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BEING THE

ANNUAL REPORTS

OF THE VARIOUS

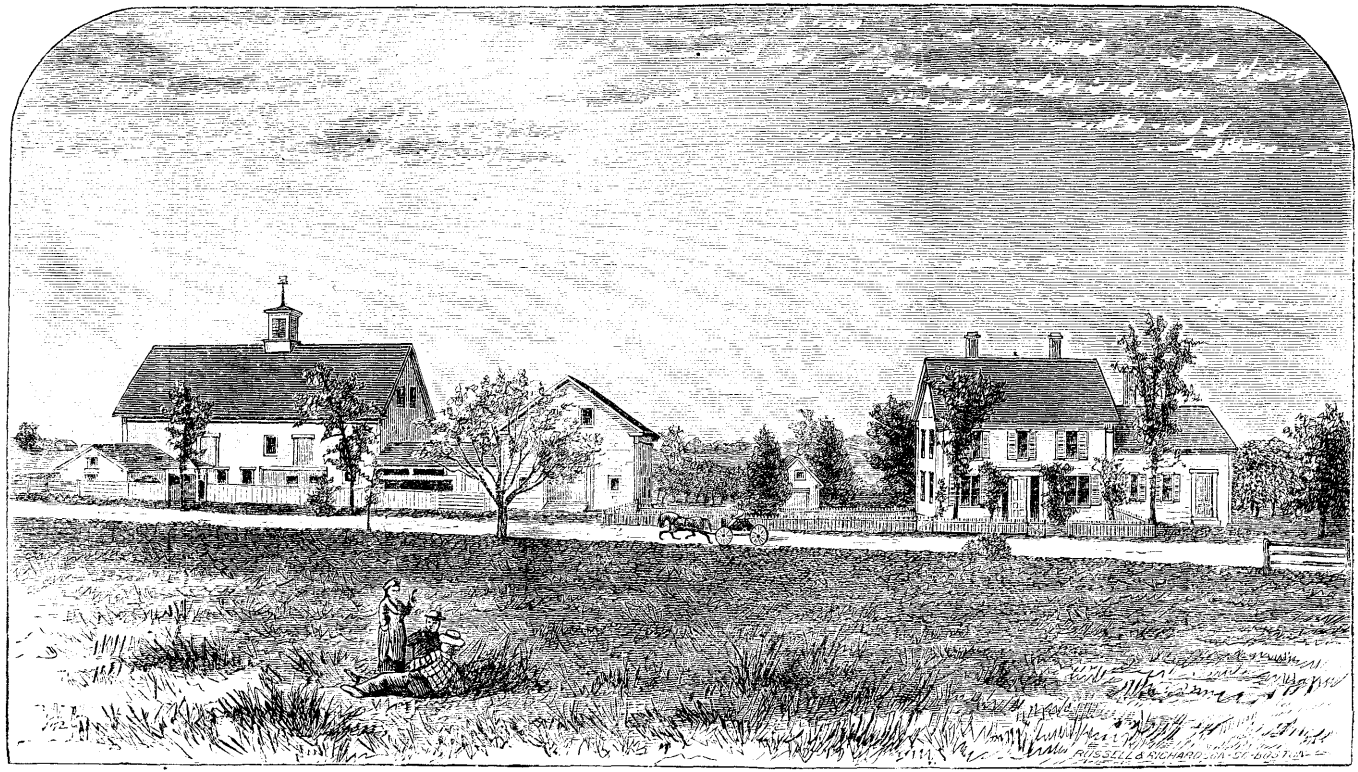
PUBLIC OFFICERS AND INSTITUTIONS

FOR THE YEAR

1878.

VOLUME II.

AUGUSTA:
SPRAGUE, OWEN & NASH, PRINTERS TO THE STATE.
1878.



RESIDENCE AND FARM BUILDINGS OF IRA E. GETCHELL, PRESIDENT OF THE MAINE BOARD OF AGRICULTURE, WINSLOW;
[P. O. Address, NORTH VASSALBORO'.]

