

5-10-1963

## City Club of Portland Bulletin vol. 43, no. 50 (1963-5-10)

City Club of Portland (Portland, Or.)

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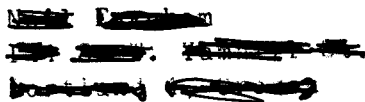
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PORTLAND  
*City Club*  
BULLETIN

Crystal Room • Benson Hotel  
Friday . . . 12:10 P. M.

PORTLAND, OREGON - May 10, 1963 - Vol. 43, No. 50



*Printed in this issue for presentation, discussion and action on Friday, May 10, 1963:*

REPORT  
ON  
**GRADUATE EDUCATION  
AND RESEARCH FACILITIES**  
FOR  
**METROPOLITAN PORTLAND**

*The Committee: DR. E. DEAN ANDERSON, JOHN C. BUKER, SAMUEL L. DIACK, M.D.,  
DR. FRANK L. GRIFFIN, CARL M. SALTVEIT, JUDGE HERBERT M. SCHWAB, EDWIN M.  
STANLEY, DOUGLAS C. STRAIN, DON S. WILLNER, AND ROBERT H. TARR, Chairman.*

**Deadline for reservations is Monday, May 13, 1963 . . . for**

**ANNUAL DINNER MEETING**

**SPEAKER:** *Felix Greene*, noted author and news commentator

**TOPIC:** "*China Revisited*"

**TIME:** 7:00 p.m., Wednesday May 15, 1963

**PLACE:** Portland Hilton Grand Ballroom

**PRICE:** \$4.25 per plate

The event is informal

**Phone CA 8-7231 now and reserve your tickets.**

*"To inform its members and the community in public matters and to  
arouse in them a realization of the obligations of citizenship."*

## PORTLAND CITY CLUB BULLETIN

Published each Friday by the  
**CITY CLUB OF PORTLAND**  
 420 Park Building      Portland 5, Oregon  
 Phone 228-7231

**ELLAMAE W. NAYLOR, Editor**

Entered as second class matter at the Portland, Oregon post office Oct. 29, 1920, under act of March 3, 1879. Subscription rates \$5.00 per year included in annual dues.

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**REPORT**  
**on**  
**GRADUATE EDUCATION**  
**AND RESEARCH FACILITIES**  
**FOR**  
**METROPOLITAN PORTLAND**

To the Board of Governors,  
The City Club of Portland:

### I. AUTHORIZATION

Your Committee was appointed "to study and report on the feasibility and desirability of establishing facilities for graduate study and basic and applied research in the Portland metropolitan area, and to recommend an action program for realization of such facilities as prove feasible and desirable."

#### Committee Membership

Your Committee was selected to assure balanced representation from the community, including industry and education, both private and public.

The membership includes: Chairman Robert H. Tarr, President, Northwest Science Investment Corporation; Dr. E. Dean Anderson, Assistant to the President, Portland State College; John C. Buker, formerly Executive Vice-President, Botsford, Constantine and Gardner at Portland, now in San Francisco; Samuel L. Diack, M.D. and Vice-President, Oregon Medical Research Foundation; Dr. Frank L. Griffin, retired President of Reed College; Carl M. Saltveit, Assistant Commissioner, Oregon State Bureau of Labor; Herbert M. Schwab, Circuit Court Judge; Edwin M. Stanley, The Crown Co., and Fine Arts Engravers; Douglas C. Strain, Engineer and President, Electro-Scientific Industries, and Don S. Willner, attorney, Lenon and Willner, and a member of the State Senate of the 52nd Legislative Assembly. Ken E. Richardson served as research advisor until his term expired; R. Evan Kennedy is present research advisor.

The Committee is deeply appreciative of the valuable assistance provided by two other City Club members in the preparation of this final report: Dr. Harry J. White for his consulting assistance on technical matters, and Elliot Marple for his editorial assistance.

#### Scope of Research

In the course of its investigation the Committee, or individual members of the Committee, interviewed leading educators, scientists, industrialists, and public officials. A list of those consulted is contained in Appendix VII.

The Committee was fortunate in having the opportunity to interview several outstanding and internationally famous scientists who visited Portland during the eighteen months of the Committee's study and to draw on hundreds of hours of the time of leading authorities in our own region.

In addition, the members of the Committee read numerous professional journals, technical and general publications, including research reports, books, pamphlets, copies of speeches and papers delivered before professional and other meetings, as well as news items, feature articles and editorials of the local and other newspapers. A bibliography of reference material is contained in Appendix VIII.

## II. ERA OF SCIENCE: CHALLENGE AND OPPORTUNITY

### Background of This Study

What lies ahead for the industrial growth of Portland and indeed of the entire state? What can we do to overcome heavy dependence on timber and agriculture at a time when those industries are shrinking in employment? How can we develop new industries that will strengthen the economy and provide a solid basis for expansion in the years ahead?

Questions such as these recur with increasing insistence among informed persons in Portland and elsewhere in Oregon. The past decade has made all too clear that the timber and agriculture, the two basic industries of Oregon's first century, are far from able to bring similar growth in our second century.

In the past decade, timber and agriculture have actually lost thousands of jobs. In agriculture the decline has continued throughout most of the postwar years; from an annual average of 85,700 in 1947, employment in agriculture fell to an even 80,000 in 1952 and last year reached a postwar low of 69,300.<sup>(1)</sup>

In timber the number of jobs touched an all-time high in 1951 and 1952. Since then there has been important expansion in certain phases of the timber industry, notably plywood, hardboard, pulp and paper, but lumber production has suffered deep cutbacks. For the entire industry—from logging right through to lumber, plywood, pulp and paper—total annual average employment fell from 90,600 in 1952 to 74,500 last year.<sup>(1)</sup> The trend is still downward.

Can Oregon stand another ten years of going backwards in its two largest industries?

Put a yardstick to the economy of Oregon and deficiencies stand out. In per capita income, for example, data from the U. S. Department of Commerce showed that in rate of growth from 1946 to 1955, Oregon placed among the five lowest states in the nation. More recent data permit a comparison of the last three years, 1960-62, with the base period of 1947-49; over this span of a little more than a decade, Oregon's rate of growth lagged almost 30 per cent behind that of the nation as a whole.

Oregon's distance from mass markets is an example of the kind of limitation on the type of industry that will thrive with a location in this state. Companies producing items of large volume or great weight and relatively low unit value would be handicapped by greater costs for transportation to their markets than competitors located nearer greater concentrations of buyers.

Conversely, Oregon's greatest industrial potential lies in exploiting this state's "liveability", high productivity of labor, educational advantages and similar features supporting production of high-value items of relatively small size and weight.

In the fast-growing but highly technical defense industry and related research and development, Oregon has fallen far behind. Our state has one per cent of the total U.S. population, yet it has received only one-tenth of one per cent of federal defense contracts.

Wherever we look among other major cities of the West we see diversification and growth in science-based industries and related defense activities—in the San Francisco Bay area, in Los Angeles, San Diego, Phoenix, Salt Lake City, Denver and Seattle.

Why does Portland lag so far behind in the great surge of science-

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1. Oregon State Department of Employment, 1963.

based industry? We have the climate, magnificent setting and pleasant living conditions such as should attract scientists and engineers, but these factors alone are not enough. Does Portland, the industrial center of Oregon, lack higher educational facilities required by scientists and engineers? Do we need more industrial research? If these are deficiencies, how do we make them up?

It was from this background that your Committee was appointed to study the problem and report. Our focus is on the development of facilities in education and research which can broaden the resources and strengthen the economy of our area.

### Impact of Scientific Discoveries

The massing of effort in scientific exploration and discovery in the past dozen years is on a scale the world has never before seen. This effort, starting slowly, began to take on present proportions from the opening of the second half of this century. Each year now sees the effort gaining in strength and momentum — in the number of men and women working in science and industrial research, in the qualifications and training of these persons, in the facilities and tools with which they are equipped, and in the stimulation from new discoveries.

Each year also brings an increase in the outpouring of ideas, knowledge, and understanding of the universe in which man finds himself, and in new products useful to man. Some persons may regard this outpouring as transitory and soon to pass its peak. To the contrary, men working on the frontiers of science and technology believe that so far there has been only a beginning.

For at least the rest of this century — and no one knows how far beyond — the discoveries of science and technology will constitute one of the great forces in human affairs, remaking our economy, reshaping industry and agriculture, recasting our educational systems, altering social and political institutions and even molding the scale of human values.

In impact, the discoveries of science and technology today have been likened to the extraordinary effect which the opening of the New World had on the culture, the economy and institutions of Europe four centuries ago.

A suggestion of the magnitude of current work in science came in a talk which Wilbur J. Cohen, Assistant Secretary of the Department of Health, Education and Welfare, prepared for the City Club meeting of March 22, 1963:

“In the last 20 years mankind has acquired more scientific information than in all previous history. Ninety per cent of all scientists that ever lived are alive and working today. Vast stretches of the unknown are being explored every day for military, medical, commercial, and other reasons.”

Qualified authorities indicate that the body of scientific knowledge and applications is doubling every ten years. Speaking of the challenge which this outpouring presents to those working to build a healthy economy, Dr. Harry J. White, executive officer, Department of Applied Science, Portland State College, told a Senate Committee hearing at Salem earlier this year:

“It is apparent that no state or area can expect to maintain



continuing prosperity without taking part in and contributing to these scientific and technical achievements to a substantial degree." (See Appendix I)

An insight into the relationship between scientific exploration and growth of an economy was provided by Dr. Lloyd Berkner, president, Graduate Research Center of the Southwest, on a visit to Portland last year. He made these three points:

1. **A radical change in technology** started in mid-20th century. This new technology stems primarily from confidence in theoretical science. By understanding how nature behaves, man has suddenly discovered he can do completely new things and accomplish tasks in vastly more efficient ways.

2. **The new industry emerging from the new technology** develops around collections of brainpower that capture the technology. As the new and more efficient technology invades every field with better products and methods, older industry will disappear in the competition. To retain its eminence and to exploit new industrial opportunities, a region must have enough men of advanced education to command the new technology and to bring its industrial benefits to the region.

In the long view, those regions that fail intellectually will fail economically and become chronically poor and colonial to the intellectually advanced region.

3. **To exploit new industrial opportunities** there must be enough men of advanced education to develop the new technology to which our new science gives access.

Dr. Berkner indicates the progression: New science, new technology, new industry. The steps along the progression are discovered through research.

## University a Nucleus for Economic Development

For industry, the growth of science and technology means new products and processes which can render some established products obsolete and can in turn open up whole new areas for manufacture.

How industry grows from the products of research was set out by George S. Schairer, vice president for research and development at the Boeing Co., in a paper on Education, Research and Community Economic Health:<sup>(2)</sup>

"New industries and industrial growth appear to be located at the sources of the inspirations and ideas around which these new activities are initiated . . . The analysis of the growth of the electronics industry around Boston will show that the principal factor and probably the only important factor lies in the research conducted at MIT, and to some extent at Harvard and Boston University . . .

"The ideas which resulted in the products, and certainly the technical know-how which permitted the exploration of the ideas,

---

2. Schairer, Geo. S., Vice president for Research and Development, Boeing, Co., "Education, Research and Community Economic Health".

came from these educational institutions and the research conducted within them. It is most likely that the growth of the electronics industry in the vicinity of Stanford University is an identical situation.

“Although it has seldom been stated, I am sure that the growth of the airplane business in the Los Angeles area was stimulated primarily by the healthy aerodynamic research circumstances at California’s Institute of Technology rather than by Los Angeles weather or any other single factor.

“If one were to analyze the source of the ideas which resulted in new products and new businesses, one would look to research conducted by businesses, by universities, by non-profit research organizations, and by government in-house research organizations.

“I am certain that such an analysis would indicate that an overwhelming majority of these ideas originated within the universities. Business organizations have seldom been responsible for the generation of new ideas, although business is beginning to make a greater contribution. Business organizations more normally develop an idea and carry on its development through a sequence of similar products . . .

“In those universities where the objective includes, in addition to teaching, a desire to improve the knowledge of the world and search for new ideas, we are likely to find most of the new ideas for the growth of the economic health of our communities . . . It is within the university where most of our future will be born.”

The importance of a university to the economic health of a community was underscored by Dr. Jesse E. Hobson, former head of Stanford Research Institute, in a recent talk at the Oregon State Legislators’ Research Day. The era of science and technology, Dr. Hobson indicated, make “brain-power . . . the all-important force for the development or survival of industry and business.” He went on:

“The university, and especially the graduate school and the institute of advanced studies, is emerging as an important and necessary nucleus for industrial and economic development . . . The university has suddenly become a community’s greatest asset, more important . . . to economic and social health . . . than water resources, transportation, raw materials, labor supply, capital or management.” (See Appendix IV)

## Broader Role for University in Education

The age of science brings to the university a much broader role in its age-old responsibility in education. The number of students who go on to higher education is vastly increased, their training must carry to a more advanced level, and many must come back periodically in later years just to keep abreast of developments in their own specialties.

A suggestion of the changing role in education appears in a recent talk by Dr. Branford P. Millar, president, Portland State College:

“The principal aim of higher education as recently as 25 to 30 years ago was to transmit knowledge to persons who could pretty

much use it as received, with some adaptation, for the remainder of their lives. The discovery of new knowledge, though important, played a relatively minor role in the lives of students, schools, and persons engaged in practical affairs . . .

“The situation is very different now . . . There has been and will continue to be a great increase in the growth of knowledge in all fields, and a concomitant increase in the rapidity with which new knowledge can be applied to practical affairs. Correspondingly, there is an increase in the levels and complexity of knowledge required by society in order to get its everyday business done as well as to push forward to new ways of doing business . . .

“There is no commodity with a higher imperative than trained intelligence, and the investment in this by business, industry, the military, and government is almost insatiable . . . College teachers of science, for instance, are now a minority of the Ph.D's at work in science, whereas not long ago, no one knew what else to do with them.” (See Appendix V)

The responsibility of universities toward those who have been trained in science and engineering, and especially those who have been carried to advanced degrees continues almost throughout the life of these individuals. Scientific discoveries are expanding knowledge so fast that there arises a new problem: human obsolescence.<sup>(3)</sup>

Scientists, engineers, and technicians find that in some ways their most difficult task is to keep abreast of developments in their own specialties. This cannot be done just by reading books; it requires a periodic return to, indeed, a continuing relationship with, a university for classroom, seminar, and perhaps laboratory work, the stimulus of full exposure to able teachers and researchers, and the challenge of fellow students.

