

The Revolution in Higher Education

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I

In discussing the revolution that took place in American higher education between 1870 and 1910, it is impossible to meet the expectations created by the currently fashionable set of mind, which demands that the cultural situation be portrayed as constantly in a state of decline. One is obliged to report that this era was one of impressive achievement. We take for granted, as elements in our cultural inheritance, the existence of universities and an academic profession. But before the Civil War the United States had neither, in any respectable degree. They were created within one generation, in a country that previously had not much more than a scattered brood of small colleges in various stages of inanition.

To assess this academic revolution, it is necessary first to look at the old college without sentimentality or illusion. Troubled as we are by our present sense of educational failure, we may be too ready to imagine the old college to have been far better than it was. We think of the impersonality of so much contemporary college instruction, and long for that log with Mark Hopkins at one end and a student at the other; we think of the disorders of the modern curriculum, and long for the old classical course; we contemplate the half-literate products of many modern colleges, and long for graduates reared on Horace, Demosthenes, Cicero, and Tacitus. We tend to forget that the college that offered its undergraduates President Hopkins (himself on some counts intellectually retrograde) (1) offered them otherwise all too little; that the great writers of antiquity were commonly taught as exercises in grammar; and that students were frequently bored into disorderly reaction against the picayune discipline and unimaginative pedagogy of the old regime.

If the graduate of the old-time college sometimes turned out to be a well-educated man it was only in small part because of the contents of the college curriculum itself. Obsolescent mathematics, a smattering of science, and poorly taught classics no doubt had their disciplinary values; but whatever the typical old-time college student may have learned of modern literatures, including English, of modern languages (except in some colleges a little French), or of history or political economy came to him either through informal and

extracurricular sources or by virtue of some rare local accident. The status of history may serve to illustrate this curricular poverty. As late as 1884, even after leaders of the university movement had begun to overhaul the undergraduate colleges, Charles William Eliot pointed out that "the great majority of American colleges ... make no requirements in history for admission, and have no teacher of history whatever." (2) Nor can it be imagined that this was the case only with the inferior colleges; Eliot remarked that Dartmouth had no teacher of history-not so much as a temporary instructor and that Princeton had only one professor of history (who doubled in political science), as compared with three professors of Greek.

On occasion the old-time colleges were sentimentalized by their alumni; but rarely by their teachers or their presidents. Most of the serious literature of college reminiscence is a literature of complaint: the mordant criticisms of Harvard College in the 1850's that have been etched on the memories of countless readers by Henry Adams's *Education* were exaggerated and unfair; but they were no more than hyperbolic statements of what dozens of other graduates and many educators had to say of their schools. As to the educators themselves, one must of course remember that a large portion of the writing in their field has always been an expression of discontent; but when this allowance has been duly made, one is still impressed by the volume and the cogency of their criticisms. Outstanding pre-Civil War teachers and presidents - men like George Ticknor, Francis Wayland, Philip Lindsley, Henry P. Tappan, F. A. P. Barnard, and others - echo in their educational writings the reminiscent complaints of graduates and anticipate the tart critiques of later university-builders like Charles William Eliot, Andrew D. White, and Daniel Coit Gilman.

With the exception of a few so-called universities, feebly maintained by the states, the colleges of the old regime were creations of various religious denominations. Sectarian competition, compounded by local competition, had prevented the educational energies of the country from being concentrated in a limited number of institutions of adequate size and adequate sustenance. Instead, the country was dotted with tiny colleges, weakly founded; only one out of five created before the Civil War survived --- it is an incredible rate of failure. Those that did survive were frequently too small to be educationally effective; they lacked complexity; they lacked variety. We are too much tempted to think of the old college as being represented by the larger, better, and more famous institutions like Harvard, Yale, and Dartmouth, that had, by the 1850's, faculties ranging from fifteen to twenty-five officers and student bodies of from three to four hundred. But much smaller and more obscure and inefficient schools with faculties of six or eight and student bodies of 50 to 100

are far more typical of the 200-odd colleges of 1860, many of them inferior in quality to the best academies. Sectarian competition kept such institutions small and inadequate; the indifference of parents to good instruction, so long as their sons could emerge with degrees, made it unnecessary for these schools to do better than totter along from year to year. "What has heretofore been the idea of an University with us?" asked Longfellow. "The answer is a simple one: -- Two or three large brick buildings, - with a chapel, and a President to pray in it! (3) This was in 1829; a generation later the situation was but slightly changed, except in a few fortunate institutions.

Diversity of performance in the old-time college makes it difficult to make a universally fair appraisal of its work. Of course there were, as there always are, exceptional teachers with a gift for arousing the minds of the young. The classical curriculum, competently taught, could develop the capacity for work, instill a feeling for rhetoric, and inspire passion for learning. A not inconsiderable number of learned men came out of the old colleges, among them the leaders and scholars of the postwar university movement itself. The undergraduate literary and debating societies, whose libraries were often better and always more accessible than the college libraries made it possible for the self-education and the mutual education of the undergraduates, always one of the most fruitful aspects of college life, to be carried on to good effect. Sometimes the capstone course in moral philosophy, given to seniors by the college president, was a source of genuine intellectual illumination.