Carleton, Photographer, Waterville.

TWENTY-SECOND ANNUAL REPORT

OF THE

SECRETARY

OF THE

MAINE BOARD OF AGRICULTURE,

FOR THE YEAR

1877.

AUGUSTA:
SPRAGUE, OWEN & NASH, PRINTERS TO THE STATE.
1877.

MAINE BOARD OF AGRICULTURE.

IRA E. GETCHELL, PRESIDENT.
W. W. HARRIS, VICE PRESIDENT.
S. L. BOARDMAN, SECRETARY.

MEMBERS AT LARGE APPOINTED BY THE GOVERNOR AND COUNCIL.

Name.	P. O. Address.	Term expires Dec. 31.
M. C. Fernald	Orono	1877
Henry Carmichael	Brunswick	1877
C. F. Allen	Orono	1879
George E. Brackett	Belfast	1879
D. M. Dunham	Bangor	1879

MEMBER CHOSEN BY STATE AGRICULTURAL SOCIETY.

B. M. Hight	Skowhegan	1877

MEMBER CHOSEN BY STATE POMOLOGICAL SOCIETY.

J. A. Varney	North Vassalboro'	1878

MEMBER CHOSEN BY MAINE POULTRY ASSOCIATION.

W. W. Harris	Portland	1877

MEMBER CHOSEN BY MAINE DAIRYMAN'S ASSOCIATION.

J. R. Nelson	Winthrop	1879

MEMBERS CHOSEN BY COUNTY SOCIETIES.

Ira E. Getchell	Kennebec	N. Vassalboro'	1877
Z. A. Gilbert	Androscoggin	East Turner	1877
Lyman H. Winslow	Lincoln	Nobleboro'	1877
C. W. Hersey	Washington	Pembroke	1877
P. W. Ayer	Waldo	Freedom	1877
Horace Bodwell	York	Acton	1878
Thomas Reynolds	Oxford	Canton	1878
J. Marshall Brown	Cumberland	Portland	1878
George Flint	Somerset	North Anson	1878
Isaac E. Mallett	Sagadahoc	Topsham	1878
Samuel Wasson	Hancock	East Surry	1879
John Thissell	Penobscot	East Corinth.	1879
J. O. Keys	Franklin	North Jay	1879
H. L. Leland	Piscataquis	East Sangerville,	1879
Nathaniel Alford	Knox	South Hope	1879
C. Hayford	Aroostook	Maysville Cent'r.	1879

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INTRODUCTION.

To the Honorable Senate
and House of Representatives:

In accordance with the provisions of the statue, I have the honor to transmit the Annual Report of the State Board of Agriculture for the year 1877. At the annual meeting, which was held at Newport, Feb. 20th–22d, Ira E. Getchell of Winslow was elected President; W. W. Harris of Portland, Vice President; and Samuel L. Boardman of Augusta, Secretary. The usual standing committees were appointed, and the incoming members qualified, after which an address of welcome to the Board in behalf of the citizens of Newport, was given by Don. A. H. Powers, Esq., when the public exercises of the convention opened.

In accordance with a vote of the Board at its previous session, the subject of Indian corn and its cultivation formed the topic of leading discussion, the treatment of the same under the various heads having been previously assigned to different members. These papers and discussions occupy the first fifty pages of the accompaning report, and present a compact body of history, statistics and information upon this most important crop, which our farmers would do well to carefully study, before the opening of another season's work. The opening of the discussion having been assigned to myself, I desire to make acknowledgement in this place to the authorities consulted in the preparation of that paper, which I could not well do in the lecture itself. Beside the reports of the various State Boards of Agriculture, and agricultural societies, the general and special cyclopœdias, the reports of the

National Department of Agriculture, and the agricultural press—mention should be made of the following sources of facts and opinions: The work on Indian corn by William Cobbett, published at London in 1828; Transactions of the Essex county (Mass.) Agricultural Society for 1849; Sixth Report of the Massachusetts State Board of Agriculture, 1858, containing the very able treatise on this subject, by Hon. Charles L. Flint; the history, culture and varieties of Indian corn, by Hon. J. H. Klippart, published as an appendix to his treatise on the Wheat Plant, 1860; Indian corn, its value, culture and uses, by Edward Enfield, 1856; articles by B. F. Johnson in the Fifth Report of the Illinois Industrial University, 1873, and Transactions of the Illinois Department of Agriculture for 1875; Inventory of the Food Collection of the South Kensington Museum, London, 1872, and Mr. Edward Smith's treatise on Foods, London, 1873.