Having set out in broad outline the increasing importance of a university in education and industrial growth, we come to the hard, unpalatable fact: **Portland is the largest metropolitan area in the West without a full university**—an institution with both undergraduate and full graduate curricula and with fundamental research that mark a university of first rank. We recognize also that excellent as are the universities at Eugene and Corvallis, their distance from Portland prevents their serving adequately the needs of the state's major metropolitan and industrial center in the new era of science.

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3. Kriegel, Monroe W., “Updating the Training of Research and Development Personnel”, a paper presented at the 1962 Annual Meeting of the American Association for the Advancement of Science, Philadelphia, Pa.

### III. RECOGNITION OF PORTLAND'S NEEDS

#### Historical Perspective

The discovery that Portland needs a university is not new.

"Portland is a city on which everything in Oregon pivots and will always pivot. In the nature of the case railways must come up the Willamette Valley and down the Columbia River, meeting at Portland. Portland has an extensive harbor with many foreign ships sailing thence to oriental countries. Here are all the leading institutions of Oregon excepting only educational institutions and the State Capitol. The people of Portland are becoming thoroughly aroused regarding this important matter. The newspapers are discussing the question and the time is ripe for concerted action for the establishment of an institution of higher learning there."

This is not reprinted from today's newspapers, but from a report of the Secretary of the General Education Board, the distinguished nationwide education agency endowed by John D. Rockefeller, to its trustees at their meeting in the East on October 19, 1909. Portland's need was publicly recognized over 50 years ago.

It is somewhat startling to find that so long ago the people of Portland were working to establish a major institution of higher education. Now a city larger by several fold, richer in cultural assets, strong in economic diversity, goes back more than a half-century to take up a task so long left undone.

At the time of the Rockefeller report in the early years of the century, a major university represented a cultural asset to a metropolitan area, as essential as a good library and of immeasurable value in adding to the community's intellectual richness.

Today, with expansion in social sciences, a university can contribute to the life of a metropolitan center on a wide range of matters. These include, for example, education, business administration, political science, public administration, urban affairs, industrial relations, architecture, psychology and sociology. In addition is the work in mathematics, science and engineering which establish the overriding importance of a university in an era of science.

#### Studies by SENT I and SENT II

Fresh recognition that the state might not be meeting its responsibility for higher education in Portland came late in 1959. At that time Governor Hatfield called for an investigation and report by the Committee on Science, Engineering and New Technologies set up within the Oregon State Department of Planning and Development. This committee, known from its initials as SENT I, was headed by Dr. Walter P. Dyke, physics professor at Linfield College and president of the science-based Field Emission Corporation, McMinnville.

The SENT I report was presented in May 1961 and in turn became the basis for further study by a new Governor's Advisory Committee composed of educators and businessmen from various parts of the state. This group, headed by Richard H. Sullivan, president of Reed College, was known as SENT II, and made its report in July 1962. A further group, known as SENT III, now has been appointed by the Governor as a 15-man Board of Trustees and is undertaking the implementation of the SENT II recommendations.

Both SENT committees recognized the need in Portland for graduate education and research. SENT I called for establishment of a Portland Center for Graduate Study as an autonomous educational institution. This Center would provide graduate instruction to meet "Portland's higher educational needs directly," and through research it would also "serve all resident industry as well as new and prospectively new science-based industry."

The SENT II proposal likewise asked for creation of a new institution, which it called the Oregon Cooperative Center for Graduate Education and Advanced Research. The objectives of such a Center were set out thus: "To enlarge the opportunities for graduate education . . . and to expand the opportunities for advanced research at levels of excellence which will contribute to the advancement of knowledge and understanding."

However, the SENT II committee at the same time expressed "its strong belief that the first task of the state and its citizens is to provide for the full development of existing colleges and universities. That potential development, in every quantitative and qualitative sense, is far greater than has yet been realized. No important diversion to new institutions in the way of talent, manpower, energy, or funds from present institutional missions and commitments, for both public and private colleges and universities can be justified."

The two SENT study committees performed valuable service in setting out the importance of graduate education and research and in commenting on the needs in the Portland area as well as elsewhere in the state. However, it should be noted that these studies were made essentially by state groups rather than by Portland groups and your Committee feels that their findings were not oriented to the needs of metropolitan Portland.

Your Committee members, like other Oregonians, take pride in our state universities and their immeasurable contribution to the cultural and economic development of Oregon. Your Committee recognizes also that the problem of graduate education and research in Portland is first of all of deepest concern to this metropolitan area, and that Portland must develop the leadership and resourcefulness to build its own future. In this effort, it merits the full help of the state, for Portland, with 41 per cent of the state's population in the metropolitan counties of Multnomah, Clackamas and Washington, remains the industrial and financial capital of Oregon. The pulse of Portland is the pulse of Oregon.

### Three Requirements in Higher Education and Research

Your Committee identifies three needs in graduate education and research in the Portland area:

1. **Opportunity for graduate education for:**
  - a. The rapidly growing number of young men and women who carry their education beyond the level of a four-year college and acquire advanced degrees; and
  - b. Scientists, engineers and others who are employed in the Portland area and must pursue graduate studies in their special fields in order to maintain their professional standing and proficiency.

2. **Opportunity for advanced, fundamental research** in new and specialized fields at the doctoral and post-doctoral levels.

3. **Opportunity for industrial research** such as will provide a bridge between the findings of academic research and the needs of industry, and will nurture new science-based industry.

Your Committee differs from earlier study groups in the delineation of Portland's needs. We think it is clear that one set of needs—in graduate education and in academic or fundamental research—is a function of education and requires planning and administration by professional educators. The other set of needs—in industrial research and the creation of new jobs and payrolls—is a function of industry and requires planning and administration by businessmen and industrialists.

These separate needs and their distinct goals cannot be met at the same time, in the same place, through the same mechanism. It would be folly for a single institution to attempt to provide all Portland's essential needs in graduate education, advanced research, and industrial research.

At the same time we should recognize that research is a common denominator for both graduate education and industry. This research, however, is undertaken for two quite different purposes. In graduate education and advanced studies, academic research is an essential part of the teaching process and of a university's function of search for knowledge for its own sake, without reference to how that knowledge may be used.

By contrast, in industrial or applied research the purpose is to get directly useful results in the form of new products and new processes that have immediate commercial application.

Having identified Portland's separate needs in graduate education, advanced studies, and industrial research, we turn now to an analysis of each of these and an examination of how the needs can best be met.

## IV. GRADUATE EDUCATION AT A FULL UNIVERSITY

### A. Analysis of Needs in Portland

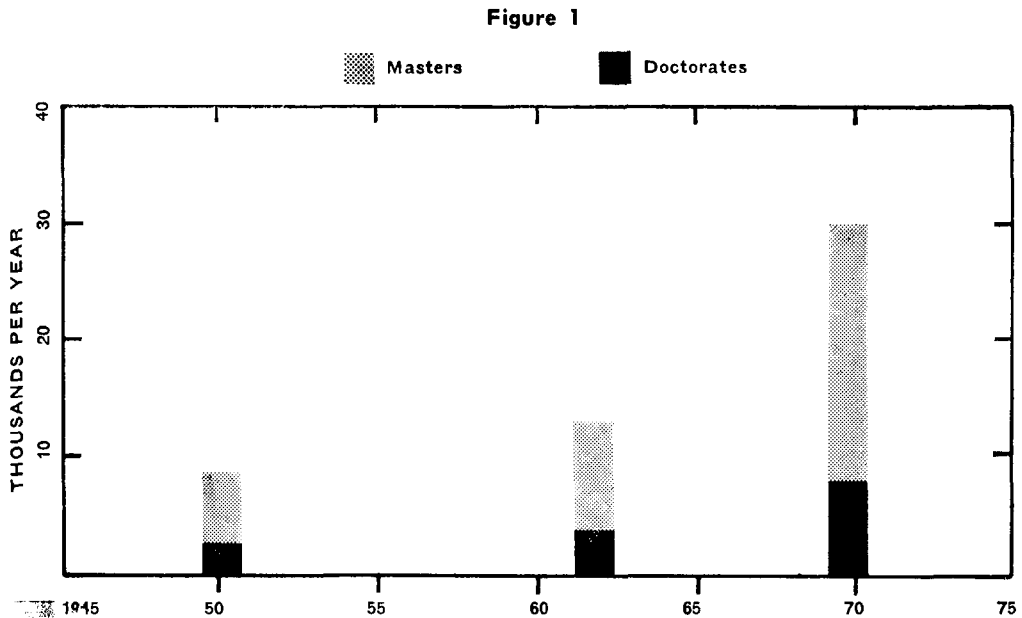
#### Graduate Education Beyond the Four-Year College

The first broad need is for graduate education of men and women who want to carry their studies beyond those of a four-year college.

The standard of formal education is rising throughout America. This has become a commonplace of life in an era of rapid scientific advance. Men and women who, 10 or 20 years ago, would have ended their formal studies with a bachelor's degree go on now for a master's or a doctoral degree; a growing number continues studies beyond the Ph.D.

In the national interest the number going on to advanced studies must increase sharply. The President's Science Advisory Committee reported earlier this year that the number of doctorates awarded in engineering, mathematics and the physical sciences alone increased from 2,100 in 1950 to 3,400 in 1962; but that Committee set the goal to meet the nation's needs at 7,500 in 1970.

The number receiving a master's degree in these same fields increased from 9,000 in 1950 to 13,000 in 1962; the goal for 1970 is 30,000. (See Fig. 1)



**Masters and doctoral degrees in engineering, mathematics and physical sciences.  
(Adapted from President's Science Advisory Committee Report)**

Increases are taking place also in other areas of study, including the social sciences, the humanities, and public and business administration.

Each year sees an exodus of talented brainpower as young men and women leave the Portland area and the state to pursue their education elsewhere. Some return to work here; many do not. There are no statistics to measure this loss, but in an economy and culture that places such reli-

ance on brainpower, the loss is serious in the development of our area.

The presence in Portland of a strong university with a full range of graduate studies would provide new opportunity to residents of metropolitan Portland and to those who for family, economic, or other personal reasons wish to pursue graduate studies in the Portland area. Such a university would also attract men and women from other areas.

So far our consideration has been for a university that would provide primarily for those who have completed undergraduate college work and go on directly to graduate studies.

## Graduate Education for Industry's Employees

**A second and in some ways more pressing need is graduate education for employees of scientific, technical and other industry in the Portland area.**

In addition to those in private industry, the approximately 1500 engineers and scientists in public employment such as the U. S. Army Corps of Engineers, the Bonneville Power Administration, the Forest Service, and city, county and state agencies in the Portland area comprise a major professional group of great value to the Portland program of engineering and scientific development. They have a major stake in graduate education in Portland. This body of professional employees in public service has heretofore been generally overlooked. Their needs are both great and worthy, and omission of consideration of this group would be a curious lacuna.

Graduate education can meet this need at different levels, such as described in the following three categories:

**(a) New graduates who must advance their education beyond the Bachelor of Science level** if they hope to progress in their careers and move on to positions of greater opportunity and responsibility. These men and women while working in industry need graduate programs leading to degrees of Master of Science and Doctor of Philosophy.

In nearly every other great metropolitan area of the country, a wide range of graduate courses is available at universities of first rank. San Francisco, Los Angeles, and Boston are three areas where science-based industry has expanded rapidly and where graduate work of high order is constantly available for scientists and engineers who have yet to reach their own potential. Unless Portland can offer graduate studies in the specialties represented by those at work in the area, Portland cannot hope to attract and hold the able young engineers and scientists that a growing area needs.

**(b) Graduates of five to ten years' experience require refresher courses.** These men are less apt to take formal programs leading to advance degrees, but they do need to update and advance their professional knowledge in order to remain effective.

The rate of obsolescence in engineering and science is so rapid that, in the estimate of one specialist, in 10 years an engineer will be reduced to 50 per cent effectiveness as far as new knowledge and overall ability go. In today's competition a man or an industry only 50 per cent effective is quickly retired to the sidelines.

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reduced 50 per cent effectiveness as far as new knowledge and overall ability go. In today's competition a man or an industry only 50 per cent effective is quickly retired to the sidelines.

An example of how the discovery of new knowledge requires continuing graduate studies comes from electronics. As recently as 1950 a Ph.D. could be in the forefront of circuit design and know nothing of transistors. Today the usefulness of such a person as a circuit designer would be seriously impaired because 70 per cent of commercial production in electronics now contains transistors.

**(c) Scientists, engineers and executives of 15, 20 or 30 years' experience need modern, mature, and broad seminars, management training, and review programs.** Men of this background and experience have little need of advanced degree programs. Nevertheless they, too, are deeply affected by the steep curve of progress. Methods, techniques, products, often even the very fundamentals of their professional fields or businesses have advanced to new and frequently bewildering levels since their undergraduate years. Rapid technological advances in business diversification have combined to put premium values on new knowledge.

It is now recognized that self-study and other informal educational means no longer provide an adequate basis for keeping abreast of developments. Management professional seminars, short courses, review programs, conferences and symposia are increasingly becoming a way of life for the professional in business, as well as in science. These are most effectively and efficiently provided by a university at the graduate level.

This insures the validity, continuity, depth of interest, and resources vital to the success of such programs. The ability to meet this need is a basic requirement of any modern, urban center.

## The Contrast of Portland and Seattle

The availability of graduate education through the University of Washington at Seattle and the use of the University by scientists and engineers at Boeing provide a striking contrast to the lack of such facilities at Portland which contributes to the difficulty of recruiting competent people for Portland's science-based industries.

Out of a total enrollment of 19,130 at the University of Washington last fall, 4,137 were in the graduate or professional schools including many employed at Boeing. A study at Boeing recently completed for the American Association of Land Grant Colleges and State Universities, in cooperation with the State Universities Association, developed these highlights:

Almost one-fourth of Boeing's employees completed at least one college course after starting work for the company. (At the time of the survey, Boeing's Seattle employment approximated 60,000, including 10,000 engineers and scientists).

More than six per cent of engineers and scientists, four per cent of supervisors and general office workers, and three per cent of executives obtained initial or additional academic degrees after their employment by Boeing.

About eight per cent of Boeing employees at the time of the study were enrolled in a regular college course; of these about one-third were working toward graduate degrees for which financial support was provided by Boeing.

Ninety per cent of Boeing's supervisors and more than eighty per cent of its executives, engineers, scientists, and general office employees said that the nearness of institutions of higher education contributed to their job satisfaction.

In the contrast to the wide use that Boeing scientists and engineers make of facilities for graduate education at Seattle, here are comments which four manufacturers in the Portland area made to the SENT I committee in answer to a survey on the needs of our science-based industries.

"We think a science-engineering center in Portland would assist us in obtaining highly trained personnel and in enabling them to maintain their competence in a rapidly changing technology. New science-based industry will likely have this factor as a major in determining whether it locates in Oregon, or elsewhere."

