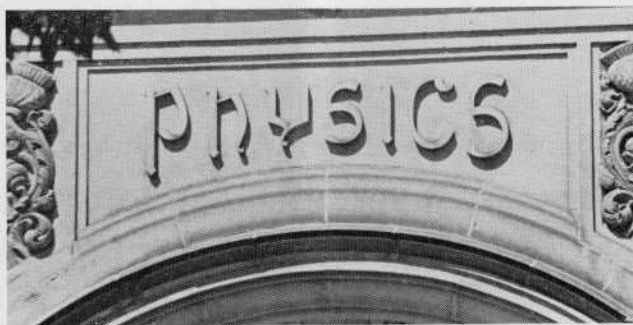


EMERGENT OKLAHOMA



In the second and concluding article about physics at the University, Dr. Richard G. Fowler, Research professor of physics, investigates the criteria by which departments are ranked and discusses the dilemma of being a late bloomer.

Part Two

By Dr. Richard G. Fowler

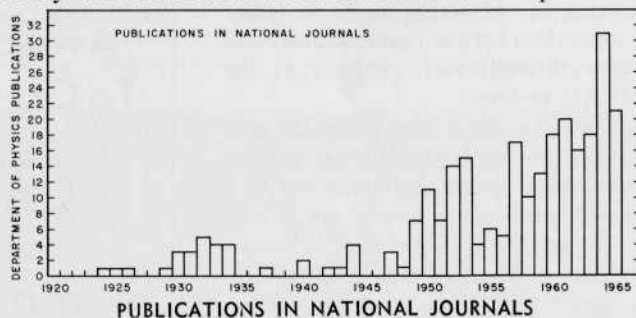
However much anyone might wish the contrary, recognition of universities is not won by the quality of their undergraduate product. It is won by their record of publication of non-trivial scholarly works, because it is faculty members in other schools who counsel "go to X university, young man, not Y, the faculty is better at X." In making this statement, hearsay evidence is largely used, and this in turn is based on publications the counselling party has heard of. Recognizing this state of affairs, there is, in an intellectually growing university, an acutely felt need for research and publication of that research. "Publish or perish" is a heart-rending slogan, recently much in the news and intended to describe the plight of persons who wish only to teach well and to do no research. More aptly, however, it describes the serious choice before universities, a substantial portion of whose faculties must publish lest their university perish by failing to deserve that proud name.

How then is Oklahoma coming along in this respect? Very well, the record shows. The first evidence came in 1955 when the Oak Ridge Institute made a survey of the publication records of the physics departments in the southern states bounded on the north by the Mason-Dixon line and on the west by New Mexico. Of these, 22 had significant numbers of publications. Totalling all publications prior to the war (1942), Oklahoma ranked 14th. If we look only at the post-war period (1947-55), Oklahoma had moved to 5th place. Encouraged by this showing, we ourselves enlarged the area of comparison in 1958 to include all state universities in our general geographic area. This included the South as before, and showed that Oklahoma had now moved up to 4th in the South, and even ranked 12th in the enlarged group of 60 studied.

PUBLICATION RANKING OF TOP FIVE SOUTHERN UNIVERSITIES

Pre-1942	1947-55	1958	1964
1 No. Carolina	Maryland	Maryland	Maryland
2 Rice	Duke	Texas	Texas
3 Virginia	Texas	Rice	Oklahoma
4 Catholic U.	Rice	Oklahoma	Duke
5 Tennessee	Oklahoma	Duke	Rice

In 1964 the OU physics department set something of a record, publishing more papers in one year than had been published up to 1947. On this basis we steeled our courage to ask where we stood with respect to all American universities, knowing full well that the east and west margins of the continent are studded with distinguished educational centers. Here OU's position was still 25th out of 95, but growth had taken place even in this six-year period. It was shown by two comparisons: first, with the same group that had been selected in 1958, where OU now ranked 10th, and second, with the group used in the Oak Ridge study, where the OU ranking was now 3rd. To reduce the job to a manageable one, at an investment of effort consistent with the vanity of asking the question anyway, the 1964 study was restricted to those schools which had published



more than four papers in 1958. This accounts for the lack of complete data in the 1964 column of the table comparing the southern universities. A look at the complete report on the schools examined in 1964 shows that the University of Oklahoma is now travelling in very fast company scholastically.