But in good part, the old-college classroom was a dreary place. The students were subjected to a curriculum which rarely gave them any choice of courses, hardly ever a choice of teachers. They were submitted to a teaching routine consisting almost entirely of tedious daily recitations, and governed in detail by disciplinary rules that were excessively demanding. Since their instructors were set over them as policemen, (4) outbursts of mutual hostility were a perennial motif. Term time was frequently punctuated by student riots, and putting the cow in the chapel was a standard college prank. In the atmosphere of tension and irritation created by rigid discipline and nagging boredom, the instructor who achieved an affectionate or inspiring relationship with his charges represented a triumph of personal kindness and ingenuity over poor institutional arrangements.

It was neither gratifying nor particularly useful to go to college. Earlier, in the latter half of the eighteenth century, the American colleges, still few in number, had done a bit to modernize their curricula, to put education into step with science and the thought of the Enlightenment, and to surmount the limitations

of sectarian control. Their achievements in educating the revolutionary generation had been considerable. But in the early decades of the nineteenth century, the excessive diffusion of the nation's educational resources and the tightening grip of the sects crippled the colleges' capacity for further advances. They became less and less related to the intellectual life of the country; or, after the rise of industrialism, to its vocational and practical life. To be sure, for those interested in the ministry a college degree was always of vocational value; and the accoutrements of a college education, not least the formality of the degree itself, continued to give cachet to anyone in the professions and to confer social prestige. But a college degree was not necessary for law or medicine, and most of the engineers in the country were trained at West Point. Some parents, resigned to the modest accomplishments of the colleges, took them cynically. as inexpensive custodial institutions -for it must be conceded to the colleges that they charged even less for their services than they were worth. Francis Wayland, the president of Brown, remarked in 1842: "Parents have assured me that they were obliged to send their sons to college because they could not afford to bring them up in a good counting house."

Cheap though they were, the colleges had ceased by the time of the Civil War to attract students in proportion to the growth of the population. In 1826 one in 1,513 young men of college age went to college. By 1855 it was down to one in 1,689; by 1869 to one in 1,927. The colleges were falling behind the birth rate, and at an accelerating pace. "The sad fact stares us in the face," said Charles Kendall Adams, "that the training which has long been considered essential to finished scholarship has been losing ground from year to year in the favor of the people." (5) But even as he spoke, the university revolution was under way, and the educational scene was undergoing drastic transformation.

II

After years of what seemed to be fruitless agitation, the university era began abruptly. It is true that some preparation had been made in the 1850's, a decade notable for lively educational criticism and new plans; and that a few leading institutions, notably Yale and Harvard, had made prewar gains that brought them to a stage of development something like that of the smaller German universities. But nothing could have prepared observers of the educational scene for the sudden explosive change of the post-Civil War years. The years 1868 and 1869 stand out --- the first for the opening of Cornell under Andrew

D. White, the second for the election of Charles William Eliot to the presidency of Harvard. Seven years after Eliot's inauguration, instruction began at Johns Hopkins under the presidency of his friend Daniel Coit Gilman. These men led the university revolution, created its models, and set its tone; and while they were rapidly building modern universities and fostering advanced studies in the East, James Burrill Angell was working, though with less success, to carry the impetus of the university idea into the largest of the state universities at Michigan.

The first surge of reform, represented by these four men and institutions, was followed by others. Minnesota and Wisconsin made marked progress in the 1880's. Between 1889 and 1891, G. Stanley Hall, William Rainey Harper, and David Starr Jordan launched Clark, Chicago, and Stanford. Around the turn of the century Arthur Twining Hadley, Woodrow Wilson, and Nicholas Murray Butler, taking over Yale, Princeton, and Columbia, helped to bring these older institutions more fully into the swing of the university revolution.

Harvard, though not quite so innovative as Cornell or Johns Hopkins, was the leading institution of the university movement, partly because it brought the prestige that no newly founded school could bring. The achievements of Eliot were a measure of what a great administrator could do with adequate support. When Eliot became president, Harvard, consisting of the College, the Divinity, Law, Medical, Dental, and Scientific schools, had about a thousand students and sixty teachers. At the close of his reign in 1909 it had added the graduate schools of Arts and Sciences, Applied Science, and Business Administration had some 4,000 students and about 600 teachers, and had increased its endowment from \$2,500,000 to more than \$20,000,000. Size is no measure of quality; but Harvard had also developed advanced study and had transformed and immensely improved undergraduate and professional studies -- had grown, in short, from a small fledgling university to a great one. Other institutions, less daring, began to imitate her.(6)

No doubt the Civil War, by giving an impetus to science and technology, had something to do with quickening the university movement. In 1861 the legislature of Massachusetts chartered M.I.T., and the following year the Morrill Act made millions of acres available as a subsidy to state universities and agricultural and mechanical colleges. But it was mainly private funds, supplied on an unprecedented scale, that touched off the movement, and private institutions that showed the way. The work of sponsoring universities in which the states had failed and the sects had been no better than a hindrance, was at last taken over successfully by the postwar millionaires.