"We need such a center . . . it is overdue. Good men are not coming to work in Portland because their further development is limited by lack of advanced degree-granting institutions."

"Without question an established graduate center would serve as a source for well-qualified personnel in their own and related fields. The wood industry is moving into a period of major technical advancement and will require highly trained men to implement these programs."

"The creation of such a center is an absolute necessity for Tektronix. We find it extremely difficult to attract competent people to our plant, and we find those who have acquired with us a degree of scientific competence also leave us for the specific reason that they do not find here further help or stimulation to their scientific development."

## **Relation to National Competition for Scientists and Engineers**

**The importance of continuing graduate education for scientists, engineers, mathematicians, businessmen, and other specialists cannot be overstressed.** The Pacific Northwest electronics industry, centered in metropolitan Portland, and other science-based industry, has to compete for talent against the extraordinary graduate educational opportunities that are available to employees of companies clustered around such institutions as the University of California, Stanford, Cal Tech, Harvard, and MIT. This is a fact of life which the city and the state must acknowledge.

We are here not considering something in a vacuum or raising the question: Wouldn't it be nice to offer further courses? Rather, we are looking at a very hard competitive situation in which

- (1) industry must attract and hold top men in order to remain in business and to expand and create new jobs;

- (2) the best men in engineering and science, eagerly sought after and free to move throughout the country, often will consider a job only in an area which has opportunities for further graduate education; and
- (3) scientists at middle and senior levels attach high importance to intellectual climate and cultural values in their fields of interest and the opportunity for associations with their peers in their specialized fields.

## **B. Present Facilities for Graduate Education in Portland**

To what extent is graduate education available in the Portland area now? Are the needs being satisfied, either in the physical sciences and engineering or in social sciences and humanities

Some graduate studies are now offered, but the fields are limited, the quality varies widely, and many courses at best are a stop-gap established in the absence of a full university.

Here are the main groups of studies and the institutions providing courses:

1. **The University of Oregon Medical School** grants, in addition to the doctor of medicine and master of science in nursing, degrees of master of science and Ph.D. in anatomy, biochemistry, physiology and other fields directly related to medicine.

2. **The University of Oregon Dental School** grants, in addition to the doctoral degree in dentistry, a master's degree in dental education and research.

3. **The University of Portland** grants the master's degree in a number of fields including business administration, education, English, history, library science, music, psychology, speech and drama, and theology. It also grants doctoral degrees in education and psychology. It offers no advanced degrees in physical sciences, mathematics or engineering.

4. **Portland State College** offers the master's degree in social work. A further program that would lead to the master of arts and master of science degrees in teaching has been approved by the State Board of Higher Education and will be inaugurated next year if the Legislature appropriates funds.

Portland State is essentially an undergraduate institution with enrollment this year of approximately 5,500 day students; only about four per cent are graduates. While Portland State has a number of faculty members capable of giving graduate courses, the State Board of Higher Education has not yet authorized PSC to offer general graduate work or to grant graduate degrees other than in social work.

A few graduate courses have been added under special circumstances, however. Through the cooperation of Oregon State University's mathematics department, for example, a year's course on modern mathematical methods was started this spring with enrollment that exceeds the anticipated number of 40. This new course provides mathematical training not heretofore available in Portland and is designed for scientists and engineers in industry and government and for college teachers of science and mathematics who have not achieved a doctoral degree. Support from the National

Science Foundation makes the course available to college teachers without tuition. The instruction staff comprises one member of the faculty from OSU and four from PSC.

5. **Reed College** offers, as a part of its summer session and in connection with evening seminars during the academic year, a program leading to an M.A. in teaching. Areas of concentration include: behavioral science, education, letters and arts, mathematics, physical science, and social science.

6. **Lewis and Clark** offers programs leading to the degrees of master of education, master of music education, and master of music.

7. **The General Extension Division** offers evening courses at Portland State College on a wide range of subjects for both undergraduate and graduate students.

These courses are taught by members of the faculty from Oregon College of Education at Monmouth, Oregon State University at Corvallis, Portland State College, and the University of Oregon at Eugene. Through the Extension Division students earn credits at these four institutions, and in some fields all or a large part of the course requirements for a master's degree may be satisfied by extension courses at Portland. The classroom, laboratory and library facilities used are those of Portland State.

Undergraduate and graduate enrollment at the Portland Extension Center in the 1961-62 academic year reached 6,371, of which 1,596 were graduate students. Thus the number enrolled at Portland State College or taking extension courses which use Portland State facilities exceeds 11,800. This compares with the forecast of a student level of 20,000 at PSC by 1970, which has been approved for planning by the State Board of Higher Education.

A recent study prepared by Dr. Miles C. Romney, then executive director of the State System's Coordinating Council on Graduate Study, indicated that almost half the students working for a master's degree through extension courses were in the field of education. Other principal areas of specialization, in order of decreasing size, were engineering, business administration, science, mathematics, social science, and liberal arts.

### **Limitations of Extension Courses**

Extension courses, both graduate and undergraduate, provide a needed service in the Portland area, particularly at the undergraduate level, and the size of enrollment alone demonstrates an otherwise unsatisfied need in Portland.

However, the basic limitations of extension courses, notably at the graduate level, should be recognized.

Many instructors, especially at the graduate level, are drawn from the campuses at Corvallis and Eugene. This requires a drive of 1½ to 2 hours in each direction to deliver an evening lecture course typically 6:45 to 9:30 p.m. at Portland. Time for any individual discussion after class, such as is characteristic of university graduate work, is extremely limited. Older experienced members of the faculty generally decline this grueling addition to their workload.

In addition, because the extension program is largely self-supporting, compensation to instructors is far less than at the universities at Corvallis

and Eugene. If pay for instructors at extension courses were projected on a full-time basis, the average annual salary would be only \$3,900, compared with \$7,500 as the average compensation for new members of the staff added in the State System. The difference is actually greater because graduate faculty are usually in the higher end of the salary scales.

There are other drawbacks. Graduate extension courses offer no continuing research work, nor the customary apprenticeship of resident graduate work. Also, the library, laboratories, and other facilities at PSC are intended for undergraduate study and generally are not adequate for highly specialized graduate work.

Further, the purposes of extension courses are quite distinct from those of a graduate university and there is wide difference in the caliber of the students. Extension courses are intended to make education available on as broad a basis as possible, primarily through evening classes. Standards for entrance are low, and as a consequence, drop-outs from other colleges and universities may sit alongside graduate students in the same extension course. Clearly this is not a basis for a quality program of graduate education.

### **C. A Full University Is Necessary At Portland**

As we have seen earlier, the pressing needs in Portland today are for graduate education in the sciences, mathematics, and engineering. Since present facilities in Portland are clearly inadequate to meet these needs, we must look to the only other solution: the establishment here of a university with first-quality graduate education.

But Portland's needs are not restricted merely to the sciences and related fields. Our long-range goal should be a true university for the metropolitan area, an institution of first rank with graduate education and basic research in all major fields of study.

#### **Four Guidelines**

Some guidelines may be set out to help insure that the quality of the graduate program will in fact meet Portland's needs and will distinguish the full university from undergraduate colleges.

**First, the quality of the faculty**—in teaching and in research—must receive primary emphasis. A university at Portland should rank at least with the established state universities at Eugene and Corvallis. It is not too much to expect that the faculty at Portland would come to include specialists of national renown.

**Second, the curricula of graduate studies** must embrace the major fields in which master's and doctor's degrees are awarded by universities elsewhere. This means that graduate curricula would cover not only those fields related to science-based industries but in addition such fields as business administration, political science, sociology, education, urban affairs, public health, sociology and many others.

Teachers and government workers are among Portland's most numerous professional people, and their educational needs include many fields of learning at the graduate level.

**Third, physical facilities must be adequate for quality work** in graduate education. These facilities include libraries and laboratories. Academic research is an essential ingredient in graduate education.

**Fourth, graduate education requires a resident program.** Effective graduate work is not possible with a commuting faculty; they are in fact mutually exclusive. The institution must have its own resident faculty. Members of faculty must be available for consultation and discussion. There must be the stimulus from fellow students and the challenge and intellectual ferment that mark a vital university.

## Graduate Education Costly

In setting forth these guidelines, your Committee recognizes also that education at the graduate level is more costly than at the undergraduate level. The reasons are obvious. Advanced studies require teaching by the more able and experienced members of the faculty and those of greatest eminence. Greater individual attention in graduate work necessitates smaller classes and seminars. At the graduate level, requirements for laboratory facilities and libraries also are more exacting.

Cost to the institution per graduate student is in the order of two to three times as much as for an undergraduate student. Findings of the Federal Office of Education are quoted in the report of the 1962 President's Science Advisory Committee. "Meeting Manpower Needs in Science and Technology" stating that the cost per graduate student ranges from \$3200 to \$4,000 per year, depending on the field of study pursued.

## D. How Can A University Be Established?

A wide spectrum of possibilities has been studied to determine the most feasible method to establish a full university at Portland. At one end of the spectrum is the creation of an entirely new, full-blown university with its own campus and faculty. Along the middle of the spectrum is the addition of a graduate curriculum to an undergraduate college. At the other extreme is simply a broadening of present extension courses.

### Analysis of Alternatives

After studying the range of possibilities, your Committee concludes:

1. **Extension courses are not the answer.** They cannot provide graduate studies in sufficient quality and depth, and they were never intended as an alternative to a full university.

In saying this, your Committee does not overlook the very real contribution of the General Extension Division to education in the Portland area. However, extension courses are primarily at the undergraduate level and for part-time evening students. Neither here nor in other parts of the country do educators regard extension courses as in any way comparable to a full-time graduate education program with a resident faculty.

2. **Creation of an entirely new, full-blown university** with its own faculty, a new campus, and new physical facilities is theoretically possible but the cost appears prohibitive and this approach is therefore unrealistic.

Far more effective use of funds and facilities can be made by building a graduate curriculum on an established undergraduate college. It should be noted that this approach has been followed even where relatively unlimited funds have been available, as for example in the creation of Duke University out of long-established Trinity College.

The combination of undergraduate and graduate programs permits the fullest utilization of faculty and facilities. Some courses or sections of

undergraduate instruction are conducted by graduate students who are working for advanced degrees or are engaged in post-doctoral studies and research. The use of an undergraduate college as the nucleus for a university also permits the addition of graduate programs in special fields as rapidly as faculty and facilities become available.

**3. The private undergraduate colleges of the Portland area do not provide the base on which a full university can be built.**

Reed College, Lewis and Clark, and the University of Portland have all been considered. The raising of adequate private funds is a major barrier.

Because of Reed's high scholastic reputation and worldwide recognition many persons have suggested Reed might be developed into a full university. Certainly from the strength of its undergraduate base, Reed would be eminently suited for this role. But funds necessary for adding a graduate curriculum with adequate endowment and the continuation of Reed's high educational standards would run into many millions. In the absence of this financial support, Reed believes that it should devote its full resources and energies to its first responsibility, its undergraduate college.

However, the presence of Reed and the other private undergraduate institutions in this area would contribute to the establishment of a university with graduate studies in Portland. The community of interest of scholars makes these institutions an additional attraction of the Portland area in the recruitment of the university faculty. It is to be expected also that leaders in the respective faculties might participate in graduate programs as well as continue in their own undergraduate fields. There undoubtedly would be common use of some facilities, such as libraries.

Thus Reed and the other private institutions can contribute immeasurably to the functioning of a first-rank university with a full graduate curriculum in Portland, without themselves being a formal part of that institution.

**4. Conglomerate offering of courses not the answer.** One suggested solution calls for the creation of a graduate center for education in the Portland area with a faculty borrowed from existing state and private colleges and universities in Oregon. Under this proposal, degrees would be awarded by the separate institutions, which would operate under contract with the graduate center.

This easy thesis has at first blush a number of attractive features, such as the relative simplicity with which faculty members may be obtained. However, for such a center to be effective, the faculty members, assigned for a quarter or a year as the case might be, would have to be in full time residence, and the courses would have to be set up around a continuing graduate program.

Close and realistic examination of this approach indicates that such assignments may well be regarded as distractions rather than as basic interests of faculty members. Coherent, effective, forward-looking programs of the caliber needed would undoubtedly be difficult to organize and implement on the makeshift basis implied in this approach. Such educational work cannot be effective when consisting of no more than flash exposure by professors or scientists borrowed from other areas and presenting evening lectures on a hit-and-run basis without opportunity for the challenge of group discussion and exploration in depth on a continuing basis.

Further, serious problems arise in the center's need for library, laboratory and related facilities.

### 5. Portland State College provides the base for a full university.

“For the journey to Utopia,  
you start from where you are.”

Portland State College already has sufficient faculty strength to offer graduate work in several fields, and its location and present facilities make it an obvious base on which to build a university for the metropolitan area.

The decision whether to go ahead with this expansion rests, as it always has, with the State Board of Higher Education, which must approve the budget for Portland State and any increases in its facilities, faculty or curricula.

With Portland State College's staff, facilities and courses expanded by the State Board of Higher Education, a university can be in operation in Portland. Then, with the cooperation and participation of other universities and resources in the State System, the strengthening process to bring Portland State to first rank as a university can be carried on.

Although in 1946 the State Board of Higher Education did establish a temporary two-year education program at Vanport to cope with the post-World War II influx of veterans, public higher education on a permanent basis in the Portland metropolitan area has been brought about largely at the insistence of the State Legislature. Offering of upper division work was made possible in 1953, with a considerable assist from legislative interest; and the 1955 legislature raised the Portland State program to four-year, degree-granting status. The Board at that time limited the new college's curriculum to general studies and teacher education. In 1958-59, the Board authorized degrees in most of the liberal arts and sciences, and in additional professional programs including first Applied Science, then in Business Administration.

At present graduate work is offered at Portland State College only in social work, the result of a 1959 legislative directive to the State Board of Higher Education calling for presentation of a plan and budget to the 1961 session. Although the granting of M.A. and M.S. degrees in teaching at Portland State has been approved in principle by the State Board of Higher Education—and its stand has been reaffirmed—no courses in graduate work in teaching are yet offered, inasmuch as no appropriation has ever been given to implement the program.

The Legislature's latest effort to assist in the development of a more adequate higher education program in Portland was the adoption recently of Senate Joint Resolution 8 which directs that “the State Board of Higher Education shall establish a quality program for graduate education in the arts and sciences in the Portland metropolitan area.” It also directs the Board to “complete plans for such a program so that an appropriate budgetary request may be made for the 1964-67 biennium.” (See Appendix VI)

The legislative vote on this resolution was overwhelmingly favorable—from both parties and from all sections of the state. Adoption of the resolution is of potentially far-reaching importance: it is strong acknowledgment of state responsibility for development of full graduate education in the Portland area.

