fertility on both the livestock and the grain farm. In either type of farming, limestone and phosphate must be used so as to permit the growth of legumes so essential in soil improvement and also in the feeding of livestock.

While Dr. Hopkins took particular pains to point out and emphasize the possibility of maintaining the fertility of the soil on the grain farm on a permanent and profitable basis, he also made important contributions to our knowledge regarding methods of maintaining the fertility of the livestock farm. The teachings of Dr. Hopkins in this respect are of tremendous importance since they provide for the extension of livestock farming to large areas where heretofore the proper feeds could not be produced. On all of the experimental fields just one half of the work is devoted to the maintenance of soil fertility in livestock farming. The livestock farmers of Illinois should have a deep sense of gratitude to Dr. Hopkins for his work in their behalf.

If a system is to be permanent, the materials removed from the soil must be returned, at least in the proportion in which they are removed by natural processes, including the amount removed by the crop and the amount lost in the drainage water. This would seem to be such a simple axiomatic truth that it need not be dwelt on; however, it is a point which must be constantly emphasized again and again. The use, therefore, of two or three hundred pounds of an ordinary commercial fertilizer of a 2-10-2 grade, which adds only five or six pounds of nitrogen, must act purely as a soil stimulant. For, if increased crops are obtained by its use, they can be obtained only at the expense of the nitrogen already in the soil, since the requirement for a 100 bushel crop of corn is 100 pounds of nitrogen. The Illinois system of permanent soil fertility, therefore, condemns in unmeasured terms the use of such soil stimulants, among which must be classified ordinary mixed commercial fertilizers and gypsum.

In the briefest way possible, the very essential points underlying the Illinois system of permanent soil fertility have thus been merely touched upon. But it is the desire to emphasize at this point that the Illinois system of permanent soil fertility rests upon a sane and safe scientific basis, and, because it makes abundant use of cheap, natural, raw, products, as legume nitrogen and finely ground materials such as limestone and rock phosphate, it is both a permanent and profitable system of soil fertility. This is the heritage to Illinois farmers left by him in whose memory we have met here to-day.

ROBERT STEWART
UNIVERSITY OF ILLINOIS

RADICALISM AND RESEARCH IN AMERICA

INVESTIGATORS who are concerned as to the possibility of adequate facilities for research being maintained by popular governments, or who doubt whether a republic working through democratic institutions like our National Research Council can equal the scientific attainments of autocratic Germany, will derive much encouragement from a review of American history. Prominent among the agencies which, in addition to privately endowed institutions, have supported the prosecution and publication of scientific research in this country are Academies of Science, State Universities, Land Grant Colleges and Agricultural Experiment Stations, Federal Department of Agriculture, Coast and Geodetic Survey and the State and National Geological Surveys. In many cases the inception or period of most marked development of these institutions has been closely linked with striking political developments. Without presenting any unpublished data the present paper aims to assemble some of the facts which seem significant in this connection.

Undoubtedly the most radical document ever adopted by an American national assembly was the Declaration of Independence. The active members of the committee appointed to draft this instrument were Franklin, Adams, and Jefferson, each of whom made a distinct contribution to the advancement of scientific foundations in America.

Franklin's fame as a scientist, as a diplomat, and as leader of the radical faction in our

constitutional convention make comment on these points unnecessary. Of special interest here is his activity in founding our first academy of science.[1] As early as 1743 Benjamin Franklin issued his circular entitled "A proposal for promoting useful knowledge among the British plantations in America," in which he urged the establishment of a society to be called "The American Philosophical Society." From this Society and another organized in 1766, of which Franklin was first president, grew in 1769 The American Philosophical Society of to-day. Of this society Franklin was president from its organization until his death and Dr. Benjamin Rush, one of the signers of the Declaration of Independence, was one of the secretaries. The American Philosophical Society began in 1771 the publication of the *American Philosophical Transactions* and soon assumed national importance and assisted in making Philadelphia for many years "the metropolis of American Science."[2]

To John Adams, who in 1776 seconded the famous resolution of Richard Henry Lee that "these colonies are, and of right ought to be free and independent states" and bore the foremost place in the debate on the adoption of the Declaration of Independence, our second Academy of Science owes its origin. The circumstances which led to Adams' deep and lasting interest in scientific foundations, and his part in founding the American Academy of Arts and Sciences which was incooperated by the legislature of Massachusetts in 1780 and published its first memoirs in 1785, are detailed by Goode.[3] One of the original members of the American Academy of Arts and Sciences was Levi Lincoln, Attorney-General of the United States under Jefferson.