The contrast between the massive postwar donations and the poverty of the old college can hardly be overstated. When Princeton, for instance, had been revived by her alumni in the middle 1830's, the largest single gift was \$5,000, and the overall goal of this unprecedented drive was only \$100,000. Williams was founded on \$14,000, Amherst on \$50,000. The largest single cash bequest received by Columbia before the Civil War was \$20,000. With these figures one must compare Ezra Cornell's \$500,000 for his new university at Ithaca, which was augmented to \$2,500,000 in twenty years by the sale of land scrip allotted to New York under the Morrill Act; Johns Hopkins's \$3,500,000; Vanderbilt's \$1,000,000; Rockefeller's \$30,000,000 for Chicago; Stanford's \$20,000,000; or the endowment of over \$20,000,000 that Harvard had built up at the close of Eliot's regime. In the twenty years after 1878, private donors gave at least \$140,000,000 to all branches of higher education.

When the rich began to give their money, the people began to send their children, and the relative numerical decline of students before the year 1869 was at last reversed. Between 1870 and 1910, while the nation's population doubled, the number of students enrolled in higher education nearly quintupled. American parents were taking greater interest in sending their sons to college, and were beginning to send their daughters.(7) Graduate education, as well as coeducation, was entirely the creation of this forty-year period: the first Ph.D. was granted by Yale in 1861; total graduate enrollment rose from 198 students in 1871 to 2,382 in 1890 and 9,370 in 1910. The sources of undergraduate recruitment also grew, as the number of public high schools rose from about 1,000 in 1870 to 6,000 in 1900. In 1898 there were five times as many pupils enrolled in secondary schools as there had been twenty years earlier.

The great universities were launched with generous minds as well as generous purses. For decades farsighted educators had pleaded with very little success to get the yoke of sectarianism lifted from American higher education. Suddenly, within the span of a few years, it was lifted; almost, it seemed, without effort. In the main, the new donors, though far from impious men, were content to let the work of inquiry go on untrammelled by sectarian restraints. They were prepared to give away immense sums without interfering unduly with the manner in which their money was spent. Abruptly, the paternalism of the small college was abandoned, along with its sectarian atmosphere.

The same generosity of mind was brought to bear upon the debate over the curriculum and the competing claims of the disciplines. One thinks of Ezra Cornell's famous statement, "I would found an institution in which any person

can find instruction in any study"; or of the opening of Eliot's inaugural address:

The endless controversies whether language, philosophy, mathematics, or science supplies the best mental training, whether general education should be chiefly scientific, have no practical lesson for us to-day. This University recognizes no real antagonism between literature and science, consents to no such narrow alternatives as mathematics or classics, science or metaphysics. We would have them all, and at their best ... It were a bitter mockery to suggest that any subject whatever should be taught less than it now is in American colleges. The only conceivable aim of a college government in our day is to broaden, deepen, and invigorate American teaching in all branches of learning. It will be generations before the best of American institutions of education will get growth enough to bear pruning. (8)

III

The university revolution broke the institutional grip of sectarianism on American education; at the same time the Darwinian revolution broke its intellectual grip. While the needs of postwar industry gave science practical prestige, Darwinism gave it a preeminent prestige in the realm of thought. The response of American scientists to Darwinism was prompt and hearty. By 1873, when Louis Agassiz, the last major scientist who opposed evolution, went to his grave, Darwinism had swept the scientific profession. Darwin himself was accorded the honor of election to the American Philosophical Society as early as 1869; it was ten years from that date before his own university, Cambridge, gave him an honorary degree.

The flexibility of the more enlightened clergy before the Darwinian challenge was impressive. However, insofar as clerics active, in academic life resisted Darwinism, their resistance only discredited their old dominion over education, and underlined the truth of Eliot's observation, "A university cannot be founded upon a sect" That scientists found occasion to attack the conservative ministers was not so fatal as the fact that they began to laugh at them.

Scientists and ministers alike had moved into an altogether different intellectual milieu. In the old-time sectarian college, orthodoxy had been a major test of the eligibility of an academic to his job. A professor had to be, in many places, a Christian of the right denomination or theological persuasion. For instance, in 1854 Oliver Wolcott Gibbs, a distinguished chemist, had been denied appointment at Columbia because the Episcopalian trustees, including several ministers, could not stomach his Unitarianism. This incident, one of many such

throughout the country, caused the few enlightened trustees to despair of making Columbia into a genuine university. But all of this was quick to change. In the postwar decades, evolutionary science and the dominant scientific ideal enlarged and aggrandized the claims of competence as a criterion for faculty appointments. As competence displaced orthodoxy, the new university promoters began quietly to ignore sectarian criteria in choosing professors, and they found themselves upheld by their boards of trustees. Enlightened men knew that there was only one way to realize the dream of creating great universities equal to those of Europe --- above all, those of Germany --- and that was to recruit men on the basis of distinguished learning, without regard to other considerations.

The strategy of such promoters of the secular university as Gilman, White, and Eliot was not one of militancy but of quiet persistence and partial accommodation. These men were not interested in making the tension between science and religion the source of unnecessary antagonism and struggle. Being administrators and promoters rather than agitators, they went on their way firmly and steadily, avoiding polemics, quietly ignoring religious interests or thrusting them into the background, counting upon the passage of time and the undeniable usefulness of their enterprises to carry them through. They preferred by-passing the major religious strongholds rather than carrying them by assault --- and not surprisingly for they were themselves by no means devoid of religious feeling. It is true, of course, that Andrew D. White wrote a two volume History of the Warfare of Science with Theology, but to him the last word of this title was essential: it was not, as he saw it, true religion but dogmatic theology that had stood in the way of science. In any case, the book was not published until 1896, when White's university-building work had been done and he had been eleven years retired from Cornell's presidency. In practice, White had not been excessively bold. For instance, he had brought Felix Adler (later the founder of the Society for Ethical Culture) to lecture on Hebrew and Oriental literature; but when Adler's latitudinarian ideas aroused widespread criticism in the local religious press, the university refused to renew an expired three-year appointment. White seems to have interposed no objection when Vice-President William C. Russel cashiered Adler.