But, one asks at once, are all these physics publications any good? Here only time can tell. Working as it is, with scant funds and a skeleton staff, the department has so far been compelled to expect no Nobel prizes. On the other hand, its reprinted articles are being sent out to request lists which number in the hundreds, and in the course of the past five years these requests have come in from every scientifically active country in the world.

RAW RANK ORDER, 1964 PUBLICATIONS IN AMERICAN INSTITUTE OF PHYSICS JOURNALS

University	1964 Publications	University	1964 Publications	University	1964 Publications
U. California	88	Rochester	29	Rutgers	17
Illinois	78	Colorado	28	Iowa State	16
Stanford	53	Pittsburgh	27	New York State	15
Purdue	46	Princeton	27	Johns Hopkins	14
Cornell	45	Texas	26	Washington (St. Louis)	13
Columbia	44	Washington	25	Penn St.	11
Chicago	42	Northwestern	24	Indiana	9
MIT	42	Michigan	20	Kansas	9
Yale	41	Duke	19	Michigan State	9
Penn	40	Minnesota	19	Ohio State	9
Carnegie Tech	37	Oklahoma	19	Rice	9
UCLA	33	Brown	18	Iowa U.	8
Wisconsin	31	NYU	18	City College of New York	7
Harvard	30	Syracuse	18	Utah	7
Maryland	29	California Tech	17	Rensselaer	7

PAPERS PUBLISHED PER FACULTY MEMBER FOR ALL UNIVERSITIES PUBLISHING MORE THAN FIVE PAPERS

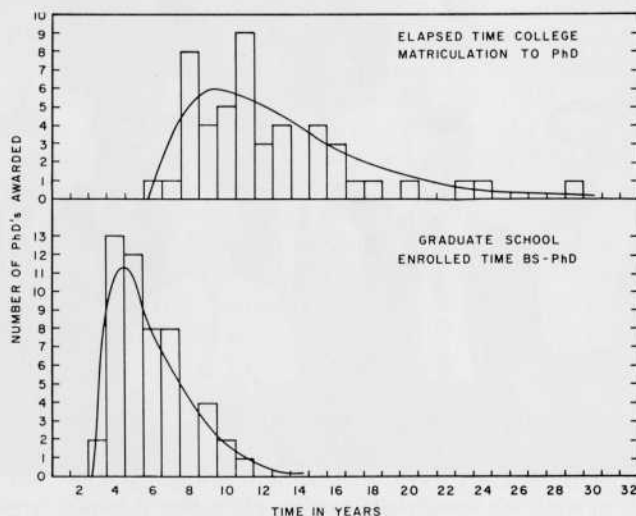
University	1964 Publications	University	1964 Publications	University	1964 Publications
Stanford	2.30	Northwestern	.92	Rice	.64
Illinois	1.47	Colorado	.87	NYU	.62
Oklahoma	1.46	Duke	.83	Cal Tech	.58
Texas	1.18	Penn	.83	Rochester	.58
Columbia	1.13	Johns Hopkins	.82	Minnesota	.56
Cornell	1.13	Wisconsin	.82	Washington	.54
California	1.05	Yale	.79	Indiana	.53
Carnegie Tech	1.05	Syracuse	.75	Kansas	.50
Harvard	1.03	Brown	.72	Princeton	.49
Chicago	1.00	Washington (St. Louis)	.68	MIT	.46
Purdue	1.00	Rutgers	.65	Michigan	.45
UCLA	.92				

The vigor of our small staff is no better exhibited than when one asks what the ratio of papers published is to physics professors working at the universities studied in 1964. Here we find the striking fact that only one university has a better record than Oklahoma's. However, this comparison distracts our attention from the true situation. Efficiently conducted research at a university is not a sport, recreation, or hobby of the faculty. It is the serious-yet-delightful, exhausting-yet-stimulating business of teaching others how to do research in the process of actually doing some. The graduate student is the essential element in university research, and his professor should be satisfied with finding one part of his own satisfaction in seeing the unfolding of true authority in the student as he becomes that man who has seen a little further than anyone else in some direction into the real unknown around us. The place of the professor is to maintain a steady pressure against the unknown as one generation of graduate students succeeds, to be aware of the chinks through which it may be worthwhile to peer, to provide reliable counsel and a wee bit of occasional sympathy.