When Washington became president these two societies were the only scientific organizations in this country and it is worthy of note that the president, vice-president and the secretary of state in that first administration were all fellows of the American Philosophical Society. The efforts of Washington himself and later of Madison to establish a national university might well be mentioned here but for the fact that the national university which was urged in presidential messages over a century ago is not yet an accomplished fact.

The activities of the author of the Declaration of Independence in behalf of science and education are well known. In the opinion of Goode[4]

> no two men have done so much for science in America as Jefferson and Agassiz—not so much by their direct contributions to knowledge as by the immense weight which they gave to scientific interests by their advocacy.

In 1782 appeared Jefferson's "Notes on the state of Virginia,"[5] the first comprehensive treatise on the natural history and resources of one of the states, and the precursor of the numerous state surveys since issued. When in 1797 Jefferson came to Philadelphia to be inaugurated vice-president[6] he brought with him a collection of the fossilized bones of some large quadruped and the manuscript of a memoir upon them, which he read before the American Philosophical Society. "The spectacle," remarks Luther,[7] "of an American statesman coming to take part as a central

[1] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 266, 1901.

[2] Goode, George Brown, *op. cit.*, p. 268.

[3] Goode, George Brown, *op. cit.*, p. 268–269.

[4] Goode, George Brown, "The Beginnings of Natural History in America," Rpt. U. S. Nat. Mus., 1896–97, p. 394, 1901.

[5] The first edition, 1782, was published in Paris and but few copies were printed. The preface to the second edition, London, 1787, states with reference to the Paris edition "the subjects are all treated imperfectly; some scarcely touched on . . . They are now [1787] offered to the public in their original form and language."

[6] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 280, 1901.

[7] Luther, F. N., "Jefferson as a Naturalist," *Mag. Amer. Hist.*, Vol. 13, No. 4, p. 386–387, April, 1885.

figure in the greatest political ceremony of our country and bringing with him an original contribution to the scientific knowledge of the world, is certainly one we shall not soon see repeated."

Jefferson's presidency Goode[8] calls the "most memorable in the history of American science." Not only was the president actively engaged in paleontological research, using one of the unfinished rooms of the White House[9] for the storage and display of some 300 specimens of fossil bones from the famous Big Bear Lick,[10] but his administration was marked by the inception of the system of scientific surveys of the public domain and the organization of the Coast Survey. Jefferson's part in originating and supporting the Lewis and Clarke expedition has been detailed by True.[11] And who ever originated the idea of a Coast Survey it is certain that the early organization of the survey itself was due to Jefferson.[12]

Nor was Jefferson's interest in scientific foundations limited to those which he originated and could further in some large way. When, a little over a century ago, Benjamin Silliman launched *The American Journal of Science* he was much concerned as to whether a sufficient subscription list could be maintained. Among those to whom he wrote asking for subscriptions was Jefferson, then in his seventy-fifth year. How Jefferson's reply, here quoted from Dana's article[13] must have heartened the first editor of what is now our oldest scientific journal, can best be appreciated, perhaps, by those who are still struggling with the question of adequate support for American scientific publications.

If not his most notable contribution to science and education, the foundation of our first state university was apparently the one nearest Jefferson's heart. His part, when well over seventy, in the foundation of the University of Virginia as originator, as organizer, as architect and as first head of the institution has been too well told[14] to warrant repetition. His special interest in the teaching of science in this university has been

[8] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 280, 1901.