The secularization of the new and more dynamic institutions proceeded from the top down, beginning with the donors. It is significant that of the three vanguard institutions in the university revolution, two were endowed by millionaires with Quaker backgrounds, who well understood the evils of sectarian oppression, while the third was Harvard with its relaxed Unitarian tradition. Moreover, donors of large fortunes preferred to have their gifts and

bequests managed by businessmen and men of affairs rather than by clergymen. As the universities came to be less concerned with matters on which the clergy were deemed authoritative, the ministers seemed less competent to run them. The development of institutions large enough to be considered great enterprises suggested the need for business and promotional skills. Quietly, with the passage of time, clergymen began to disappear from governing boards. At Harvard the combined boards, Overseers and Corporation, had seven clergymen out of thirty-six members in 1874; by 1894 there was only one. Earl McGrath's study of the boards of fifteen private institutions shows that while in 1860 39 per cent of the trustees were clergymen, the figure had dropped to 23 per cent by 1900 and to 7 per cent by 1930.

Boards increasingly dominated by men with an eye to the needs of business and the development of research began to think naturally of laymen for college presidencies. By solemn tradition, the presidential office had gone to clergymen, and it was secularized at the same time as the trusteeships themselves. Columbia, choosing the chemist and naturalist F. A. P. Barnard in 1864, was one of the pioneers; and took as his successor in 1889 Seth Low, a businessman and politician. Harvard, which had already had two nineteenth century lay presidents --- Josiah Quincy in 1829 and Cornelius C. Felton in 1860---turned from a minister, Thomas Hill, to a scientist, Eliot, in 1869. Cornell and Johns Hopkins began their existence with laymen as their presidents, as did Clark with G. Stanley Hall, a psychologist, and Stanford with David Starr Jordan, a biologist. Yale's first lay president was Arthur Twining Hadley, an economist, in 1899; Princeton's was Woodrow Wilson, a political scientist, in 1902.

A final phase in the induced secularization of the colleges came only after the turn of the century. The Carnegie Foundation for the Advancement of Teaching, established in 1906 to provide retirement allowances for professors in private, nonsectarian colleges, excluded from its bounty all colleges having intimate relations to religious denominations or requiring that trustees be members of a stated church. Many good colleges suffering from sectarian affiliations were happy to use their need for the foundation's bounty as an excuse to throw off church control. A number renounced their sectarian connections and revised their charters or by-laws to qualify for aid. At first only fifty-one institutions satisfied the foundation that they were nondenominational; but within four years twenty more managed to qualify, and others did so soon afterwards. Several hundred colleges still held the sectarian line, to be sure, but by and large these were the weakest colleges at the bottom of the educational ladder. Sectarianism was left mainly with the rearguard of American education.

IV

If we look for the educational convictions underlying the university revolution, we find ideas that may now seem so obvious as to have little compelling interest --- ideas, moreover, so clearly anticipated by men like Jefferson, Ticknor, Wayland, Tappan, and others that they could hardly have been considered new in the years after 1869. The novelty lay in the means and the determination to implement them. Still, the convictions had to be reasserted in the university era and to be established against a tenaciously held counter-philosophy. During his first twenty years of service as Harvard's president, Eliot once said, he was "generally conscious of speaking to men who, to say the least, did not agree with me." President Hyde of Bowdoin remembered him as having been "misunderstood, misrepresented, maligned, hated," for his first twenty five years.(9)

As education had been understood in the Anglo-American college tradition, the formation of character was held to be more important than the development of intellect, the transmission of inherited knowledge more important than the search for new knowledge, and discipline more important than stimulation. Of course these are not necessary antinomies. Few spokesmen either of the old or the new regimes would have been prepared to say that there is some inevitable antagonism between character and intellect, or between conserving past knowledge and acquiring new knowledge. But there was an undeniable difference in emphasis, a difference that, carried far enough, aroused real antagonism. For this reason men like Eliot, Gilman, and White could not simply assert their ideas, but had to campaign for them. If cultivating intellect was to become their central business, colleges devoted to character and discipline must undergo important changes. Again, to foster research was not to challenge the importance of conserving the past; but it did lead to an upheaval in a curriculum and in teaching methods that had been based almost entirely upon the ideal of conserving knowledge. To exalt the ideal of secular knowledge in the age of Darwinian science constituted, whether one was looking for controversy or not, a subversive movement against institutions reared upon sects.