Our studies have convinced your Committee that the most feasible and effective way to build public graduate education in metropolitan Portland is on the present undergraduate institution of Portland State College. We believe that in this expansion, attention should be directed first to the physical sciences, which tie in with the urgent need in Oregon for diversification of the economy and the evolution from dependence on timber and agriculture to vigorous growth in science-based industries.



Graduate education in Portland should then be extended to serve the social sciences and other curricula which fit the very real requirements and aspirations of a determined and expanding metropolitan area.

### Three Steps

As a guide we set out three steps toward establishment of graduate education and a full university at Portland:

1. **The State Board of Higher Education at the earliest possible date** should authorize the addition at Portland State, effective with the 1963 fall quarter, of such graduate courses as present faculty members are qualified to offer without extensive and expensive facilities. The Board will also need to allocate modest funds to provide such minor facilities as the new courses may require.

It should be noted that even if the State Board should later decide on another institution as the vehicle for quality graduate education in Portland, the graduate courses authorized for Portland State in the 1963-64 academic year could be transferred to that new institution.

2. **In response to Senate Joint Resolution 8**, the State Board will prepare a broad program for graduate education in Portland for submission to the Legislative session which opens in January 1965. It is incumbent on leaders in Portland to provide the State Board every assistance in its response to the will of the Legislature.

3. **After progress has been made in the establishment** of a first-rank university in Portland with full graduate curricula, it may be useful to supplement the work of Oregon's own experts with specialized aid from a national foundation. Oregon's efforts to shape the educational facilities in its major metropolitan center to meet the new needs in an era of science may have interest and application in other parts of the nation. Not too long ago Portland obtained assistance from the Ford Foundation for a pilot program in reshaping secondary education.<sup>(4)</sup> The civic leaders who obtained outside funds and expert assistance for that program may be willing to take the leadership in seeking similar funds and help for the new program for higher education in Portland.

### Responsibility of the State

**Public education is a basic responsibility of the states** under the Constitution of the United States. In educational matters, the state is a unit and the legislature is the source of power.

In Oregon, as in other states, the exercise of this authority **at the elementary and secondary school levels** is vested in state and local school boards, with financial support derived primarily from local property taxes.

In sharp contrast, legal control of public **higher education** is lodged in a **single state-wide board**. In Oregon, as in many other states, this is the State Board of Higher Education, whose members are appointed by the Governor and confirmed by the Senate for staggered terms of sufficient length to insure the Board's independence. Major financial support of state institutions of higher learning is provided by legislative appropriation. Not only legally but also traditionally in the United States, responsi-

4. Portland High School Curriculum Study, Nov. 1959

bility and authority for meeting the public higher educational needs of all of its people rests with the central state government. This authority has not been delegated to local communities—local governments are powerless to tax for higher education. It has already been demonstrated that meeting Portland's needs through construction of a private university with full graduate curricula and broad academic research is out of the question. Portland simply does not have the industry and other resources to provide for the construction, operation and endowment of a private university of first rank.

For historic reasons, the two state universities in Oregon were established in areas away from the major population center, the Portland metropolis. With 41 per cent of Oregon's population and an even higher proportion of its tax-paying resources, the Portland metropolitan region has been paying close to one-half of the costs of operating the state universities at Corvallis and Eugene. The right of the state to collect from this concentrated population center nearly 50 per cent of the money used to support public higher education in Oregon carries with it the commensurate obligation to provide to this area full equality of higher education opportunity.

**Equality of public higher education opportunity today requires, in addition to undergraduate programs, full university graduate curricula.** Your Committee calls to your attention the fact that this obligation of the state to the Portland area is not fulfilled. Deficiencies are especially critical in the fields of science, technology and teacher education. The latter deficiency has recently been made dramatically evident by the resignation and loss to the state of Dr. Willard Spalding, nationally eminent educator, who decided to accept a post in California, which has "almost universal enthusiasm for improvement in schools—with funds available for it", after a wait of some five years for the Oregon Legislature and State Board of Higher Education to support with funds Portland State College's authorization to provide the graduate program leading to a master's degree in education. (See Appendix X and XI)

As brought out earlier in this report, the present disjunction in graduate education is not only inequitable, but even more important, seriously impedes the economic development of the entire state. The establishment in the Portland metropolitan area of the graduate education and research facilities recommended in this report is essential to expand and diversify the industry of the state and broaden its tax base. The cost of these facilities should be considered a basic investment necessary to assure Oregon's role and participation in the benefits of the modern scientific era.

Some federal funds may be forthcoming to help public and private colleges and universities. A bill in Congress, introduced by Rep. Edith Green of Portland, would provide \$2.7 billion, largely in grants for construction of libraries, laboratories, and science and engineering classrooms. This legislation has strong bipartisan support, but whatever financial assistance the federal government may give will not in any way reduce the state's primary responsibility.

Educators, so cognizant of the public's needs yet troubled by lack of funds, ask: Where is the money coming from? It is time Oregon faced up to the fact that higher education is a basic problem in state finance and must be met.

The pressure for expansion in educational facilities and opportunities is state-wide; it is nation-wide as well. It is also one facet of the new era of science.

Various states respond to this pressure in various ways: California

has just announced a stupendous plan to spend three quarters of a billion dollars in twenty years for an entirely new university at Santa Cruz to serve eventually 27,000 students. Oregon does not have California's resources, but neither is Oregon so poor it cannot provide for the educational facilities needs of its own people and long-range growth of its economy.

Enrollments are building rapidly at undergraduate and graduate levels—here and throughout the nation. Growth is certain to continue in the decades ahead. New facilities must be built, new institutions must be created. **It is time Oregon expanded its university system from two campuses to three—at Eugene, Corvallis, and Portland.**

Twenty-five or 50 years ago a full state university could have been established in Portland only by cutting seriously into the older institutions at Eugene and Corvallis. This is not true today. The inevitable expansion which lies ahead will require increased expenditures for higher education in Oregon. In this expansion the proportion of the state's funds for higher education that go to Corvallis and Eugene can be reduced while the actual number of dollars distributed may increase even though at a slower rate than in recent years. New funds then will become available to Portland.

Your Committee believes that not only must the state expand from two university campuses to three, but that Portland in the years just ahead must receive top priority.

## V. THE RANGE OF RESEARCH

Graduate education at a full university is the first requirement for a city that is developing as a center for science and science-based industry. A second requirement is research.

One type of research—fundamental, or basic—will be carried on at the university itself. Such research is essential to the teaching process at graduate levels—the discipline, training and development of the minds of outstanding men and women. It is also a part of a university's age-old quest for knowledge and the search for truth and understanding.

Research related more directly to commercial products is likewise essential. But evaluation of the place of research in Portland's growth requires first that we be more explicit as to what we mean by research and where the work can best be carried on.

### The Types of Research

**Basic or fundamental research**, sometimes called pure research, is undertaken for the advancement of knowledge. It seeks through scientific discovery to help man understand why things happen the way they do and to learn new principles. Fundamental research is undertaken without expectation of commercial return. The objective is knowledge for its own sake, not new products. Out of this new knowledge, however, other researchers at more mundane levels develop new products.

An example of fundamental research is the study of the structure of atoms.

**Applied research** is research aimed at practical ends. It is undertaken to create products and processes of commercial value. This research may lead to new scientific knowledge but it differs from fundamental research in that it is carried on for financial return and has a very practical goal.

An example is the effort of timber companies to learn more about the chemical composition of tree bark so that this byproduct of lumber, plywood and pulp can be converted into chemicals with a market.

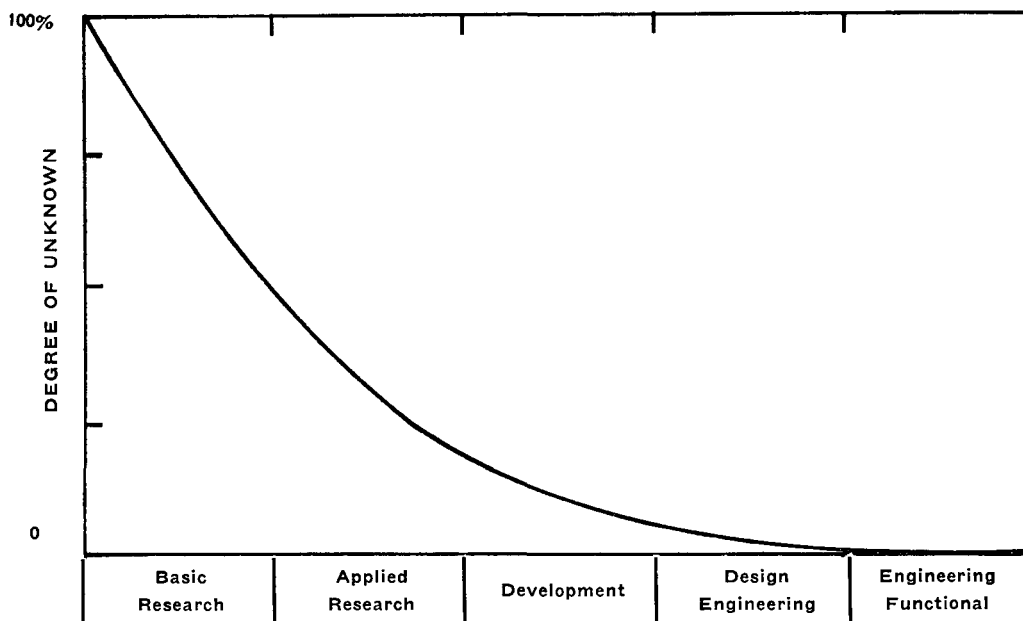
**Development** is one step farther along toward the creation of what is immediately useful and practical. Here research activities commonly begin with new scientific discoveries and results obtained in fundamental and applied research and translate these discoveries into useful products or processes. Essentially, development is in the middle ground between scientific research at one end and engineering at the other.

An example is the laboratory work and pilot-plant of a pulp manufacturer in developing a new grade of pulp from sawdust, previously regarded as useless for this purpose.

**Design engineering** is essentially the completion phase of the research and development progression on which the amount of scientific exploration diminishes and the amount of applied engineering increases.

These various aspects of research may be schematically set out as gradations, blendings from one into the other, in this fashion:

Figure 2



Graph illustrating the degree of unknown (in scientific sense) for the several phases of industrial research activity

## Who Performs Research?

**Fundamental research** by tradition is carried on at universities as a part of the quest for truth. Support for academic research, once obtained almost solely from university endowments and other income, has broadened as the need for research has grown. Now federal agencies are the largest source of money for fundamental research, but the work continues to be carried out primarily at universities.

In addition, government and industrial laboratories are expending their efforts in fundamental research. Mellon, Battelle and Stanford are examples of research organizations whose activities include some fundamental research.

Larger industrial corporations also conduct fundamental research, generally in broad areas where discoveries might be of interest to the sponsor. The General Electric and Bell laboratories are early and outstanding examples of this type of research. One of the most recent is the Boeing Scientific Research Laboratories, opened in 1960, entirely separate from Boeing's engineering and applied research.

**Applied research** is more often undertaken either through sponsorship of a government agency with a specific problem to solve, or by an industrial corporation seeking to build new products or to obtain fuller utilization of raw materials.

Emphasis on the types of research activities will vary widely among companies, depending upon their particular problems and the amount of money they can invest in studies which may not bring an immediate return. A characteristic pattern of research effort, representative of the research policies and practices of many advanced technical companies in the United States today, is exhibited in Figure 3. Emphasis will vary also within a company over a period of time. Three fairly common patterns are suggested in the following graph, the solid line showing an organization with substantial effort in fundamental and applied research, the dotted

line indicating an organization with primary effort in product development and engineering. The relative emphasis in academic research is also shown in Figure 4.

Figure 3

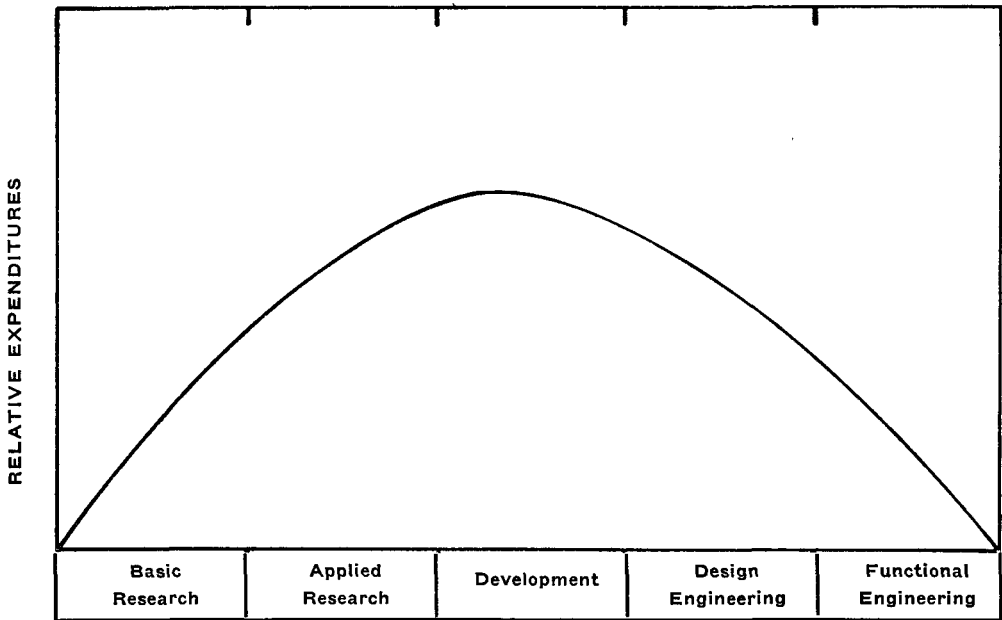
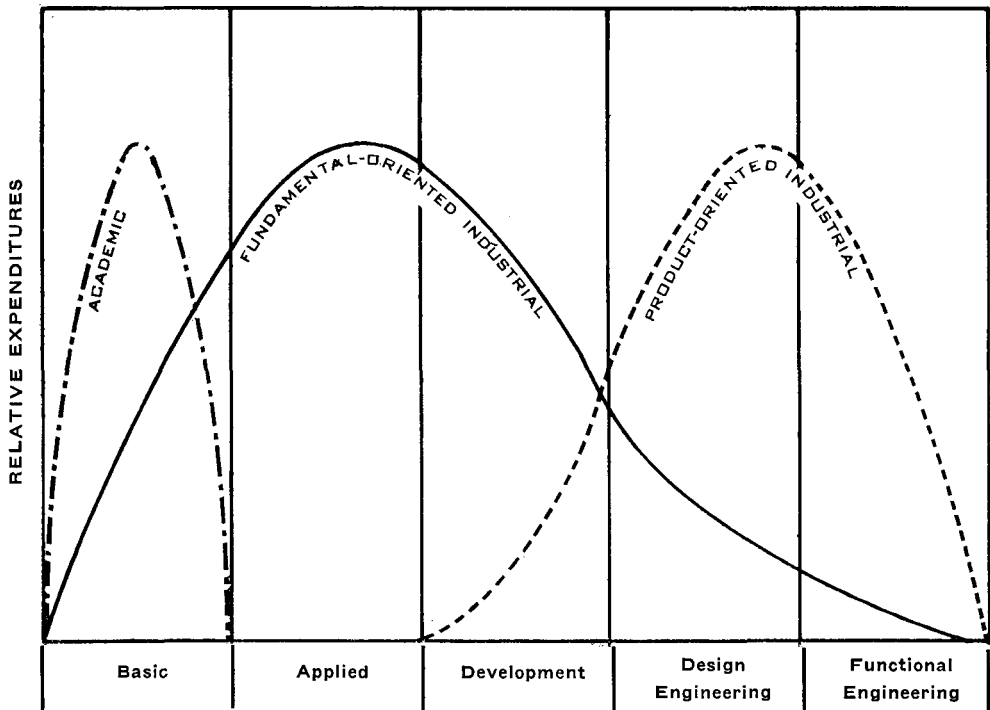


Diagram showing relative expenditures for the various phases of research, development, and engineering for typical industrial research laboratories.