In addition to the treatment of this subject, numerous essays and lectures were presented by members of the Board and other gentlemen, most of which are published in full, in the following pages. Where not so published, they related to subjects, which have heretofore received the attention of the Board, or were withheld at the request of their authors. Among others, and bearing directly upon one of our leading industries, was that of Hon. John L. Hayes of Boston, on Wool Production and Sheep Husbandry, which forms one of the most important contributions to the present volume.

The meeting at Newport was one of the largest in point of attendance, and one of the most successful in results that the Board has ever held. Meridian Hall, the use of which was generously given to the Board by the citizens of the place, was crowded during the entire convention, and the meeting could apparently have been continued for a number of days to decided profit.

The semi-annual meeting, in accordance with a vote of the Board, was held at Alfred, in York county, on the 16th–18th of October. At this meeting, by previous assignment, the subject of manures formed the leading topic, the report of

which will be found on page 169. The main object of their discussion was not to treat the subject with completeness, but to take up some important, but rather obscure points which have not heretofore received much attention from the Board. These related to our imports and exports of manures and fertilizing substances, the value of liquid manures with the methods of their application, and the use of muscle bed as a fertilizer. Upon these points valuable information was elicited, as the full report will show.

At the annual meeting at Newport, the Committee on Topics made the following recommendations: "That there be appointed a committee of four to report at our next session what measures, if any, should be taken to enlarge the scope, increase the facilities and promote the efficiency of the agricultural department of the State College; and that the exercises of the students on the last day of the coming session be mainly confined to reports upon the experimental and practical workings of the college, so far as that work relates to purely agricultural pursuits."

In accordance with this vote, the exercises of the students of the State College, who were in attendance at the meeting, had special reference to the experimental work of the college in the agricultural department during the season, and a selection from the reports thus presented, is given on page 236, and susebquent pages of this volume. They show good work on the part of the students, and were presented in such a manner as to receive the hearty approval and commendation of all present. Following these, a lecture given by Prof. Carmichael, before the Board at its meeting at Fryeburg, is published in full, taking the place of the lecture on the work of experiment stations, delivered at Alfred.

It is believed that the leading subjects given in the accompanying report, are among the most important that can be presented to the farmers of Maine. When it is realized that we purchase annually nearly THREE MILLIONS of bushels of corn, and pay out over $325,000 for commercial fertilizers of different kinds—it is time our farmers turned their attention

to the husbanding and enlarging the home resources of manures, and to growing more corn and wheat for our own consumption. I doubt if the Board of Agriculture could make a better disposition of that portion of the State Bounty to agricultural societies over which it exercises control, than to devote it to the encouragement of these two great food crops of our people; and I earnestly hope, at its coming meeting, this matter will be given a careful consideration.

At this date two or three local societies have failed to make the report to me, which by law they are compelled to make, but as some unforeseen or Providential matter may have caused the delay, (which I am daily expecting to receive) I omit in their place the table of returns from such societies, showing the amount of monies expended, &c., which will be given in the second part of the volume.