[9] Merrill, George P., "Contributions to the History of American Geology," Rpt. U. S. Nat. Mus., 1903–04, p. 213, 1906.

[10] Such scientific tendencies were the object of much criticism in the more conservative portions of the country. The following lines from the "Embargo" written by William Cullen Bryant (when a boy of 13) probably represents public opinion in his locality.

Go, wretch, resign the presidential chair
Disclose thy secret measures, foul or fair,
Go, search with curious eyes for horned frogs,
'Mid the wild wastes of Louisianan bogs,
Or where the Ohio rolls his turbid stream
Dig for huge bones, thy glory and thy theme.

[11] True, Rodney H., "Thomas Jefferson in Relation to Botany," *Sci. Mo.*, Vol. 3, No. 4, pp. 354–357, October, 1916.

[12] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 293, 1901.

[13] Dana, Edward S., "The American Journal of Science from 1818 to 1918," *Amer. Jour. Sci.*, Sr. 4, Vol. 46, No. 271, p. 30, July, 1918.

MONTICELLO, April 11, '18

Sir: The unlucky displacement of your letter of Mar 3 has been the cause of delay in my answer. altho' I have very generally withdrawn from subscribing to or reading periodical publications from the love of rest which age produces, yet I willingly subscribe to the journal you propose from a confidence that the talent with which it will be edited will entitle it to attention among the things of select reading for which alone I have time now left. be so good as to send it by mail, and the receipt of the 1st number will be considered as announcing that the work is commenced and the subscription money for a year shall be forwarded. Accept the assurance of my greatest esteem and respect. TH. JEFFERSON

PROFESSOR SILLIMAN.

[14] Adams, Herbert B., "Thomas Jefferson and the University of Virginia," p. 308, pl. —, Washington, D. C., 1888. (U. S. Bur. Educ. Circ. Inform. 1.) True, Rodney A., "Thomas Jefferson in Relation to Botany," *Sci. Mo.*, Vol. 3, No. 4, pp. 345–360, port., October, 1916.

emphasized by True,[15] and that in Jefferson's mind at least, political radicalism and interest in higher education were clearly joined may be judged from the epitaph he himself prepared.

> Here was buried Thomas Jefferson, author of the Declaration of Independence, of the statute of Virginia for religious freedom and father of the University of Virginia.[16]

If this subject were pursued into the field of state and local history much relevant data could be presented. Merrill[17] traces "the beginning of the work which resulted in the establishment of the State survey" in New York to a course of lectures on natural history delivered by Amos Eaton before the State Legislature in Albany during April, 1818, on the invitation of Governor DeWitt Clinton. Clinton, while best known historically for his work in behalf of the Erie Canal, was active in securing the abolition of slavery in New York state and in perfecting a system of free public schools and was the author of a series of letters signed "A Countryman" in reply to the "Federalist."

Edward Hitchcock's Survey of Massachusetts (1830–1833), which Merrill refers to[18] as marking "an epoch in American geological work, since it brought to a successful conclusion the first survey of an entire state at public expense," was also a result of the interest of a radical governor, Levi Lincoln, (son of the Lincoln mentioned above) who recommended the survey and Professor Hitchcock's appointment. Governor Lincoln is known in the history of his state as the first governor to exercise the veto power, and as the leader of the minority in the Massachusetts State Legislature who protested against the Hartford convention of 1814.

Nor was the fostering of science and education wholly the concern of individual radicals at this period. For hardly had the Democratic majority in Maine effected the separation of the state from Federalist Massachusetts (1820) than the State Legislature made an annual grant of $1,000 to aid in maintaining an institution which was to give mechanics and farmers "such scientific education as would enable them to become skilled in their professions."[19] This institution was incorporated as the Gardiner Lyceum and opened January 1, 1823.