Figure 4



Comparison of academic and industrial research emphasis.

## VI. CENTER FOR ADVANCED STUDY AND RESEARCH

Your Committee believes that Portland has an exceptional opportunity to strengthen its position as an area for science and science-based industry through establishment of a Center for Advanced Study and Research.

This opportunity grows out of two related circumstances: first, the emergence in science of a new field of research as a result of the interaction of mathematics, physical sciences (physics, chemistry) and engineering on life sciences (biology, medicine and medical psychology); second, the presence in Portland of research activities at the Oregon Primate Center and the Oregon Medical School.

### Interaction of Physical and Life Sciences

As man expands knowledge in physics, chemistry and biology, a new area of research and development arises from the focus of these once-separate sciences upon areas of common interest. Important scientific exploration is being conducted, for example, by physicists, chemists, mathematicians, engineers and biologists working together to learn more of the fundamental nature of a biological cell.

Exploration at the interface of the physical and life sciences ranges from fundamental research to development work and engineering. Russia a decade ago recognized the potential and established the Scientific Research Institute for development primarily of new surgical apparatus. The Institute has no counterpart in America.

One development from the Institute is a blood vessel stapler which enables a surgeon to join quickly the tiny blood vessels that are almost too small to sew. This kind of device, now used in America, extends the capabilities of a surgeon and has made it possible to attach an arm that has been cut off. The technique involves nothing new to medicine in the past 50 years but was the outcome of an engineering project focussed on a problem in medicine.

Another product of interaction of physical and biological sciences is the electron microscope, which permits examination of cell tissue under far greater amplification than with the conventional light microscope. This instrument was the outgrowth of research in physics directed to a problem in biology.

Although activity has begun in the systematic application of the physical sciences, engineering and mathematics to the life sciences, a great opportunity in this new field is open to Portland to achieve a high level of excellence here. This is a new area of great challenge and promise in research. In the words of Dr. Lee B. Lusted, head of the department of physical sciences at the Oregon Primate center, "the alliance of the physical sciences and the biological sciences is . . . of national importance."<sup>(5)</sup>

Such an alliance calls for a wide range of activities. The primary need is for fundamental and to some extent applied research. This scientific exploration could lead later — perhaps with development and product research by other research centers — to new products of commercial value.

### Portland's Head Start

Portland already has a good start toward scientific exploration in interaction of the physical and life sciences, sometimes called bio-physics and bio-engineering. The Oregon Primate Center, first organization of its

<sup>5</sup>. Lusted, Dr. Lee B., at dedication of Sunset Science Park, Beaverton, Ore., Oct. 31, 1962

kind in the nation, and the University of Oregon Medical School both bring to this area fundamental research in biology and to some extent in bio-physics.

This effort could be greatly expanded and strengthened through establishment of a Center for Advanced Study and Research, concentrating heavily on bio-physics and bio-engineering.

Such a center would operate in the highest academic tradition and would supplement the activities of Oregon's universities. It would work at the post-doctoral level in highly specialized fields. It could start in a single basic specialty in which it would seek to gain national and perhaps world eminence. It would expand as funds and staff become available. In time it might attain in its own field a rank comparable to that of the famed Institute for Advanced Study at Princeton, N.J., where Albert Einstein, Arnold Toynbee and other scientists and scholars of greatest eminence have made outstanding contributions to knowledge.

A Center for Advanced Study and Research would have importance to the Portland area far greater than might be indicated by size alone. For one thing, such a Center would help establish Portland's position as a leader in science and science-based industries. Both the full-time and part-time staff at the Center would be available here for consultation in their specialties and also for conducting graduate courses and guiding graduate program development.

From the Portland Center would also come a stream of new scientific knowledge which, with applied research and product development elsewhere in the area would lead to new products and new science-based manufacturing.

A further advantage for the Portland area would be the training that the Center would provide for those engaged in its scientific exploration. Persons thus trained would go on to careers in three main fields:

- (1) pure and applied research, as, for example, medical and industrial research institutes and research attached to manufacturing;
- (2) teaching at institutions of higher learning, and
- (3) government service requiring outstanding talent and training, such as the National Aeronautics and Space Administration (NASA).

## Administration and Finance

For maximum effectiveness a Center for Advanced Study and Research in bio-physics and bio-engineering would be under independent auspices and administration, but it would necessarily work in close cooperation with Oregon universities and research organizations. It would require its own laboratories and facilities. Its financing would be by private funds, not public; its sources for continuing support would include primarily national foundations and federal agencies.

For its formation the Center would depend on funds from local corporations and individuals. Later additional funds from these sources would accelerate the Center's growth. Your Committee believes that such support will be forthcoming. Further, this project fits closely to the essential proposal of the SENT II committee. **The backing of the SENT II trustees now would go a long way toward making the Center for Advanced Study and Research at Portland a reality.**



## VII. INDUSTRIAL RESEARCH INSTITUTE

Creation of one or more privately supported industrial research institutes is the third major step in development of science and science-based industry in the Portland area. It would round out the program of which the first two steps are a publicly supported university of first rank and a privately supported Center for Advanced Study and Research.

### The Specialized Needs of Industry

Industry requires research focussed on its particular activities—on the development of improved processes and toward new products that can lead to growth.

More research is being undertaken by manufacturers in the Portland area than ever before. But this is not enough in an age of rapid scientific development and of extremely sharp industrial competition.

Your Committee believes that for Portland to grow in science-based manufacturing there must be established one or more industrial research institutes, working in advanced fields in which no one manufacturer can afford to undertake research alone.

Such an institute would provide a bridge between scientific exploration on the frontiers of knowledge and the day-to-day needs of industry. The institute would bring new scientific knowledge to economic fulfillment in the shortest possible time and thereby lead to new and expanding manufacturing and other industry.

A research institute would have a staff capable of working over a wide range of activities. At times it might be doing fundamental research, but more often its emphasis would be on applied research and development. Its findings would be open and published. Local industries, working closely with the institute, would have first access to its research for development of their own products.

### Concentration on Salients

For most effective results a research institute would concentrate in special fields or salients. Each salient would capitalize on the research, raw materials, manufacturing skills, and other resources of this area. By this concentration, even a small organization can mount a strong enough effort to make its work and this region preeminent. National recognition, in turn, would help draw top men to the region.

For greater effectiveness, the salients should tie in closely with the fundamental research in bio-physics and bio-engineering of the proposed Center for Advanced Study and Research.

The concept that better knowledge of biological phenomena can help solve industrial and engineering problems has already animated industrial research. As an example, fundamental research in Germany on how a particular species of beetle reacts to changes in optical stimulation led to the design of a ground-speed indicator for aircraft, which operates like the beetle's eye.

Studies at the Rockefeller Institute on inhibitory influences in the eye of the horseshoe crab resulted in an electronic eye that sharpens contrast and might be applicable in military target or character-recognition systems.

Some forms of life exhibit fantastic sensitivities compared to man-made systems. The noctuid moth, whose ear contains only three nerve fibers, detects the high-frequency sonar of its enemy, the bat. One species of fish can sense the change in an electric field of 1/3000 microvolt per centimeter. The rattlesnake has an infra-red sensing organ between its nostril and eye that responds to a temperature change of its surface of 0.001 degree Centigrade.

A decade ago these facts might have carried no more than passing interest to an engineer. But today, biology, physical science and engineering are coming together and in their combinations offer an unlimited potential for research and development.

One salient in which the Portland area already has an important start is electron-beam technology, also called electron optics. This is a fast-developing field of science in which a vigorous newcomer can concentrate and achieve a position of national and perhaps world eminence. Applications of knowledge in electron optics range from new processes for hardening metals to new tools for medical and biological research.

Some of the exotic metals so essential in space exploration and nuclear activity—zirconium, tantalum, hafnium, columbium and others—are extremely difficult to work and require high-vacuum techniques and electron-beam welding. Electron-beam welders and furnaces are already manufactured in Portland. An important body of knowledge in these metals and in special alloys already has been developed by Portland and Albany manufacturers and by the U.S. Bureau of Mines Laboratory at Albany. Related studies are being conducted at a high-temperature metals laboratory recently established in the Portland area.

Another salient with substantial research under way is silvichemicals, which seeks to derive from wood a wide range of chemicals useful as raw materials in manufacture. Georgia-Pacific, Crown Zellerbach, Weyerhaeuser and state and federal agencies are all active in wood chemistry in the Portland area.

## Organized and Supported by Industry

The purpose of an industrial research institute is to help industry—either through improvement of industrial processes or through creation of new or improved products. Even when such an institute is undertaking pure fundamental research, its ultimate objective still will be to meet the needs of industry, and its fields for research will be chosen with this in mind.

Because of these close ties to industry, we believe that an industrial research institute should be organized, controlled and financed by business firms, not by public agencies.

One industrial research institute is now forming under guidance of a group of Portland businessmen and scientists. It will specialize initially in electron-beam technology. We hope that industry-oriented research will be furthered by creation of additional industrial research facilities and their generous support, even though direct benefits will never be evident at the outset.

## VIII. SUMMARY

**Portland has reached a crossroads.** For a century the economy of Oregon and of its industrial and financial capital, Portland, has depended primarily on timber and agriculture. More recently tourism has come along, but it is still small in the total. At the end of a century the state's resources in timber and agriculture have been well developed; in the decades ahead they cannot support the inevitable broad expansion in population or a hoped-for healthy growth in the economy.

What other resources can Oregon and Portland develop?

We believe that the answer lies with science and science-based industry, in the fostering of scientific exploration and in the development and manufacture of new products that grow out of such exploration. This is not idle speculation. Already clusters of industry are growing up around centers of science. The classic example is metropolitan Boston, where today the largest manufacturer in New England is an electronics firm.<sup>(6)</sup>

Development of science-based industry is not easy. Competition is severe. Advantages offered in other sections of the country are notable. Portland's start is late, but it has certain advantages. Portland has much the largest employment in electronics in the Pacific Northwest, though the total is trifling in comparison with California. Portland also has skilled labor in metals, metal-working, and machinery. And it has the climate and countryside where thousands of families in less-favored parts of the country would love to live.

Now Portland must add to these assets the missing ingredients that can build a metropolitan center for an era of science! A first-rank university with graduate education and academic research; a center for advanced study and research; and one or more industrial research institutes that will translate new scientific knowledge into the products of industry. Manufacturers will go on from there to create the jobs and the payrolls which Portland and Oregon so urgently need.

Happily, by the nature of these activities, we can create more jobs and new wealth without losing the priceless asset of natural beauty that helps make this part of the country so worth living in.

### A Waiting Opportunity

Portland, as a late starter, cannot hope to match areas like San Francisco, Los Angeles and Boston in those special areas within the fields of electronics and other science-based industries which those centers have already built up.

But new specialties are opening up, and here a newcomer can be as effective as the older centers.

In one big new area of science, the interaction between the physical sciences and the life sciences, Portland has a good start in research and in industry. If Portland moves rapidly and with determination, it can establish itself as a leader in the nation in bio-physics. As one scientist now working in this field remarks: For Portland this is an opportunity that may not happen again for 30 years.

6. Raytheon Co., 33,000 employees, as reported in Science Magazine, March, 1962.

## Critical Mass

Advances in science and technology grow not so much from isolated efforts as from the assembling of scientists, industrial capability, and capital in what might be regarded as a critical mass, comparable to the critical mass which sustains a chain reaction in atomic fission.

The combination brings together able minds working in close proximity in a related effort. The activities encompass the entire spectrum of science and technology, from one extreme in fundamental research to manufacture of new products at the other extreme. Frequently the by-products of advanced research become the raw materials for an industrial research institute or of a science-based manufacturer.

The propinquity that brings educators, scientists and businessmen together in related work in a metropolitan area makes possible a continual easy stream of informal and unplanned exchanges, visits, conversations and ideas.

What counts is bringing together all the productive elements—from academic research to manufacturing—in one area. Neither academic research alone, nor manufacturing alone can create the growth we seek. Note that the University of Illinois, long eminent in physics and chemistry, is located in a rural area and has never spawned a cluster of science-based industries. The same is true of numerous other universities such as Purdue and Pennsylvania State, which are located in rural areas untouched by manufacturing. This is why it is so desirable that a full university be located in Portland.

We repeat: Portland has reached a crossroads. The turn it takes will determine the place Oregon will take as America moves into the new and expanding era of science and technology. Can Portland establish itself as one of the nation's centers for science and science-based industry? Or will Portland sink into the economic backwash, a secondary city by-passed by the vibrant new force for growth in the economy?

Will Portland be able to retain its gifted young people, or will it continue to export its ablest men and women to other parts of the country for their graduate education and professional work?

Your Committee believes that Portland has the vision, the will, and the ability to seize the opportunity and move ahead.

## IX. CONCLUSIONS AND RECOMMENDATIONS

### A. Graduate Education and a University

#### CONCLUSION

Your Committee concludes that Portland needs a first-rank university with full graduate curricula as quickly as possible.

#### RECOMMENDATION

Therefore, your Committee recommends:

1. that the State Board of Higher Education immediately authorize Portland State College to add graduate studies as rapidly as faculty and facilities permit and bring Portland State to a full university rank as soon as feasible.
2. that after authorization for university status for Portland State College has been granted, civic leaders including those who obtained funds and expert assistance for the Portland High School Curriculum Study seek similar support for the development of higher education in Oregon to aid in the transition from its primarily agricultural economy to one building more on science-based industry.