The cheese factories in the State are not compelled to make returns of their operations to me, but I have sent out to such as were known to have been in operation during the year, blanks for a statement of their doings, and have replies from twenty-seven, against thirty-five in 1876. But in the returns for 1876 are reports from thirteen factories not heard from in 1877, and the returns for 1877 give reports from seven factories not reported as in operation in 1876. In 1875, there were sixty cheese factories in operation in this State; and in 1876 returns were received from but thirty-five—yet it is believed that the business of associated dairying in Maine had not depreciated to the extent indicated by the less number of factories from which returns were received in the last named year. The fairer inference is that many factories from having made a less amount of cheese in 1876 than in 1875, refused to make any report to any source from which a statement of their business would be likely to be made public. Taking these facts into consideration, it is fair to say that any statement of the amount of factory cheese made in this State in any one year is rather comparative than accurate, and is to be taken with some allowance. The full returns from

these factories will appear in a subsequent part of the "Agriculture of Maine" for 1877–8.

The year has been one of satisfactory returns to the farmer, and the impetus given to the growing of wheat and Indian corn by the public agitation of the importance of these crops to our agriculture, through the press and the public meetings of the Board, has resulted in the production of a very large increase of these crops over previous years, the results of which can but stimulate our farmers to greater exertions in the same line of effort in the future. The rewards of such a course will be abundant and sure. But little damage was done in our State during the year by the Colorado beetle, although it is believed to be very generally introduced. The timely warning given our farmers of its approach, through circulars from this Board, and the advantage in fighting them we are able to avail ourselves of from the experiences of our Western neighbors, will enable us, it is hoped, to keep them in check to such an extent that great injury will not follow their presence in our State.

The State College has passed a most prosperous year, and is more firmly grounded in the good will of the people of the State than ever before in its history. Measures are now being taken by the Trustees to render it more distinctively and purely a school of Agriculture and the Industrial Arts, which effort I feel sure will be heartily seconded by our citizens.

I much regret, that owing to severe and protracted illness during the printing of a portion of my report, several pages were obliged to go to press without a final revision of the proofs, and that in consequence several errors have crept into one or two forms. The reader, is therefore requested to make the following corrections of the press:

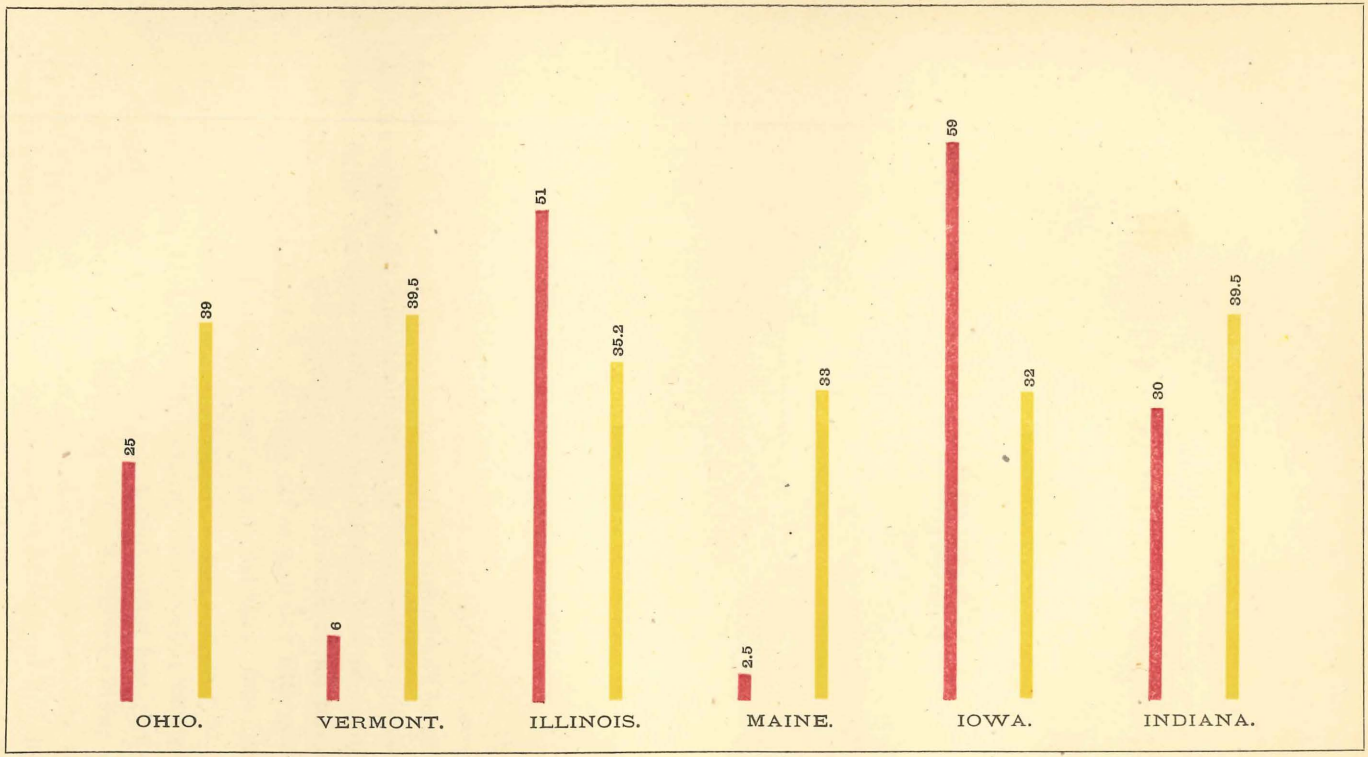
On page 71, seventh paragraph, for "miller," read midge; page 74, first paragraph, in all places where the word "gnats" occurs, read ants; page 75, fifth paragraph, last line, for "tents," read belts; page 101, second paragraph, for "grapes" read grass; page 102, for "colens," read coleus; for "stabria,"