The greatest radical movement after the Revolution was that which resulted in the abolition of slavery. Of those whose names have already appeared in this sketch, Jefferson and Clinton were conspicuous advocates of abolition. The first prominent opponent in Congress of the extension of slavery was probably John Quincy Adams. One is not surprised to learn that this sturdy individualist who changed his political affiliations at will and maintained an influential position in Congress for many years, independent of party and who refused to be silenced by the "gag rule" of 1837 was deeply interested in science and its advancement. As outlined by Goode[20] he revived Washington's National University project, worked for a national astronomical observatory, was actively interested in the foundation of the Smithsonian Institution and considered his most important achievement to be the Report on Weights and Measures prepared for Congress in 1818. Of this he was justly proud for it was a very admirable piece of scientific work. He found the presidency of the American Academy of Arts and Sciences so congenial to his tastes and sympathies that he did not hesitate to say that he prized it more highly than the chief magistracy of the nation.

It was during his term as president that the consuls in various parts of the world were instructed to send to the Department of State rare seeds and plants for distribution, and about the same time a Botanical Garden was

[15] True, Rodney H., *op. cit.*, p. 359.

[16] True, Rodney H., *op. cit.*, p. 360.

[17] Merrill, George P., *op. cit.*, p. 234.

[18] Merrill, George P., *op. cit.*, p. 307.

[19] True, A. C., "Agricultural Education in the United States," U. S. Dept. Agr. Yearbook, 1899, p. 163, 1900.

[20] Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, pp. 302–311, 1901.

established in Washington. These measures proved, according to True[21] to be the "germs from which has grown the United States Department of Agriculture."

The movement against slavery resulted in the election in 1854 of a majority in the House of Representatives of men pledged to oppose the extension of slavery. Among the members of the Republican majority which gained control of the House in 1855 was Justin S. Morrill, who in December, 1857,[22] introduced a bill "donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and mechanic arts." This bill, though finally passed by Congress, was vetoed by the reactionary Buchanan. A similar bill, however, introduced by Mr. Morrill in December, 16, 1861, was passed by both Houses and approved by Abraham Lincoln July 2, 1862, the very day when McClellan's army began its retreat from the Peninsula after the battle of Malvern Hill. Although under the provisions of the act ten per cent. of the fund might be expended for "the purchase of lands for sites and experimental farms,"[23] the chief significance of the Morrill Act for research lies in its relation to the subsequent and closely connected development of experiment stations.[24] After the fund which had been established by the sale of the landscript donated to Connecticut under the Morrill Act had been given to the Sheffield Scientific School of Yale University in 1863, a professor of agriculture was appointed. Under Samuel W. Johnson, professor of theoretical and agricultural chemistry and William H. Brewer, professor of agriculture in the Sheffield Scientific School, experimental work for the benefit of agriculture was carried on. And True[24] does not hesitate to ascribe to these men and their pupils more than to any other single cause, the recognition of the importance of the establishment of agricultural experiment stations.

Professor W. O. Atwater, the first director of the first regularly organized experiment station in this country, was among the students trained in this school. From such a beginning grew the experiment stations of the United States, first regularly organized under the Hatch Act, approved by President Cleveland, March 2, 1887.

Although the chief energies of Lincoln's administration were turned toward the prosecution of our Civil War, Congress passed a bill establishing a Department of Agriculture, an act which became law by approval of President Lincoln on the 15 of May, 1862.[25]

Even during the trying days of reconstruction members of the first Republican Congress did not neglect scientific investigation and "in the spring of 1867 Hayden [F. V.] acting under the direction of the General Land Office, and with an appropriation from Congress amounting to $5,000, began his work as U. S. geologist in Nebraska, and in so doing laid the foundation for the U. S. Geological Survey"[26] which "for breadth of scope and financial resources, is without counterpart in the world's history of science."[27]

To attempt to maintain that science can be encouraged only under popular governments would be impossible, even if desirable. The history of science and education in the United States does indicate, however, that in America there has been no antagonism between popular government and government supporting research. Radicals in America have never raised the cry "The Republic has no need of

[21] True, A. C., "Education and Research in Agriculture in the United States," U. S. Dept. Agr. Yearbook, 1894, p. 99, 1895.

[22] True, A. C., 1900, *op. cit.*, p. 167.