### B. Center for Advanced Study and Research

#### CONCLUSION

Your Committee concludes that the Portland area has an opportunity to establish itself as one of the nation's centers for science and science-based industry in bio-physics and bio-engineering. Building on existing metropolitan Portland activities in this interfacing field could produce the "critical mass" of talent needed for major breakthroughs and substantial achievement at levels of excellence which will contribute to the advancement of knowledge and understanding. Portland's present unique nucleus must be supported and expanded immediately if it hopes to achieve top rank.

#### RECOMMENDATION

Therefore, your Committee recommends:

3. that there be established in the Portland metropolitan area a privately-supported center for advanced study and research at the post-doctoral level to further integrate physical sciences, engineering, and mathematics with the life sciences—medicine, biology and medical psychology;
4. that financial support for this center be sought locally, regionally, and nationally.

### C. Industrial Research

#### CONCLUSION

Your Committee concludes that the national economy is undergoing a radical and fundamental shift to increased industrial dependence on excellence in engineering, science and mathematics. To further develop, expand and diversify the economic base of Oregon, an urgent need exists for the establishment in metropolitan Portland of one or more privately-supported facilities for industrial research.

**RECOMMENDATION**

Therefore, your Committee recommends:

5. the sponsorship and financing by private enterprise of one or more industrial research institutes in metropolitan Portland;
6. greater coordination among the local, state, and national elected representatives, the scientists and educators, and the businessmen and industrialists of this area, for the purpose of
  - a. obtaining funds from diverse sources for education and research in Portland, and
  - b. utilizing this education and research to achieve greater productivity in more fields, and to get more contracts and jobs for Portland and Oregon.

**IMPLEMENTATION**

These three things—a first-rank public university offering full graduate curricula; a post-doctoral center concentrating the physical sciences, mathematics and engineering upon the life sciences; an industrial research institute, and the resulting contributions to the intellectual and material growth of the region—can occur in Portland through the cooperation of educators, engineers, scientists, and businessmen.

**RECOMMENDATION**

Therefore, your Committee recommends:

7. that management of private enterprises, educational institutions and government agencies in metropolitan Portland ascertain which graduate courses will benefit their employees; and support those courses, as they are established, with released time and financial assistance to employees who engage in these studies;
8. that enlightened individuals and organizations endow academic chairs and provide buildings and funds for orderly development of the graduate education and university program for Portland; and
9. that industrialists, educators and scientists initiate efforts and seek out areas in which they may cooperate in research and the expansion of economic opportunity.

Respectfully submitted,

Dr. E. Dean Anderson  
John C. Buker  
Samuel L. Diack, M.D.  
Dr. Frank L. Griffin  
Carl M. Saltveit  
Judge Herbert M. Schwab  
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Robert H. Tarr, *Chairman*

Approved March 26, 1963 by the Research Board for transmittal to the Board of Governors.

Received by the Board of Governors April 1, 1963 and ordered printed and submitted to the membership for discussion and action.

## APPENDIX I

**TESTIMONY PRESENTED TO SENATE EDUCATION COMMITTEE  
CONCERNING SENATE JOINT RESOLUTION 8**

by

**HARRY J. WHITE, Executive Officer  
Department of Applied Science  
Portland State College**

My remarks pertain primarily to the fields of science and technology, to the interactions of these with modern industry, and to the vital significance of these to the Portland metropolitan area.

**1. Growth of Science and Technology.**

The rapid growth of science and technology is a central fact of today's world. Estimates made by qualified authorities place the growth rate at about 10 percent per year, or a doubling every 10 years. This avalanche of scientific knowledge and applications has both its good and bad aspects, but its impact on all of us is inescapable.

Nuclear energy has revolutionized defense strategy, but also promises vast quantities of electric power and other civilian benefits; electronics has become one of the nation's largest industries; high-speed computers are literally revolutionizing engineering practices, business data processing, and even mathematics itself.

It is apparent that no state or area can expect to maintain continuing prosperity without taking part in the contributing to these scientific and technical achievements to a substantial degree. An indication of Oregon's standing in this vital matter is the fact that with one percent of the nation's population, it has been receiving only one-tenth of one percent of the federal contracts in the highly technical defense industry.

**2. Changing Patterns of Education in Science and Technology.**

In pure science and mathematics, graduate education through at least the master's level and more often through the doctorate has long been a prerequisite for advanced work in these fields. However, in the applied areas of science it is only recently that the necessity for graduate education has become apparent. This has come about because the geometric growth of sciences has not only produced burgeoning new applications, but also a corresponding obsolescence of technical knowledge and practices, estimated conservatively to be at least 5 percent per year. This means, for example, that a technical graduate of say ten years ago will by now have lost at least 50 percent of his effectiveness unless he has been able by various means to keep pace with new knowledge and developments. He is faced with the problem of keeping current in applied mathematics, physics and chemistry as well as in his own purely technical field.

In Portland this is extremely difficult because of the lack of graduate education. Elsewhere in the country it is becoming accepted practice for employers in advanced technical industries to encourage graduate study and advanced degrees through financial support and released time. Thus, graduate study is an essential part of the science-based industry environment. Portland's inability to fill this need undoubtedly accounts in part for the paucity of defense contracts received by Oregon. Furthermore, this lack forces the top students to leave the area to complete their education, after which they seldom return—thus representing a critical loss of what might have been a prime resource.

**3. Needs for Graduate Education in the Portland Metropolitan area.**

The deficiencies and needs for graduate education and research in Portland have been affirmed and re-affirmed during the past several years by several committees and citizens groups who have studied the situation at length. These deficiencies cover virtually the entire spectrum of knowledge outside of the medical field. However, the most critical needs lie in the areas of science and technology because of the close relationship of these to industrial and economic development. Earliest requirements are for graduate courses and master's level programs in technical fields and the supporting sciences of mathematics, physics, and chemistry. Science-based industry does not happen by chance, but rather grows out of scientific research, development, and creative technology. It therefore flourishes best in a science-mathematics-technical environment. Really significant growth of modern science-based industry in Portland, with all of its implications for the entire state of Oregon, cannot be expected until these needs are met.

## APPENDIX II

**STATEMENT PREPARED FOR THE SENATE EDUCATION COMMITTEE  
CONCERNING SENATE JOINT RESOLUTION 8  
(emphasis supplied by your committee)**

by

**BRANFORD P. MILLAR, President  
Portland State College  
February 12, 1963**

. . . We are all aware that in the last 20 years or so an industrial revolution has taken place, involving science-based industries which have a remarkable dependence on advanced study and research. These industries have concentrated in areas where the production of university research and graduate students is high, and this is not accidental. These industries

have had an extraordinary economic and social impact on these areas. Gradually, as TIME magazine has said (August 10, 1962, pp. 9-10), other areas which have been losing ground are getting the message.

Portland is one such area and is increasingly aware of the urgency. It has such industries in very limited degree, and little of the graduate education necessary to mount and sustain them. It is among these areas which TIME refers to as the "have-nots" in terms of present activity, capacity, and potential. Measured any way I know of, it has developed as yet comparatively little of such business and industrial activity, and acquired few defense contracts and little of the \$15 billion current annual expenditures on research and development which a recent issue of NEWSWEEK describes as being laid out for military or civil activities.

#### **Sense of Urgency**

During the last year, I have talked extensively with Portlanders in business and industry and with other Oregonians in public and private capacities. I observe among them an **increasing sense of urgency about new technological industries and the graduate education which supply the basis for the area's economic growth and future life.** You know the Governor's SENT committee and his special committee on graduate study and research in the Portland area, of which I was a member. There has been an increasing investment in research on the part of individual firms.

More and more concern is expressed about the advanced aspects of higher education, including serious consideration of investment of private and industrial funds in a graduate research center, because of a knowledge that putting funds in education and research is not a factor of consumption but of fundamental investment for economic growth.

It is rightly maintained that Portland is in short supply of graduate study and research, uniquely so for its size. There is a remarkable dearth of such resources at the very point in the State where now they are needed in greatest supply. The single exception to the deficit is in the medical-biological fields. For an example, the recent economic study of Oregon made by Hubert J. Soher Co. (incidentally a California group) for Pacific Power and Light Company, reports \$31 million of research projects underway in the State System of Higher Education, of which \$7½ million are at the University of Oregon, \$6½ million at Oregon State University, whereas in Portland \$278,000 at Portland and \$14½ million at the Medical School. The latter two figures indicate what is not going on for lack of resources in the System at Portland in all areas except medicine; and by contrast, what is going on in medicine and at the Universities gives some indication of what would be available in other fields if resources were available in Portland.

#### **Starvation Diet.**

**There is clearly a starvation diet in almost all of the fields upon which a metropolitan area these days depends so heavily.** Let me pose the question, what it would be like if other fields were as adequately represented as medicine, in terms of teaching, research, training and retraining of personnel, development and utilization of new knowledge, interchange of persons and processes in basic and applied scientific and professional fields, the spawning of entrepreneurs in new and specialized businesses, and the whole climate of inquiry and development. Portland would be on the mainline of certain essential activities, as it is not now. And even now the medical studies are without adequate support in the basic sciences.

#### **Neither a "Program" nor requisite quality**

The Senate Resolution which you are considering directs the State Board of Higher Education to establish a quality program of graduate education in the arts and sciences in the Portland area.

**Let it be clear that there is now hardly a "program" in any real sense of the word, nor is there "quality" in what is being offered.** Until fairly recently, apparently the need was not felt, but such circumstances as I have previously mentioned have greatly altered the criteria for need. Aside from medicine, and the newly established School of Social Work, the State System offers no graduate work on a full-support basis, with the full-time faculty, adequate facilities, library, equipment, and the close contact with students required for quality work at this level. As a substitute, there are numerous extension courses, and some complete programs offered through the General Extension Division on a nearly self-supporting basis.

**The Extension Division has done great service to the area, but it is neither budgeted for fully mounted instructional services nor can it provide facilities beyond those of Portland State, which are in many ways substandard for undergraduate work.** And unfortunately the illusion may prevail that the most pressing needs of the area are somehow being met at bargain-basement rates.

#### **Proposed Cooperative Center**

There may be some feeling that the proposed new cooperative center for graduate study and research may meet the needs of the Portland area and thus avoid the need for development of System programs. The proposers of the Center, however, did not make this assumption. On the contrary, they assumed the presence in Portland of strong graduate programs. The cooperative center requires graduate schools to cooperate with: faculties, institutional resources, and even basic accreditation and degree-granting authority. Though administratively independent, it is greatly dependent on private and public institutions and programs, existing and to be developed. Senate Regulation 8 rightly describes the proposed Center as not a substitute for but complementary to the development of the System. It must be observed, also, that the thinking about the Center has focussed largely around scientific and technological fields, whereas the needs of the area are by no means so restricted.

#### **Combination of Resources**

There have been suggestions from some quarters that graduate work by the System in Portland could best be accomplished by the unilateral development of Portland State College. It is true that the College provides the major accumulation of resources of the System in Portland (aside from medicine and dentistry) and that these resources constitute the most likely and economical base for the wide range of studies in all major fields in the area. It is true that a superstructure of graduate study seems to require a basic undergraduate structure, a solid institutional base on which to build. Therefore, while the College and its developing resources would quite naturally be expected to play a part in the development of public graduate work, it is not necessary to assume that its role be an exclusive one.



The universities have long experience, specialized staff, resources, and institutional "know-how" which can in cooperation with the College contribute much to the area and doubtless permit more rapid response to the needs. Moreover, they will themselves profit by opportunities to be involved in many fields in a major metropolitan complex.

I take it that the combined strength of several institutions is greater than that of one, and that the combined utilization of resources and the avoidance of unnecessary duplication are desirable objectives. The State System's Council for the coordination of graduate work in the Portland area, which has been in being for a year, so far has been studying the present situation and is or soon will be at a stage where it can move to plan for coordinated action as desired by the Resolution under consideration.

#### **State System the only basis**

It seems to me apparent that the State System provides the only basis in the Portland area for developing, at such a rate as seems necessary and economically feasible, the wide range or span of graduate studies and research required by a metropolitan area, simply because the private colleges, whatever their considerable strengths, are limited in the scope of activities they may undertake.

Moreover, on a national scale, private resources are becoming inadequate to carry the burden of extensive graduate programs at a level requisite to essential needs; public support has been required to bear the load, and in Oregon it would appear that the State, despite the many demands on it, will remain the major source of support of sufficient magnitude to make the investments which seem so vital to our economy and society.

#### **Other deficiencies than in science alone**

In this connection, in our concern for scientific and technological development, we realize that this is not the only essential to a healthy condition, nor the only one requiring advanced study and research. In a metropolitan area of this size and complexity, there are important needs for highly developed studies in business administration, public administration, urban affairs, the related social sciences and professional fields—not to overlook teacher training, upon which we depend so heavily for our future. And for the latter, we must cover all the fields in which knowledge and students must be nurtured.

In this respect, there is a serious deficiency in the Portland area, in that where there is the greatest concentration of teachers, there are relatively the least opportunities for their continued graduate training, so that at present Portland State College, a major teacher training institution, is the only one in the System which cannot offer the minimal post-Bachelor requirements for standard certificates as passed by the last legislature.

This brings me to my concluding point, that in order for a quality graduate program to be developed by the System, the basic resources of Portland State College will need to be shored up for whatever role the College takes and others can perform, since it is not possible to shore resources which don't exist. The College is the weakest in resources and support per student in the System, it is overtaxed for its present undergraduate commitments. The State Board's "B" budget requests for removal of some of the most glaring deficiencies at Portland State College would do much in this direction, as would also the "B" funds requested to begin Master of Arts and Master of Science in Teaching programs, planned since 1957, but not yet able to be supported.

I would respectfully request your attention to these requests as important steps toward the objective of providing the basic structure upon which a quality graduate program may be built.

I am grateful for the opportunity to indicate my support of Senate Resolution 8. In my judgment, the College and the System are now at the point where they can jointly plan and bring into action a significant beginning to a strong program of advanced study in an area which will be increasingly dependent on it.

### **APPENDIX III**

#### **THE PLACE OF THE UNIVERSITY IN THE GROWTH OF A COMMUNITY**

From a talk by

**JESSE E. HOBSON, Ph. D.,**

**Industrial Consultant and formerly head of Stanford Research Institute, speaking at the Oregon State Legislators' Research Day at Salem, November 23, 1962:**

"The university, and especially the graduate school and the institute of advance studies, is emerging as an important and necessary nucleus for industrial and economic development . . . Our society becomes ever more intellectual and sophisticated; our business and industry ever more directly related to scientific and technological developments coming from the university laboratories and through the skills of highly trained men and women . . .