The new generation had a strikingly untraditional sense of what higher education should be, derived in the main from their experience with the German universities.(10) Since the early nineteenth century, American students returning from Germany had brought with them a conception of university

work altogether at odds with their American college experience. In the German university two things were central: scholarship and freedom. Scholarship was specialized and advanced, so that it was possible for students and faculties to go beyond the elementary stages and reach depth of understanding in special subjects. Freedom for the students meant not only the chance for a choice in one's studies, but also the opportunity to form one's habits and goals of conduct independently. The German idealization of scholarship gave to the professor a position of social importance unheard of in America. The German ideal of educational freedom (not to be confused with the modern conception of political-academic freedom) stressed the free pursuit by the professor of his scholarly interests without regard to curricular limitations. Where the American college had fitted its faculty to a curriculum, the German university tended to fit the curriculum to its faculty. The established German professor taught what he wished. The student too was free to choose among professors and even among universities in the pursuit of a self-determined and specialized scholarly goal. The German emphasis on *Lehrfreiheit* and *Lernfreiheit* was translatable (though in the process of translation it was substantially altered) in the Anglo-American conceptions of democracy, competition, and laissez-faire (11). As the new open curriculum crept into the American college, an academic subjects were thought to have been created equal, and all teachers and pupils entitled to the pursuit of intellectual happiness by exercising their free choice among subjects. Professors and curricular offerings were to engage in a measure of open competition, thus realizing more closely the model of economic behavior portrayed in classical economics. It would be exaggerating to suggest that this is what was done, but this was the ideal toward which changes were directed.

The canons of university education were, then, in some sense new. They embraced the following propositions. First, education must be freed from sectarian and political domination. Moreover, it must be freed from paternalistic domination: trustees must leave educational, curricular, and disciplinary matters almost entirely to the faculties. Trustees should consider themselves business managers and general overseers; but must largely forgo control of the educational process itself. (12)

Secondly, the faculties were now recognized, not in law but surely in fact, to constitute the universities. Not grand buildings, not imposing presidents, not respectable church sponsorship, not large and well-behaved student bodies--none of these was any longer assumed to be the important thing. A university was an aggregate of intellectual talents. Illustrious teachers- recruited from at home or abroad without serious concern for anything but their scholarly or scientific achievements -were understood to be the heart and soul of the

university. To attract them an institution must be prepared to pay well, and the whole community must be willing to make the academic profession roughly commensurate with other professions in salaries, in dignity, and in freedom.

Thirdly, a university must make advanced study its main concern. The graduate school was not an afterthought or an adornment, but a necessity and a model. Not only must advanced scholars be recruited to teach in graduate schools, but good students must, in effect, be hired to attend them--i.e., fellowships must be provided. It was assumed that all instruction, including professional and undergraduate instruction, would be improved in the atmosphere created by advanced research and experimentation. When opponents of a graduate school at Harvard suggested that it was useless to compete in this respect with Johns Hopkins, and that a graduate school would weaken the College, Eliot replied: "It will strengthen the College. As long as our teachers regard their work as simply giving so many courses for undergraduates, we shall never have first-class teaching here. If they have to teach graduate students as well as undergraduates, they will regard their subjects as infinite, and keep up that constant investigation which is necessary for first class teaching." (13)

Fourthly, the resistance of the old college to the scientific and vocational demands of the community gave way. Scientific and technical education were no longer frowned at, or isolated in separate "scientific" schools, but were made an integral part of the educational process.

Finally, undergraduate teaching and the undergraduate curriculum were overhauled. Science was given an increasingly important part in the course of studies. But even more drastic was the enlarged place of the social sciences and modern languages and literature, hitherto but slightly represented. Under the elective system the undergraduate was given a high degree of freedom to choose his course of studies. Now the disciplines had to compete with each other for enrollment--which could put a premium upon fresh and interesting teaching (as it could also, unfortunately, upon the easy course). The tedious recitation session lost favor, and ultimately disappeared, in favor of more imaginative methods of instruction: the lecture, the small discussion group (borrowed from the graduate seminar), and, in science, demonstrations and laboratory work. The elective system, while making more specialized courses available to undergraduates, made it possible for teachers to teach subjects of vital interest to themselves. The consequent improvement in the morale of instructors contributed substantially to the liveliness of teaching.

The greatest single weakness of the old colleges had been neither their

curriculum, however archaic, nor their faculties, however limited, but their hopelessly dull recitation method of teaching, which could deaden the most interesting subjects and convert faculty men of genuine intellectual and scholarly distinction into drillmasters. 14 James Freeman Clarke's ironic remark at the Harvard commencement dinner of 1886 may be taken with entire seriousness: "Formerly, the only business of a teacher was to hear recitations, and make marks for merit. Now, he has the opportunity of teaching. This is one of the greatest educational discoveries of modern times, -that the business of a teacher is to teach." (15)

V

Before the university era, men had spent their lives teaching in colleges, but there was nothing that could be called an academic profession. There were no well-recognized and generally maintained standards of competence in scholarly subjects; professional and intellectual specialization was not generally recognized as a prerogative of the college teacher; there was no lively academic marketplace in which competing institutions could or would regularly bid for the skills of eminent men; there were few opportunities or facilities for specialized research or experimentation; there were few scholarly organizations or publications. With these elementary prerequisites of professional life so conspicuously lacking, there could be no such spirit of professional solidarity as began to manifest itself in informal ways after 1870 and finally found formal expression in 1915 in the organization of the American Association of University Professors.