[23] True, A. C., 1895, *op. cit.*, p. 96.

[24] True, A. C., 1895, *op. cit.*, pp. 105–106.

[25] In calling attention to the fact that the bills creating our Land Grant Colleges and Department of Agriculture, were signed by the author of the Emancipation Proclamation and Gettysburg address, one is tempted to mention that the granting of a charter by Congress to the United States Agricultural Society was opposed in the Senate in 1855 by Jefferson Davis. (True, A. C., *op. cit.*, 1895, p. 92.)

[26] Merrill, George P., "Contributions to the History of American Geology," Rpt. U. S. Nat. Mus., 1903–04, p. 592, 1906.

[27] Merrill, George P., *op. cit.*, p. 551.

savants."[28] On the contrary those periods in which political radicalism has been most marked have been those in which science received most liberal governmental aid and encouragement.

Neil E. Stevens
Bureau of Plant Industry,
Washington, D. C.

SCIENTIFIC EVENTS

BIOMETRIC AND EUGENIC LABORATORIES AT UNIVERSITY COLLEGE, LONDON

The *British Medical Journal* states that the new building given by Sir Herbert Bartlett, Bt., to the Department of Applied Statistics formed by the Drapers' Company and Galton Laboratories at University College, London, was opened on June 4 by the Minister of Health. The Drapers' Company Biometric Laboratory was instituted under the direction of Professor Karl Pearson in 1904; it is a research laboratory and training school in the modern mathematical theory of statistics. The Galton Laboratory for National Eugenics was instituted in 1905, and was, by Sir Francis Galton's wish, associated with the other. When Sir Francis Galton died in 1911 he bequeathed a large part of his estate to found the Galton professorship, and Professor Karl Pearson was appointed to the chair. At the same time the senate of the university appealed for funds for building and equipment, and Sir Herbert Bartlett came forward with an offer to provide the building on a site at the northwest front of the college. During the war the new building was used as a military hospital, and only now has the department been able to take full possession. On the ground floor of the building is a large museum for the illustration of heredity, statistical processes, and social problems, a lecture theater, a room for the exhibition of Galton relics and apparatus, and an anthropometric laboratory. On the first floor there are laboratories, a library, and a common room, and on the second a photographic studio, a large room for biometric workers in craniometry, and rooms for archives and instruments. The apartments in all number over twenty, and it was announced that a site has been reserved for extension, which will include animal breeding accommodation.

The vice-chancellor of the university, Dr. Russell Wells, who presided over the opening ceremony, said that statistics, properly understood, was one of the most difficult and advanced mathematical studies, but it was a dangerous weapon in the hands of the partially educated. Medicine in particular had suffered greatly from its misuse. The method introduced by Professor Karl Pearson would make it possible to arrive at the proof of many complicated medical problems. In sketching the history of the department, he reminded the audience of Florence Nightingale's well-known interest in statistics, and of her desire to found a professorship of applied statistics at University College, for which, however, her means were not sufficient. It was not until the generous provision of the Drapers' Company was made that a start became possible.

Dr. Addison gave an appreciation of the value of statistics which he had discovered when minister of munitions. There were few branches of public service with greater scope for the trained statistician than that of communal health, but here and in social science many statistics had been of a thoroughly incomplete and unsatisfactory nature. He commended to the support of the public the further appeal which University College was making to maintain and complete the equipment of the new building.

The provost, Sir Gregory Foster, expressed the thanks of those present to Dr. Addison. The thanks of the university to Sir Herbert Bartlett for his gift were expressed by the vice-chairman of the college committee, Dr. J. Bourne Benson. Professor Karl Pearson said

[28] When during the "Reign of Terror" Lavoisier was condemned to death, a petition was presented to the rulers that his life might be spared for a few weeks in order that he might complete some important experiments, but the reply was "The Republic has no need of savants." (Goode, George Brown, "The Origin of the National Scientific and Educational Institutions of the United States," Rpt. U. S. Nat. Mus., 1896–97, p. 324, 1901.)