read salvia; for "bar," read var; for "centanceas," read centaurias; for "achyremthes," read achyranthus; page 103, for "zennias" read zinnias; for "helitropes," read heliotropes; page 111, third line from top, insert the word thousand, between the word "fifty" and "bales," so that the sentence shall read, "one hundred and thirty to one hundred and fifty thousand bales." A few other unimportant errors the reader will naturally correct.

Respectfully submitted,

SAMUEL L. BOARDMAN, *Secretary.*

OFFICE OF STATE BOARD OF AGRICULTURE,
Augusta, Dec. 25, 1877.



RED—Yield per capita in bushels.
YELLOW—Yield per acre in bushels.

LINE-EXHIBIT OF YIELD OF INDIAN CORN IN SEVERAL STATES—1870.

MAINE BOARD OF AGRICULTURE.

PAPERS AND DISCUSSIONS

AT THE ANNUAL MEETING AT

NEWPORT, FEB. 20th, 21st and 22d, 1877.

INDIAN CORN.

I. Historical and Introductory.

BY THE SECRETARY OF THE BOARD.

It was decided by the Committee on Topics, at the last session of the Board of Agriculture, that Indian Corn should furnish the leading subject of thought and discussion at this meeting. It was subdivided into four sections, which were given out for treatment to members of our Board—the first division, that relating to the history, varieties, chemical composition and statistics, having been assigned to myself. It is, I assure you, a broad and intricate theme, demanding for its satisfactory presentation greater ability than I have ever laid claim to; and in the time I am to occupy, I can only glance at the points involved. The gentlemen who are to follow me to-day and to-morrow, each have most important divisions of this subject to present to you; and they have indicated to me in the correspondence we have found it necessary to have

upon the matter, that they each had the most difficult part of this great subject assigned to them—an evidence of the vastness of any one of the branches of our agriculture, which only presents itself in its magnitude and importance, whenever we sit down to thoughtfully and persistently study it. As for myself, I need to ask your indulgence beforehand, and if I make mistakes, you will be so good as to acknowledge I go astray in good company, and belong to a large and quite respectable portion of the community.

And first, a few words concerning the name; which, as some writer has said, is called "Indian" because it did not come from India,—which may be reasonably doubted, however—and "corn" because it is not corn at all, but something else. It is indeed one of the natural grasses, and has been called by botanists, *Zea Mays*, the genus *zea* comprising but a single species, though an almost endless number of varieties; so far as this country is concerned, at least, and possibly throughout the world; the other species described by M. Hueze, five in number, being really sports, or vegetable curiosities, and not with either accuracy or justice to be classed as species.