What can be said about the students who have labored successfully in the OU vineyard of physics? How long has it taken them? How much time have they spent in their studies? Is the process of obtaining a degree taking longer these days, as we often hear, or shorter? We have made a study of our men and find that the average time elapsed between *matriculation as freshmen* and *receipt of an OU PhD degree* was 12¼ years, the modal time was 11 years, and the most probable time was 9⅔ years. The half of the students graduating in less than the modal time took an

average of a half year away from their studies, while those with more took an average of 5 years off.

It is the actual enrollment time in the graduate college which measures the cost of the education to the student and to society. The average time spent by OU students of physics was 5¾ years, the modal time was 5 years (exactly the same as the national modal time for PhDs in physics), and the most probable time was 3½ years. The half of the students graduating in less than the modal elapsed time from freshman to PhD spent 5 years enrolled. The half taking more of their lives to complete the degree spent 7 enrolled years. This corresponds to time wasted



ELAPSED TIME TOWARD A PH.D. AT OU

in re-acquiring forgotten knowledge. I think we can conclude that it is a clear loss of 2 years of a man's life to prolong his studies by an extensive working period, and society is certainly right to make sure that more persons can go directly through graduate school with public financial support.

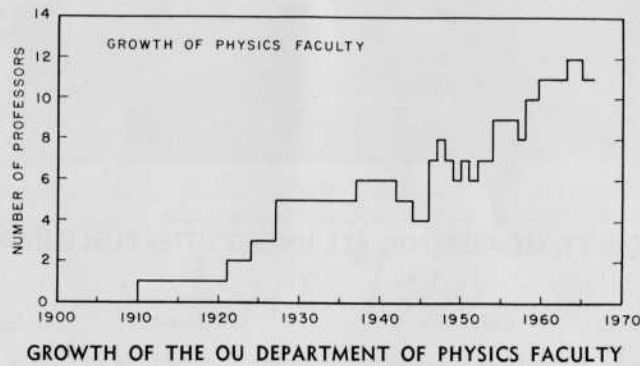
The curves drawn on the two graphs for time spent in obtaining a PhD degree show an interesting mathematical behavior which is highly suggestive to a physicist. (1) They have an onset threshold. This is caused largely by the rules of the university, and so is probably artificial. (2) Graduations increase in frequency proportional to the time enrolled beyond this threshold. This means that knowledge must really be acquired to achieve the degree, as everyone would expect, and this takes time. (3) Graduations also decrease in frequency exponentially. This last is the interesting point. Processes in nature which show this behavior are governed by chance, by accident. Since we do not as a faculty believe for a moment that we simply confer our degrees at random, it is curious to speculate on what the chance event is which serves to punctuate a graduate student's efforts. I suggest that it is the discovery of something new, the "contribution to knowledge" which all PhD programs are supposed to include, and which does not come with routine precision at the end of a three-year period.

To the frequently asked question, "Are graduate schools getting tougher—does it take more time to receive a PhD degree?", the physics staff at OU can say "no" with some pride. Dividing our graduates into three nearly equal groups, the group prior to 1947 averaged 6.6 years of grad-