"Suddenly brainpower becomes the all-important force for the development or survival of industry and business. Suddenly brainpower becomes our greatest natural resource; and the greatest resource available to a state, a region or a community for economic health and for economic growth. The university and its undergraduate, graduate, and post-doctoral schools supply the highly trained men and women; the scientific, humanistic and artistic knowledge and skills; the basic facts, and the creative ideas which are now the life blood of business and industry.

"The university has suddenly become a community's greatest asset, more important than water resources, transportation, raw materials, labor supply, capital or management to economic and social health . . .

"We are rapidly changing from an economy based on agriculture, mining, gas and oil to an economy based on technologically based manufacturing and processing industries . . .

"Industry must be able to attract, to hold, to stimulate, to upgrade and update competent brainpower. We are rapidly learning that this means a nearby university as a necessary condition for industrial development and growth, and for adequate employment opportunities, and for economic health.

"People, companies, industries, and especially engineers and scientists are extremely mobile these days. They will go where creative opportunity exists and where there is a stimulating and an effective environment. Today, that means they will go to centers of research and education . . .

"For more than 100 years science and technology have guided the destiny of man in his economic, social and political life even though we only now begin to see the pervasive significance of scientific development. Scientific discovery is replacing geographical exploration and war in the expansion of a nation's economic resources and the improvement of its economic life. Scientific strength, scientific resources and scientific creativity—science itself—is becoming the chief instrument of national policy."

## APPENDIX IV

### MEETING MANPOWER NEEDS IN SCIENCE AND TECHNOLOGY

From "Report Number One: Graduate Training in Engineering, Mathematics, And Physical Sciences,"  
a report of The President's Science Advisory Committee, December 1962.

"In seeking to meet its varied commitments and responsibilities, the Nation depends on specialists in many fields. These include the biological, medical, social and agricultural sciences, mathematics, the physical sciences, and all branches of engineering.

"Each field makes essential contributions to our society. But today's technological challenges put heaviest demands upon engineering, mathematics, and the physical sciences, designated in this report as EMP.

"These fields, EMP, absorb:

- (a) the services of at least three out of four of all scientists and engineers in the Nation;
- (b) six out of seven Federal research and development dollars;
- (c) two out of three Federal dollars for research alone; and
- (d) the greatest portion of space and military expenditures for research and development.

"In addition, EMP fields provide the technical basis for most industrial aspects of worldwide economic competition.

"The expected marked increase in the number of EMP college graduates, together with the opportunity for increasing the percentage of those who continue on to graduate school, offers a unique opportunity for achieving an abrupt increase in EMP manpower at graduate levels, promptly, and without a diversion of bright people from other fields.

"Over the last several decades, the numbers of persons graduating from college, undertaking graduate study, or obtaining a Ph.D. have grown relatively steadily. Increasing efforts by all sectors of the Nation have been required to maintain this trend. In view of special needs for those highly trained in EMP disciplines, we believe that the time has come to do more—to take those steps necessary to accelerate and sustain even faster EMP growth. Accordingly, we recommend an immediate, vigorous national effort to increase graduate training in engineering, mathematics, and the physical sciences. Implementation of this program would increase the number of persons well trained for teaching and thus would add significantly to the capability of the colleges and scientific institutes to handle the anticipated increase in undergraduate students in the EMP areas, without lowering standards.

"The Committee urges the Nation to direct its efforts toward achievement of these four goals:

- "(1) Increase the number of doctor's degrees awarded each year in EMP to reach 7,500 in 1970.

"There were 2,000 doctorates in EMP awarded in 1950 and 3,000 in 1960. Attainment of 7,500 in 1970 is recommended as a necessary and achievable goal. Percentage increases are intended to be greater in engineering than in other EMP fields.

- "(2) Increase the number of students who complete a full year of graduate training in EMP to reach 30,000 during 1970.

"Achievement of this goal will expand the pool of graduate students from which the most promising ones can be selected for doctoral training; will permit a greater number of secondary school teachers of science and mathematics to deepen their knowledge of their subject by taking a year of graduate study; and will increase the number of persons who possess specialized training needed for the technical tasks that the Nation has undertaken.

- "(3) Encourage the strengthening of existing centers of excellence in EMP and develop new centers of educational excellence.

"A center of excellence, one that offers first-rate educational training, may comprise an entire institution, a department, a group of faculty, or one distinguished man.

"Until recently, the number of doctorates awarded in the sciences and engineering has been limited largely by the number of students motivated to pursue graduate study. Institutional capabilities have been ample to train all qualified students. However, if in coming years qualified and motivated students increase in number as we propose, they will exceed the present capacities of first-rate educational institutions. The availability of superior training will become the limiting factor unless present centers are expanded and unless new centers of excellence are developed.

"The first step in providing the required facilities consists in making more effective use of recognized centers of excellence and in encouraging and making possible their expansion. But this alone is not sufficient.

"The second step consists of recognizing and developing new centers of excellence.

- "(4) Promote wider geographic distribution of centers of educational excellence

"Existing centers of educational excellence in EMP are concentrated in relatively few geographic areas in the United States. In order to increase graduate enrollments in EMP, additional first-rate educational opportunities should be located in such a manner as to serve all geographic areas more effectively. Centers of excellence serving more regions and states would stimulate and

spread economic progress because, as recent experience has shown, new industry tends to concentrate around leading institutions of science and technology. In addition to enlarging the present programs, special arrangements will be required to assist areas of the country which now possess inadequate foundations for an effective graduate education program.

“. . . the recommended National program would provide:

- (1) adequate financial support for all full-time graduate students in EMP;
- (2) funds to cover the full costs of graduate education in EMP;
- (3) funds for physical facilities and equipment used; and
- (4) funds for developing new centers of educational excellence in EMP.

“While this program anticipates funds from Federal, state and private sources, the Committee urges the Federal Government to take the lead in establishing this program, to encourage its pursuit by all relevant segments of the Nation, and, through appropriately coordinated efforts of agencies concerned, to supply such funds as may be necessary to ensure its effectiveness in achieving the goals.

“In the development of additional centers of educational excellence, funds for construction would be set aside for special support of institutions that show great promise for achieving excellence. Similarly, a fraction of the funds for equipment, for cost of education, and for student support in the form of training grants would be allotted to the development of new centers of excellence. All grants would be awarded to institutions competitively, on the basis of demonstrated or potential ability to provide superior training in EMP; criteria for award on the basis of excellence must not be sacrificed to other considerations, and must be applied with fairness and impartiality to inspire general public confidence.”

## APPENDIX V

### THE CHANGING ROLE OF HIGHER EDUCATION IN AN AGE OF SCIENCE

Excerpted from an address

to the Portland Chamber of Commerce Members' Forum, February, 1963

by

**BRANFORD P. MILLAR**

President, Portland State College,

. . . . the role of higher education within our lifetime, and especially very recently. Without exaggeration, it may be stated that the principal aim of higher education until as recently as 25 or 30 yeears ago was to transmit knowledge to persons who could pretty much use it as received, with some adaptation, for the remainder of their lives. The discovery of new knowledge, though important, played a relatively minor role in the lives of students, scholars, and persons engaged in practical affairs. Those who went to college were so small a proportion of the 18-20 year olds—about 10-12%—as to constitute an elite of brains, wealth, or social position. The total national cost of higher education was \$483 million in 1930, as against over \$3 billion in 1960. There were relatively few professions requiring specialized knowledge beyond that available to the generally well-educated man. Remarkably enough, there existed neither widespread demand nor effective outlet for more specialized knowledge or for persons trained to this level.

The situation is very different now, due to several factors all interlocked.

**FIRST**, there has been and will continue to be a great increase in numbers of college students. The proportion of college-age youth in college has increased tenfold in 60 years, more than tripled in the last 30 years, to the extent of about 40% at present. When Oregon became a state, about one and one-half per cent of the youth were in college nationally! In Oregon while the college students have gone from 19,000 in 1956 to 32,000 at present, Portland State has gone from 3,000 to 5,800, which is almost the size of the University of Oregon in 1957-58, not counting another 6,000 or so who use the plant in the evening Extension courses. This increase in numbers comes from a population explosion compounded by a student explosion.

**SECOND**, at the same time there has been and will continue to be a great increase in the growth of knowledge in all fields, and a concomitant increase in the rapidity with which new knowledge can be applied to practical affairs. Correspondingly there is an increase in the levels and complexity of knowledge required by society in order to get its everyday business done as well as to push forward to new ways of doing business. There is a host of new specializations with practical professional application and an increasing demand in all areas for such practitioners. There is no commodity with a higher imperative than trained intelligence, and the investment in this by business, industry, the military and government is almost insatiable, to the extent that college teachers of science, for instance, are now a minority of the Ph.D.'s at work in science, whereas not long ago no one knew what else to do with them.

**THIRD**, the resultant obligation of higher education is a great increase in the diversity and complexity of our tasks, to train the many more people for the many more complicated tasks, to say nothing of providing the general education needed for an intelligent citizen, an education composed of traditional knowledge constantly subject to revisions and modifications as great within a few years now as used to occur in decades or centuries. Let it clearly be understood that rapid obsolescence is as great a problem in education, demanding as much continuing research and development, as in business and industry. A college that hasn't adapted to such changes is manufacturing buggy whips.

Out of these three situations there arise several plain and inescapable observations.

The first is that higher education is not today a matter of providing cultural advantages to a limited number of privileged individuals and professions. Higher education is of central importance to modern existence as it has never been before. In scientific and technologically based industries, for instance, there has been a revolution both in products and the manner of handling them which has stemmed largely from the disinterested scientific researches of the Universities and

is carried on by the people trained by the universities. There is no question but that such progress will continue, that we have just seen the beginning. Less and less will significant progress and change be wrought by the slow accumulation of practical experience and skill, or patient trial and error, but more and more by the application of highly abstract principles with immediate and far-reaching effects upon practical problems.

Second, not only will the tasks of advancement, frontiersmanship, and new-product development require highly trained elite specialists, but the ordinary, journeyman tasks, too, will require much specialized and up-to-date knowledge. The problem is not to educate highly the elite alone, but at the same time to educate in depth, as far down the scale of ability as is necessary in order that the tasks not only of research and development be properly manned but also the continuing tasks of production and distribution, so to speak. In fact it is apparent that what is needed is masses of people trained to the best of their ability far beyond the average attainment of previous generations and for tasks which already our generation—if it will be frank—doesn't altogether understand, and for other tasks we can hardly imagine. The question here, then, is not how **FEW** we can afford to educate, but how **MANY**.

Third, the rising needs **OF** higher education will continue to be pressing as the need **FOR** higher education and for increasing numbers of students goes on unabated. The tidal wave of students hasn't reached its peak yet, and will start to rise drastically in 1965, when the crop of post-war babies pours out of the high schools. College population in Oregon has doubled in 10 years, and with normal growth, especially with the addition of long-postponed community colleges, is expected to more than double again.

Fourth, the critical question for higher education, then, is whether quality education can be provided for so many students on so many fronts for so many essential purposes. Under any circumstances the task will be a difficult one, but it can be done on one condition, that the resources will be available. The doubling of the past ten years has been kept up with fairly well, but now we have fallen behind, and in order just to catch up we must budget for 35% more students in the State System of Higher Education alone. If the job of the next ten years is to be well done, there is no question but that funds of much greater magnitude will be needed, beginning now. There is no way of avoiding this—whatever is postponed will either be made up later or will result in a deterioration which will be no less real because it may not be visible when you are dealing with intangible products. It would be nicer if the problem could be licked by an increase of efficiency, by an automatic lowering of unit costs as volume increases.

We all know that the overall costs of some products and services have been significantly reduced over the years; we know equally well that some have not. I can assure you that colleges and universities in general, and in Oregon in particular, have never been operated as efficiently as they are now, if for no better reason than by sheer necessity, and they will continue to seek and attain this objective. Yet the simple fact is that as costs of goods and services to us generally rise, and as the tasks which we have to undertake are more and more sophisticated, the costs per student generally will continue to rise.

Education will economize, but it is not so expert at reversing the basic economic laws as some who seek to prescribe for it and cure it of its expensive habits.

Let it be clear, then, that the crisis we face now is in all respects not one of the moment, not merely a hurdle to jump over, but the crisis of facing a permanently altered situation of which, to recapitulate, the elements are: increased numbers of students, youth and adults; increased diversity and complexity of tasks necessarily undertaken by today's colleges and universities; and the increased dependence of all segments of business and society, individually and in the aggregate, on higher education.

The percentage of our Gross National Product devoted to higher education which has prevailed will no more be adequate in the future than the percentage devoted to research and development which earlier sufficed in industry. An area like this which does not have a broad investment in research and development is going to live on its past ways of doing business even as they give signs all around of failing to be sufficient for the future, and the circumstances nowadays are quite simply that a large investment in higher education is the essential base for the steady maintenance of research and development and the competencies required to carry on the newer and very sophisticated business and industrial economic, social, and governmental enterprises.

Whatever the circumstances of the past, a metropolitan area today and in the future requires the total range or continuum of education services. And I would stress again that we must get out of our heads the notion that we are merely talking benevolently about "good educational opportunities" for our youth as private individuals, not that as a humanist I underrate the importance of an informed, alert, sophisticated citizenry in this bewildering age. As I've tried to indicate, it is no longer realistic to look on higher education as a factor of consumption alone, but we should view it as a matter increasingly indispensable to the public interest, so that higher education is more accurately seen as an investment, as a factor of production. . . .

## APPENDIX VI

FIFTY-SECOND LEGISLATIVE ASSEMBLY—REGULAR SESSION

# Senate Joint Resolution 8

Introduced by Senator WILLNER and Senators FLEGEL, IRELAND, MONAGHAN, OVERHULSE and STADLER and Representatives ATIYEH, BACK, BATESON, DICKINSON, EYMANN, HAIGHT, HANSELL, KELSAY, KIRKPATRICK, McCLURE, MORGAN, MOSSER and WHELAN and read January 25, 1963

1 Whereas the Portland metropolitan area is the only major metro-  
2 politan area in the West which does not have a state university  
3 with a graduate school of arts and science; and

4 Whereas there is need for opportunities for excellent graduate  
5 education in Oregon for many students who are not able to take  
6 up residence in Eugene or Corvallis; and

7 Whereas excellent graduate education in the Portland metro-  
8 politan area will help attract new science-based industry and pay-  
9 rolls to our state and will make an essential contribution to the  
10 development of current business and industry; and

11 Whereas the Governor's advisory committee which recommended  
12 the new privately supported cooperative center for graduate edu-  
13 cation and advanced research has stressed that this institution is  
14 not a substitute for but should be complementary to the fullest  
15 development of the State System of Higher Education; now, there-  
16 fore,

17 *Be It Resolved by the Legislative Assembly of the State of Oregon:*

18 (1) The State Board of Higher Education shall establish a  
19 quality program of graduate education in the arts and sciences in  
20 the Portland metropolitan area.