The lack of specialization was only slowly overcome in the university era, except in the vanguard institutions. We need not, perhaps, concern ourselves overmuch with such institutions of the educational underworld as Florida State College of Agriculture, with its professorship in agriculture, horticulture, and Greek. But distinguished men were often reduced to drillmasters and petty disciplinarians, tormented by the tedium of under specialization. James Burrill Angell, president of the University of Vermont in the 1860's, finding that the institution lacked the funds to round out its faculty, taught all the missing subjects himself - including rhetoric, German, history, and international law. David Starr Jordan, as late as the 1870's when he taught at Lombard University in Illinois, had classes in natural science, political economy, evidences of Christianity, German, Spanish, and literature, and pitched for the baseball team. Eliot well knew the costs of this system -- or lack of system --for he had

suffered from it as a young assistant professor at Harvard in the 1850's. To Charles Eliot Norton he wrote in 1860:

I generally experience a slight disgust at recitations at the beginning of a term, particularly at Mathematical recitations. I wish I could teach the science in which I am most interested, and in which I work during leisure hours, but at present I have four recitations in Mathematics for one in Chemistry, and I see no reasonable hope of any change.... And yet the College demands so much of my time that I can do original scientific work only by working up to the very limit of physical endurance and sometimes going a little beyond it.(16)

The feebleness of the libraries was almost as great an obstacle to professional work in the old colleges. A privileged scholar like George Ticknor might build a private library, mainly in his own specialty, of 13,000 volumes; but it was upon such efforts, or upon inconvenient resort to general libraries not maintained by their own schools, that American academics did what important scholarly work was done. Ticknor had pointed out when he joined Harvard that its library, then 20,000 volumes, was only one-tenth the size of Gottingen's. By 1839, when Harvard's library had grown to 50,000, Yale's was the only other college library with more than half as many; and in the country at large there were only sixteen colleges that could claim more than 10,000 books. As late as 1873 the library of the University of Pennsylvania, with 20,000 volumes, was dwarfed by the Philadelphia Mercantile Library with 125,000. This poverty persisted into the post-Civil War period. In 1869 Gilman, who had only recently ceased being Yale's librarian, pointed out that "Yale College has not a dollar on hand to buy books for the next two years, its scanty library income having been expended two years in advance." 17 To scholars familiar with these conditions of the pre-university era, the growth of libraries was immensely heartening. By 1900 Harvard's, the leading library, had 560,000 volumes and 350,000 pamphlets. Such lesser libraries as that of Pennsylvania had grown to respectable size with about a third as many.

The situation of laboratory science in the old colleges had been still worse. American colleges provided no laboratories for teaching, or even, normally, for the experiments of faculty members. At Yale, pre-eminent in science, Benjamin Silliman, Sr., could do no more for his students in this respect than perform some experiments for them in the lecture room. He disliked having students in his private laboratory for fear they would "hinder me and my trained assistants, [or] derange or break the apparatus." 18 The younger Silliman, as his father's assistant, was able to get a room at Yale in 1842, in which he could give

practical laboratory instruction to a few students, but this was an unofficial arrangement having no functional connection with college instruction. The foundation in 1847 of Sheffield Scientific School at Yale and Lawrence at Harvard represented a step toward academic laboratories, but adequate support for scientific teaching and research had to await the more substantial endowments of the period after 1870.

Professionalism moved from the institutions to the disciplines. There had been professional organizations before the Civil War, but usually they had been either local organizations, like the Massachusetts Historical Society, the American Academy of Arts and Sciences, and the American Antiquarian Society, or comprehensive and unspecialized, like the American Association for the Advancement of Science. Now the various disciplines, many of them being taught for the first time in the universities, began under the stimulus of Gilman and Johns Hopkins to form their own specialized societies. Learned societies began to proliferate with rapidity in the 1870's and 1880's; by 1908 there were 120 national societies and countless local ones besides. Again spurred by Johns Hopkins, professional journals began to develop, led by the mathematicians, chemists, and philologists. Chicago followed the example of Johns Hopkins in becoming a major center for the publication of professional journals.

The development of graduate studies and professional standards spread from academic studies to the professional schools. Legal and medical education, as they had been carried on in the United States during the nineteenth century, were hardly professional. Law schools had little to offer that was better than the informal apprentice training available in the office of a good lawyer. Eliot found the law school at Harvard in disgraceful condition, unchanged for the past twenty years, staffed by three lawyers busy with their own private practices, and attended by students less than half of whom were college graduates, and none of whom had to pass examinations in order to get the LL.B. degree. The new president forced Christopher C. Langdell into the deanship in 1870, and thus instituted a series of changes that in good time set the pace for legal education throughout the country. A capable faculty was recruited, law study was extended from eighteen months to three years, written examinations were required, and the case method of study replaced the old textbook method. These reforms, much resisted at first, paid off within a little more than a dozen years. By then the student body had doubled ; and the Harvard Law Review had been founded. After 1893 none but college graduates were admitted. Harvard set a pattern that was widely imitated.

Where legal education had been lax, medical education had been lethal. The old proprietary medical schools were essentially profit making institutions, devoid of laboratories and hospital connections, in which teaching was done by lecture and a rare dissection. The course of study was normally one academic year; the tuition income was divided among the local medical practitioners who did the teaching. "Chairs" in medicine were sold to their occupants. Examinations were brief and oral. Even at Harvard the candidate who could pass with five out of nine examiners was qualified for medicine. There were no state boards to impose standards. Eliot considered that "the ignorance and general incompetency of the average graduate of American Medical Schools, at the time when he receives the degree which turns him loose on the community, is something horrible to contemplate." (19)

Harvard Medical School began its reforms under Eliot simultaneously with the reforms in the law school. A three- year course of study was set up, and written examinations established, with the requirement that all fields be passed by those who were to receive their M.D.'s. Johns Hopkins opened its great medical school in 1893 requiring a bachelor's degree for admission. When Abraham Flexner made the famous investigation in 1910 that launched a general reform in medical education, he took Johns Hopkins as the model of what an American medical school should be, and graded other institutions by measuring their distance from the Johns Hopkins standard. Twenty years earlier there had been no school in America good enough to serve as a standard.