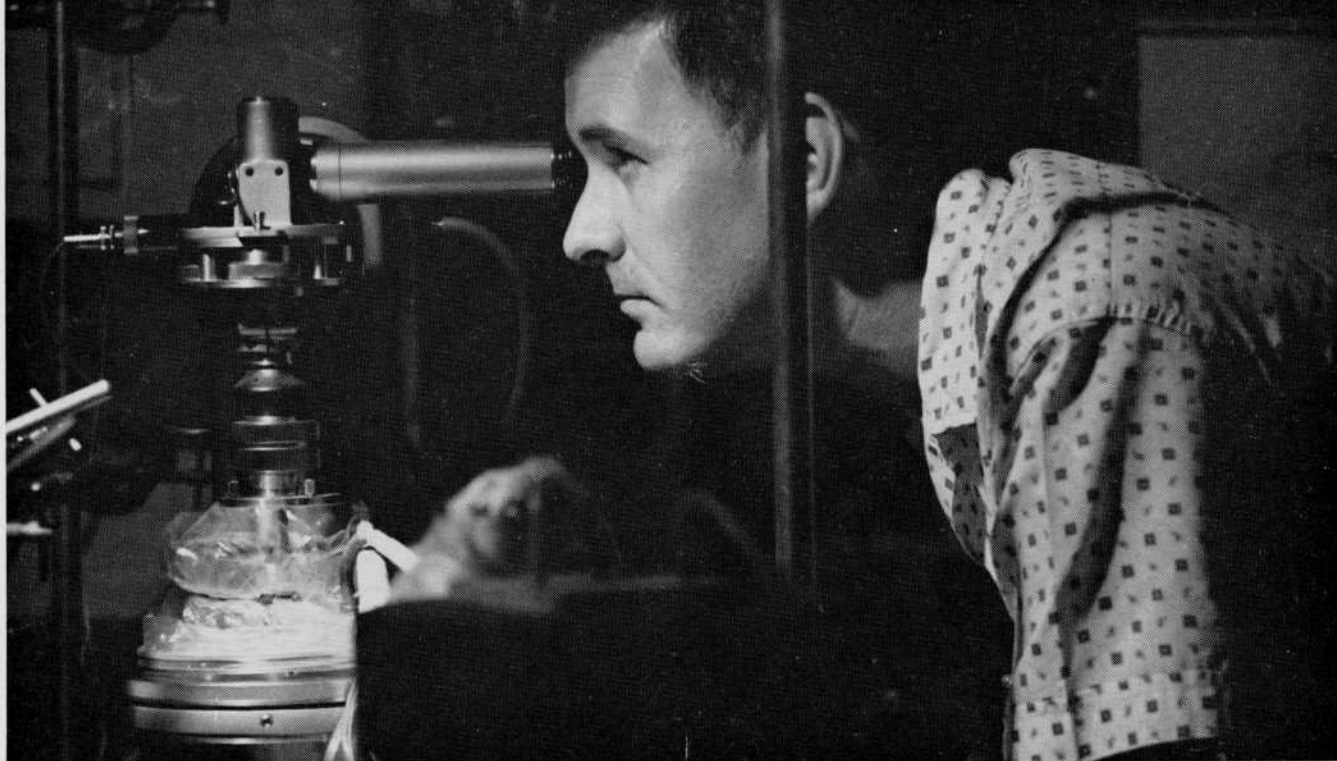
uate enrollment to receive their degrees, the group from 1954 to 1959 took 6.4 years, and the group from 1959 to 1964 took 6.0 years. The missing period from 1947 to 1954 was wholly anomalous in that the average was only 4.4 years. I think we can understand this peculiarity in terms of student backgrounds. This group was composed of highly motivated veterans with educational experience which did not show on their transcripts. They were also able to devote full attention to their studies because of

their GI benefits, while most students at other times can only give half their attention to their studies, and half goes to earning a living. In explaining the trend downward in time consumed in reaching the PhD degree, I would like to think that it is owing to the increased self-assurance of our staff, and the generally improved level of American PhD education which has fostered this self-assurance. Another

probable factor is the increasing availability of fellowship money. The reason that I tend to emphasize the factor of staff maturity is because among the seven staff members who have so far directed Oklahoma PhD theses in physics, the average elapsed time was 10 years between their own PhD degrees and their first student's degree. Owing to staff instability, the number of physics faculty with more than 10 years postdoctoral experience averaged only two in number even up to 1950. Since then it has risen at a rate of one man every two years to the present level of nine persons, and promises to continue rising. A university administration which desires to foster its graduate program must make every effort to enhance stability of a high quality staff, since of a man's 30-year working span, 10 years is normally without PhD productivity, and the



