Humanities	37,208 9
Psychology	Borkowski	Origins of Memory Development	North Atlantic Treaty Organ.	24,492 48
		PROPOSALS FOR FACILITIES AND EQUIPMENT		
Physics	Biswas, LoSecco	Supplemental Equipment for E735	Natl. Sci. Fdtn.	50,000 12
		PROPOSALS FOR INSTRUCTIONAL PROGRAMS		
Law School	McLean	Food and Drug Law Course	Food & Drug Law Inst.	3,000 4
		PROPOSALS FOR OTHER PROGRAMS		
English	Kucich	Dryden's Annotations of Spenser's Poetry	Natl. Endow. Humanities	1,134 1
Amer. Studies	Allen	Narrative Themes in Western Oral History	Natl. Endow. Humanities	27,173 8

summary of awards received and proposals submitted

IN THE PERIOD JULY 1, 1987 THROUGH JULY 31, 1987

AWARDS RECEIVED

Category	Renewal		New		Total	
	No.	Amount	No.	Amount	No.	Amount
Research	10	804,534	10	343,367	20	1,147,901
Facilities and Equipment	0	0	2	75,000	2	75,000
Instructional Programs	1	100,000	2	42,637	3	142,637
Service Programs	0	0	8	42,489	8	42,489
Other Programs	1	17,964	2	75,750	3	93,714
Total	12	922,498	24	579,243	36	1,501,741

PROPOSALS SUBMITTED

Category	Renewal		New		Total	
	No.	Amount	No.	Amount	No.	Amount
Research	2	147,364	8	17,914,226	10	18,061,590
Facilities and Equipment	0	0	1	50,000	1	50,000
Instructional Programs	0	0	1	3,000	1	3,000
Service Programs	0	0	0	0	0	0
Other Programs	0	0	2	28,307	2	28,307
Total	2	147,364	12	17,995,533	14	18,142,897

notre dame report

An official publication of the University of Notre Dame, Department of Public Relations and Information. Individual copies are available in the Notre Dame Hammes Bookstore at 50 cents each. Mail subscriptions are $10 per year. Back copies are available through the mail at 70 cents each.

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