But quite as important as the effects of the university revolution on the other professions was its effect on the academic profession itself. Now, for the first time, the profession developed the capacity both for large-scale innovative work in scholarship and for social criticism and practical contribution to the political dialogue of American society. If one considers only philosophy and the social sciences, the roster of men reared in the university movement is impressive enough: Oliver Wendell Holmes (one of Langdell's first recruits) and Roscoe Pound in law; Thorstein Veblen and John R. Commons in economics; John Dewey and William James in philosophy; Charles A. Beard, Carl Becker, James Harvey Robinson, Frederick Jackson Turner in history. The important and original movements in thought and scholarship -pragmatism, legal realism, institutional economics, the "new history," which are all products of this era, stand in refreshing contrast to the earlier borrowings from Scottish realism and classical economic doctrine.

Pragmatism itself, the most significant product of American academic work, was in part the result of applying to philosophical problems certain insights

derived from Darwinian evolution and from Anglo-American case law. It became, in a sense, almost the official philosophy of American liberalism. It was ideally adapted to a time when the academic man was beginning to overcome his traditional civic passivity and take an active part in the shaping of political events. A long-standing estrangement between the life of the mind and the life of politics was overcome at the turn of the century, and in the new synthesis of academic life and politics, scholars like John Dewey, J. Allen Smith, and Charles A. Beard were to play a signal part. Among the consequences of the empirical specialized skills that had been fostered by the University movement, academic men had not only prestige but some real marketable advice to bring to public life. It was not surprising that they played an important part in the Progressive era, both on the national level and in the states. In Wisconsin, under La Follette, the idea of the university in the service of the reformist state received a remarkable consummation. In the nation at large, the participation of professors in government had become a thing familiar enough not to cause exceptional notice. In 1918, when Woodrow Wilson, himself a product of the university movement, took to Paris a team of about 150 scholars to give technical advice on the making of the peace, the employment of experts seems to have been sufficiently taken for granted to elicit only faint hostile comment.

VI

Every revolution has its excesses, its disappointments, its Thermidor; the university revolution was no exception. Its leaders, who were familiar only with the under specialization and impracticality they had to surmount, could not very well anticipate or prevent the new evils of overspecialization and excessive vocationalism. The modern university brought with it the defects of its merits. If the old college had preserved too much of what was dead in the past, the new university became in time all too responsive to trivial innovations of the present. Limited though it had been in the quality and range of its achievement, the old college had had a clear form and mold and a firm sense of purpose. The university often lost its center and became a diffuse federal union whose parts seemed to work at cross purposes. It replaced under specialization with over specialization, over discipline of the young with excessive indulgence, archaism with a restless and sometimes indiscriminate passion for novelty, impracticality with a crass surrender to vocationalism, neglect of science with obtrusive scientism and crude positivism, stubborn resistance to change with complaisant response to the demands of an anti-intellectualist

society.

The history of the elective system is a perfect case of the difficulties of change. By 1910 it was recognizable that those institutions which had made the elective experiment too fast and carried it too far had invited curricular chaos. Students, freed from set courses of study, sometimes chose courses largely because they were easy or entertaining; some were capable of devising for themselves strange collections of courses aggregating enough credits to earn the B.A. but hardly constituting a liberal education. Much of the curricular planning of the twentieth-century college has been an attempt to surmount this tendency toward formlessness, to devise meaningful core curricula, and to conform once again to the old-college ideal of giving the student a minimum base in general education preliminary to specialization.

Although the old college subordinated intellect to character and discipline, it never doubted that education was basically concerned with the mind. The modern university, with its multiple concerns and its effort to meet a variety of needs, has at times degenerated into a kind of cultural filling-station. This tendency has reached its peak among the state universities, one of whose presidents once declared: "The state universities hold that there is no intellectual service too undignified for them to perform. 1120 By 1930, when Abraham Flexner published his famous survey, *Universities: American, English, German*, his account of the trivialities to which the universities at their worst had descended ---- the correspondence courses, the offerings in advertising, judo, food etiquette, and home laundering, the graduate theses on ways of washing dishes, on the bacterial content of cotton undershirts, or on "the origin and nature of common annoyances" ---- matched in scorn his earlier account of the inadequacies of the medical schools.

These things must be said as a caution against claiming too much for the university revolution. But no one who looks carefully into the old college and the work of the university reformers would propose that we simply set the clock back. We go on, trying to strike a balance between the vocational and the intellectual, between the general and the specialized, between the "two cultures" of science and humanities with an uneasy awareness that the problem is not susceptible to perfect solution. No doubt there is something missing and something wrong in every educational dispensation. Education is a field in which everyone is, in his own mind, an expert; a field in which everyone cherishes a Utopia which he imagines to be realizable. We think of men or women whom we consider well educated, and we demand that somehow institutions be created that will turn out such products wholesale; but a good

education depends upon an uncommon, happy conjunction between institutional excellence and personal capacity and desire.