Men from seven countries are members of the physics faculty. Front row (l-r) are Dr. Jack Cohn, Dr. Richard Fowler, Louis Leistner, Dr. Robert Howard, Dr. John Canfield, Dr. Sybrand Broersma, Dr. S. J. B. Corrigan. Second row (l-r), Dr. Chun Lin, Dr. J. Rud Nielsen, Dr. James Burwell, Dr. Stanley Babb, Dr. Minouru Sumita, and at the rear are Dr. Ralph Parsons, Dr. Colin Plint and Dr. Robert St. John.



Much of the credit for supplying equipment essential for physics research goes to alumni contributions through the ADF, says Dr. Fowler.

next 10 years frequently shows only a slow rise, with the last 10 years as the period of maximum results.

Whatever the reason for this saving in student time, it is not because of any reduction in standards. *This* the growing publication rate attests, as do distinctions which have come to specific recent graduates. Thus, E. E. Ferguson was awarded a J. S. Guggenheim Fellowship, while W. Z. Osborne and N. F. Lane have received NSF Postdoctoral Fellowships, all for study abroad, and Lane was awarded a Joint Institute for Laboratory Astrophysics Fellowship as well. G. W. Paxton, T. M. Holzberlein, and William Sibley have been invited to present their researches before international conferences in Europe and Australia.

Finally we might inquire how the opportunities in our department look to the entering graduate student. What are his chances of progress toward various educational goals? I do not think the word "success" should be coupled to achieving the awards along the route. The education one departs from a college or university with at any level is itself the important aspect of success, and the stopping point chosen by each person is in large measure a compromise between the time he can afford to invest and the kinds and sizes of rewards he will be satisfied in life. Many students enter our graduate program who do not intend to remain for higher degrees. It is the estimate of the staff that slightly more than half of our entering graduate students are clearly capable of earning PhD degrees. In fact, only one in six does so. Half of the entering students spend only one year in graduate study. These are equally divided between those who might have achieved a PhD degree and those who probably wouldn't have done so. The remaining half will receive their MS degrees at least.

One reason for our relatively large attrition among students who could have gone all the way to a PhD is that more than half of them were our own undergraduates. In general it is not to a man's best interests to obtain all of his education from a single school, however good. Recognizing this, often upon our advice, many have left for other schools, or at least for other fields of graduate study.

It is here that our Johnny-come-lately status among graduate schools poses a most painful dilemma. It is all very well for mature graduate schools to talk about making sure that every student changes schools and to say that Oklahoma owes it to its best undergraduates to be sure that they turn up at Cal Tech and Columbia. This philosophy resulted 15 years ago in a self-perpetuating vicious circle (intentionally so designed I'll be bound) where good Oklahoma students were common at Harvard, let's say, but the best Harvard undergraduate had an absolutely zero probability of turning up at Oklahoma. Oklahoma was a class AAA farm club, a fat milch cow. In such an atmosphere, even good transfer students from small colleges found little competition and stimulation, and generally settled for MS degrees.

We attacked the circle by simply bringing Mahomet to the mountain instead of letting the mountain go to him. The real disadvantage to a student staying in the same environment is that he comes to learn the foibles of the staff and relaxes his own efforts. By a regular admixture of distinguished visiting professors we have kept our own students constantly facing these necessary new ideas and new standards over their entire career. The dividends this system has paid have been recited earlier in this article, and now the circle is beginning to fall apart and the probability of Antiquity University's best undergraduate turning up at Oklahoma is no longer precisely zero.

The department of physics is not without problems still. It needs additional staff to distribute the heavy work load carried by the present group, more space even for the present staff, and ever more equipment. In solving the last problem we all vote our sincere thanks to Oklahoma's generous alumni who have made a great many items available through the Alumni Development Fund, which could not be justified for inclusion when requesting federal research grants, but which were vital in securing such grants once they were on hand and in working order. It's great to be in a school that is headed up, because there's no place to go from the top except down.