1 (2) The State Board of Higher Education shall complete plans  
2 for such a program so that appropriate budgetary requests may be  
3 made for the 1965-1967 biennium.

## APPENDIX VII PERSONS INTERVIEWED

- Dr. W. E. Baird, Dean, University of Oregon Medical School  
 Dr. Lloyd Berkner, President, Graduate Research Center of the Southwest, Dallas, Texas  
 Dr. Vernon Cheldelin, Dean of Science, Oregon State University  
 Dr. John C. Declus, Professor of Chemistry, Oregon State University  
 Dr. Walter P. Dyke, President, Field Emission Corporation (1) Chairman; (2)  
 Dr. Arthur S. Flemming, President, University of Oregon (2)  
 Amby Frederick, Director, Medical Research Foundation, University of Oregon Medical School  
 The Honorable Mark O. Hatfield, Governor, State of Oregon  
 Dr. James H. Jensen, President, Oregon State University (2)  
 John B. Kenward, Director, Portland Development Commission  
 Dr. Roy E. Lieuallen, Chancellor, Oregon State System of Higher Education (2)  
 Dr. Lee Lusted, Professor of Engineering, Oregon State University; Professor of Radiology, University of Oregon Medical School; Senior Scientist, Oregon Primate Research Center  
 Dr. Branford P. Millar, President, Portland State College (2)  
 William R. Morrish, Assistant to the Publisher, The Oregonian (1)  
 Sterling P. Newberry, Electron-Optics Engineer and Physicist, General Electric Laboratories, Schenectady, N.Y.  
 Dr. Thurman S. Peterson, Chairman, Division of Science, Portland State College  
 Dr. Donald Pickering, then Director, Oregon Primate Research Center (1)  
 Gerard Piel, Publisher, **Scientific American**  
 Dr. Miles Romney, then Executive Director, Coordinating Council on Graduate Study, Oregon State System of Higher Education  
 Dr. Larry Schector, Professor of Physics, Oregon State University  
 Dr. Arthur F. Scott, Head, Department of Chemistry, Reed College (1)  
 Dr. Robert Lee Smith, Professor of Food Technology, Oregon State University  
 Richard H. Sullivan, President, Reed College (1); (2) Chairman  
 Dr. John M. Swarthout, Dean of Faculty, Portland State College  
 Dr. Rudy Thieleman, President, Sierra Metals Corporation  
 Howard Vollum, President, Tektronix (1); (2)  
 Dr. Harry J. White, Executive Officer, Dept. of Applied Science, Portland State College  
 (1) SENT I Committee  
 (2) SENT II Committee

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## APPENDIX IX

## THE KEY TO ESTABLISHMENT OF SCIENCE-BASED INDUSTRY IN OREGON

A summary prepared for Portland by

**STERLING P. NEWBERRY**

General Electric Co. Research Laboratory

Schenectady, N.Y.

October, 1962

It has already been decided wisely that development of science-based industry is the best choice for improving Oregon's economy and retaining her most gifted young people. The central problem is to determine the key steps necessary to develop this industry, and then determine how to accomplish these steps.

Most of the steps have already been identified. The need for graduate training is a good example. A graduate program trains people for the crucial jobs of technology, brings key people into the area, provides a source of new discoveries, and helps maintain contact with the new discoveries of the outside world.

Other steps identified include bringing outside sources of money into the economy, the wise use of investment capital to sponsor beginning businesses, and making full use of talents and organizations already available. One is especially impressed by the Medical School, the Primate Center, and the vigorous young industries already gaining strength. Almost all the key ingredients for success are already present.

Concurrently, several fortunate external circumstances have combined to create a very favorable climate for the entry of Oregon into technological eminence.

#### Electron Optics, a Field For New Manufacturers

There is a rapidly growing activity in electron optics and in solid-state electronics. The field of solid-state electronics is already overcrowded and should not be entered whimsically. The field of electron optics, on the contrary, is almost untouched in this country.

A great many manufacturers are trying to make electron optical hardware but they know very little about basic principles. The few well-trained people in electron optics in America are employed in groups which are not suited for small-volume specialized manufacturing required for electron optical business today. The group with specialized manufacturing skills who first gain technical leadership in this field will control most of the business. They will have an edge on systems business which contains electron optical components also. Eventually, manufacture of precision electron optical components and devices will become large-scale production, and this same group should be able to stay on top.

There is another reason why electron optics and also light optics are of interest. There are people in government, responsible for disbursement of government-sponsored research funds, who are very much concerned with the following circumstances:

1. The unfair proportion of taxpayers' research dollars which go to a few large centers because they have the only people and equipment to do the work. . . .
2. The extremely weak position this country has in . . . electron optics and the not-too-strong position in . . . light optics.
3. The rapidly evaporating backlog of fundamental discoveries from which practical developments can arise.
4. The large segments of our country which are not contributing to the technological economy. Oregon is particularly of interest to them because of the very intelligent potential work force and because circumstances are right for it to be lifted into technological orbit.

These people would be very pleased to see competence built in these fields and once it were in place, would fund research programs in Oregon. Such programs could become an important source of outside funds required to help support the community of outstanding specialists needed for success in the proposed expansion.

#### Other Opportunities for Portland

Many other areas of technological manufacture are attractive for Oregon. The opportunity for leadership in the field of bio-engineering has already been considered and is unquestionably a good direction for growth.

Portland is already world-famous for the quality of some of the specialized measuring equipment it manufactures; additional opportunities exist in this field.

The need for electronic aids in the classroom (so-called teaching machines, etc.) is opening up tremendous business potential. Strangely enough, very few of the businesses which are entering this new field are well coupled with educators. This coupling is essential both to insure a more useful product line and also to gain the respect of the teaching profession which will be the customers. Portland is in a very fortunate position of having an outstanding school system which is nationally recognized for its excellence. Proper use of this potential could assure success to a business group in educational aids.

Medical electronic instrumentation will eventually catch on, just as precision measurement has already become essential in industry. Here again, the government has realized the need to promote this activity and has sponsored an institute at Northwestern University. It is generally agreed that there is room for more effort in this field.

It must be realized that this is not yet a developed market but it is capable of development and the very process of development, because of outside support, can bring in extra funds. It is particularly interesting to Portland because it would take advantage of the already existing strength in the Medical School and perhaps the strength in the Primate Center.

### Need for Applied Research

Thus far we have discussed the natural advantages Portland has for excelling in development of science-based industry and the fortunate outside influences and opportunities which are available. Now let us consider what key steps are missing.

There are only two important steps missing. One of them, the establishment of graduate training in the area schools, has already been recognized. . . . However, graduate activity alone will not bring new industries into competitive strength nor provide opportunity for the young people it trains to stay at home in challenging occupations. What is needed is advanced, applied research on a sufficient scale to support continued technical growth of Portland industries.

Small industries cannot support sufficient applied research because they lack diversification and cannot, therefore, use most of the products of an advanced research group. On the other hand, a community of small industries can collectively use most of the output of an advanced research group and thus become competitive with large industry at a reasonable per-member cost in acquiring new technical knowledge. At the same time they hold on to the competitive advantage they enjoy because of their ability to move quickly into a new field.

The best way to manage a community research group is by establishment of a research institute. The idea of a research institute to support and expand a region's economy is not new. Some, like Midwest, are government-supported. Others, like Armour, depend upon project sponsorship. A few, like Franklin Institute, have lost their purpose and are supported chiefly by competing for government-developed contracts. None of them has realized the full potential of benefits for their sponsors because of the unimaginative and near-sighted charters under which they operate.

### Benefits to Expect

The institute should, if properly chartered, yield the following benefits:

1. Initially bring in a large number of winning product ideas already uncovered by the new people who must be brought in to staff the institute. This is only a temporary benefit but a very real one, which will build the economy while the long range benefits of the university graduate school and the institute gradually accrue.
2. Put together a hard core of outstanding industrial problem solvers and product innovators who can discover the technical opportunities very early and carry them from the university discovery to a practical state from which clever product laboratories in member industries can develop new products.
3. Provide outstanding consultants for the member industries.
4. Provide a buffer between commercialization and education which strengthens communication without impairing the academic freedom of the university and the student. Interestingly enough, the co-mingling of commercialism and education has been the chief cause of the weakness of one school which specialized in the field of light optics.
5. Operate a scientific information clearing house which could gather new technological information from every available source and put it into convenient form for the member groups. This could not only include an automated library of open literature but also information of the latest findings of leading world research centers gathered through personal contact and private communication.
6. Provide training of industrial staff members in the latest scientific techniques.
7. Make available very specialized manufacturing and research equipment such as a large digital computer and electron-beam welding equipment.

### A Non-Profit, Open Organization

The Institute should be a non-profit, non-secret organization whose knowledge and facilities are equally available to all member groups, and publication will gain more information from outside than can possibly be given away to competitors, providing Portland industries maintain their ability to move into new areas once technical people indicate that the time is ripe to move in.

The membership's advantage of proximity to the institute and advantage of in-service training in the details of a new process will give all the protection the members need to keep outsiders from stealing their developments and will permit their institute to be academically free to receive information from all academic sources and to benefit from all forms of non-profit support.

The problem of financing is the most critical. Once the scientific economy is rolling, financing will be simple. The member industries will find the research institute the best investment they have. The professional staff does not have to be large, in fact it is better if it is not. It will be extremely helpful if the non-profit feature permits it to be essentially tax-free. It will require generous housing space, best possible equipment and a large staff of supporting personnel to maintain and operate the equipment.

The question of how large an institute the present industry can support is a matter to be determined and this size should not be exceeded. It must, however, exceed a certain critical size to be of any great value. This critical size is approximately ten professional people and twice as many supporting staff. . . .

The longer the decision to establish outstanding competence in electron optics is put off, the greater the chance that someone else will take the ball and run with it. When an opportunity is ready, it usually does not go begging long. It may be another generation before a new field as ideally suited to Portland's abilities becomes available. If Portland has the courage to start this project and see it through, Portland cannot do else but win.

### Results Come Slowly

You would want to be sure that you realize how much and how long it takes for scientific work to pay off and the sometimes unforeseen and indirect manner in which the payoff comes about. . . .

1. The useful results of research work cannot generally be predicted ahead of time. The only people who should support a research laboratory are those who have sufficient product diversification to make use of almost every discovery it makes. One seldom solves the problem which he sets out to solve at the time he intends to solve it. . . .
2. Despite the unpredictable nature of the discoveries a laboratory needs direction and purpose. The men at the bench should have an active part in determining the direction and it should be subject to evolutionary change. I do not believe in isolating scientists in an ivory tower . . . They should have frequent down-to-earth contacts with practical problems, and



- should work to solve these problems . . . Contrary to popular belief, research people do not explore the byways frequently enough. They need constant encouragement and coaxing to explore side findings which are contrary to their preconceived ideas of what to expect. It is exploration of these byways which usually brings in the worthwhile discoveries, because they either represent something new in nature (a discovery) or a point in which our older ideas are wrong and are causing us to miss the boat technically. . . .
3. I believe the scientist should have periods of hiding out from the world. He is a problem solver much like the fabled Sherlock Holmes. . . The scientist must have frequent intervals in which he has no commitments to other people so he can have thinking time. . . .
  4. A scientist needs communication with and challenge from the rest of the staff. He needs opportunity for both formal and informal presentation of his work and problems to his co-workers, and frequent "bull session" on general scientific problems. The . . . process of explaining to a critical audience is very good in forcing him to clear his own thoughts.
  5. He needs continued long-range support. The scientist should not have to worry about either work or personal finances on a short term basis. He should feel that his salary is taken care of year by year and that his moral obligation is to make the best possible contributions with that time. . . .
  6. A research institute should be kept small enough so one does not have to keep salaries down or struggle to provide sufficient equipment. Scientists are usually too timid about purchasing equipment and if they have to spend time convincing others that the equipment is needed to give a top performance in their field, then they usually will try to get by on too little equipment. . . .
  7. I believe there are no difficult concepts in science; difficulties arise from inaccurate observations or inaccurate memory of past experiences, from inept nomenclature, from misunderstanding of the true identity of the problems to be solved, and from poor communications. . . .

## APPENDIX X

### GENERAL'S BATTALION

Editorial from  
**THE OREGONIAN**  
 April 2, 1963

The loss of Dr. Willard Spalding to California dramatizes a deplorable shortcoming in the Portland State College program.

Dr. Spalding, a former superintendent of Portland Public Schools and a nationally known educator, is chairman of the Division of Education at PSC. As such he has been a general confined to a battalion. He has been denied the resources to accomplish the most elemental purpose of his division: The education of teachers.

Oregon has adopted commendable new standards for teaching certificates, requiring a range of graduate study, and for the past five years Portland State College has been authorized to provide the required graduate program to include a master's degree in education. The program has been "authorized" but it has not been supported by appropriations. Frustrated, Dr. Spalding has chosen to leave the city he prefers as a home for California, which, as he notes pertinently, has "almost universal enthusiasm for improvement in schools—with funds available for it."

We sympathize with Oregon's legislators in their quest for new revenue. Be that as it may, it is a disgrace that, in all of the State System of Higher Education, Portland State College—in a metropolitan area that employs nearly half the state's teachers—is alone without a program of instruction adequate to meet the standards of the new teaching certificate.

## APPENDIX XI

Letter to the Editor  
**THE OREGONIAN**  
 April 14, 1963

from

**Willard B. Spalding**  
 Chairman, Division of Education  
 Portland State College

To the Editor: A copy of your editorial about my decision to accept a post in California and about Portland State College's deficiency in graduate programs for teachers has just reached me in Washington, D. C. where I am working on a small national committee studying standards for teacher education. Thank you for your kind words about me and especially for your strong suggestion that the Legislature appropriate funds for graduate education at Portland State.

It is true, as you quote, that previous Legislatures did not provide money to correct deficiencies at Portland State College. But the Board of Higher Education received a full report of these deficiencies in January, 1961, yet it did not act to remedy the situation. The board has consistently passed the responsibility for providing adequate higher education in the metropolitan area to the Legislature. When the Legislature failed to act, the board was not willing to use funds available to it to discharge its responsibilities more effectively.

If the Board of Higher Education persists in its unwillingness to remedy deficiencies at Portland State in the absence of substantial added appropriations by Legislature, the metropolitan area will continue to lack needed quality in higher education.