NOTES

1 In his excellent book, Mark Hopkins and the Log (New Haven, 1956), Frederick Rudolph examines the myth of the old college, as exemplified by Mark Hopkins and Williams College, judiciously but with disillusioning results.

2 Charles William Eliot, Educational Reform (New York, 1898), p. 105.

3 Quoted in Orie W. Long, Literary Pioneers (Cambridge, Mass., 1935), p. 166.

4 Cf. Andrew D. White: "I had, during my college life, known sundry college tutors seriously injured while they were doing police duty. I have seen a professor driven out of a room, through the panel of a door, with books, boots, and bootjacks hurled at his head; and even the respected president of a college, a doctor of divinity, while patrolling buildings with the janitors. subjected to outrageous indignity." Autobiography (New York, 1922), 1, 348.

5 Representative Phi Beta Kappa Orations, ed. Northrup, Line, and Schwab (Boston, 1915), pp. 160-161.

6 The size and wealth of an institution were in fact of vital importance to the quality of its achievement. George W. Pierson has pointed out that Harvard in this period was working with endowments that made even such rivals as Princeton and Yale "plain and poor." "American Universities in the Nineteenth Century: the Formative Period," in Margaret Clapp, ed, The Modern University (Ithaca, 1950), p. 80.

7 Practically all the new state universities of the West and South adopted a coeducational policy more or less as a matter of course. In 1880 fifty-one per cent of the colleges were mixed; in 1898, it was seventy per cent, "the number of women students rose from about 2,700 to more than 250,000, BY the turn of the century four out of five colleges, universities, and professional schools admitted women.

8 Eliot, Educational Reform, pp. 1-2.

9 Eliot Morison, Three Centuries of Harvard (Cambridge, Mass., 1936). p. 358.

10 Despite the clear preponderance of the German influence in the American idea of the university, some English influences persisted; they were especially strong in the better colleges and in some universities like Yale and Princeton. The English concern with the development of character in undergraduates and something that might be called atmosphere in the institutions is a noteworthy feature; as is the passion for imposing buildings, somewhat separated, if possible, from the urban community. An emphasis on teaching, as opposed to research, remains. In some institutions--notably, again, Yale and Princeton--the centrality of the college among the various parts of the university is an Anglo-American survival. So too is the aim of creating a broadly educated leadership, as opposed to a body of specialists. Finally, the English passion for undergraduate sports has survived and grown in this country but with the unfortunate difference that the English emphasis on amateurism and broad participation has been supplanted with American commercialism and spectator sports.

11 See the account of this transformation by Walter P. Metzger in Richard Hofstadter and Walter P. Metzger, The Development of Academic Freedom in the United States (New York, 1955), ch. VIII.

12 Of course it should be clear that the universities were not the creations of a democracy, or of the faculties. In the main, they were created, or reformed, from the top down. They were triumphs of elite leadership, of enlightened autocracy. In the long run, they advanced academic "democracy" simply because they assembled faculties so large and so eminent that they had to be permitted in some considerable degree to govern themselves.

13 Quoted in Morison, Three Centuries of Harvard, pp. 335-336.

14 Cf. Andrew D. White on Yale in the 1850's: "Though the professors were most of them really distinguished men, and one at least, James Hadley, a scholar who, at Berlin or Leipzig, would have drawn throngs of students from all Christendom, they were fettered by a system which made everything of gerund-grinding and nothing of literature." Autobiography, 1, 27.

15 Morison, p. 347.

16 Henry James, Charles William Eliot (Boston, 1930), 1, 87.

17 Fabian Franklin, The Life of Daniel Coit Gilman (New York, 1910), p. 80.

18 Quoted by Dirk J. Struik, Yankee Science in the Making (Boston, 1948), P. 339.

19 Quoted by F. C. Shattuck and J. L. Bremer in Samuel Eliot Morison, ed. The Development of Harvard University, 1869-1929 (Cambridge, Mass., 1930), P. 558.

20 Quoted in Logan Wilson, The Academic Man (New York, 1942), p. 175.

institutions of higher education during the period of the Second Industrial Revolution were co-educational and helped foster an increased role for women in industrial and academic settings. An intensified commitment to large-scale higher education across the world has resulted in increasing rates of participation in higher education in India, China as well as the United States. For example, in the United States the fraction of the population with some access to higher education has risen from 4% in 1900 to nearly 70% in 2000. The increasing diversity of higher education institutions in the workforce pipeline for the quantum industry, we have conducted interviews with 21 different companies that have self-identified as being within the quantum industry. Each interview covered questions on company context, skills and knowledge required as a function of academic preparation and job type, as well as training and hiring (full interview protocol included in Supplementary Materials Section S.IV). In Section IV, we discuss the results and present our conclusions on what the role of higher education is in preparing for the quantum revolution.

II. Methodology

That conversation was typical of our highly educated tribe – for us to imagine something is good, it has to be good for us. Meanwhile, back in America, online education isn't succeeding because it's better than Oberlin, it's succeeding because it's better than nothing, and nothing is what's currently offer for millions of people. Compare the recent threatened closings of Sweet Briar versus the City College of San Francisco. The same study notes that – students with higher index of risk had a significantly greater preference for distance education classes. – Among undergraduates taking all their classes online, half are married, compared with fewer than one in five undergrads generally. Half also have children.