It is a curious fact, that *zea* comes from a Greek word meaning to live, because of the great amount of nutritive matter which it contains; while maize in the Gaelic or Irish is "food." In the Lettish and Livonic languages of the north of Europe *mayse* means "bread." The word corn comes from the Saxon "corn," the Dutch koorn, and the Danish, German and Swedish, "korn." In England corn means all grain, but especially wheat, while in our country the courts of one State at least—Pennsylvania—have decided that "corn" means maize: Indian corn.

Botanically, maize is characterized by its monœcious flowers forming a terminal panicle or tassel, each spiklet containing two flowers, each with two palæ and three stamens. Or in other words, it has both male and female flowers, the tassel being the male portion, and the silk the female—being unlike the flowers of the wheat plant, which are hermaphrodite, or

male and female flowers both included, and each forming a portion of the same flower. The male or fertile flowers of maize (the ear) form a long dense spike, completely enveloped in a number of floral leaves (husks) from which the thread-like stigmites (silk) protrude several inches. The spiklets, as in the male, contain two flowers, but they have no stamens—one flower has an ovary with a long style ending in the thread-like forked stigmite, the other flower has only two empty palæ.

The origin of maize, if not unknown, is a disputed matter among naturalists; and its early history is obscured by the shadows of the most remote antiquity. And notwithstanding writers on the subject lament the dearth of information, and the poverty of knowledge accessible to the student concerning its origin and history, yet I have found that a careful study of what *has* been written upon the subject, is somewhat bewildering to a person seeking to know just exactly where Indian corn originated, and what has been its history—for all our useful and cultivated plants have a history which is often as interesting as that of individuals who have taken a conspicuous part in the great affairs of the world. Indeed, the history of some plants is so intimately connected with the progress of civilization as to be inseparable from the annals of kingdoms and peoples. It will only be necessary for our present purpose, however, to examine very briefly some of the theories and facts which have been put forth regarding the origin and history of the plant under consideration.

Among the most famous and enthusiastic admirers of this grand plant, was that able English reformer and defender of the people against all forms of oppression and monopoly, William Cobbett, who in 1828, introduced it into England from this country, attempted to give his own name to it, and was so infatuated with its valuable properties that he ate it constantly, smoked its leaves, planted it, and wrote a treatise upon it, some parts of which were printed on paper made from the husks. He believed that the allusions frequently made to "corn" in the Bible, could have had reference to no

other plant than our maize or Indian corn. Mr. Flint expresses the belief that the misconception of Cobbett in regard to the Biblical language, arose from his ignorance of the ancient mode of sowing wheat or as it was universally called by the old writers "corn." Large fields of it were sown, between which a narrow road or path was left for the public —a road just wide enough for the team to pass without injury to the grain, there being no fences for protection, so that the "going through the corn-fields" might indeed be taken literally. It was sometimes gathered with the sickle, and sometimes by passing through the field and plucking off the heads or ears, the reaper having an apron or pouch into which to drop them. But for myself I am more than half inclined to believe Cobbett was right in his inferences;—at any rate no one who has read his comments upon these Biblical passages, can fail to admire the enthusiasm with which he states his case, and the truthfulness of his applications of these passages to the modern practices relating to the culture and uses of our maize. Listen to some of these scriptural quotations:

In 2d Kings, 4th chapter, 42d verse, it is said "There came a man from Baal-shalisha, and brought the man of God twenty loaves of barley, and full ears of corn in the husks thereof, and said, give unto the people that they may eat." In Leviticus, 2d chapter, 14th verse, there is an injunction to offer as a "meat offering of first fruits unto the Lord, green ears of corn dried by fire, even corn beated out of full ears." In Deuteronomy, 23d chapter, 24th and 25th verses, there is a command respecting the conduct of persons who may be in need of food, in these words: "When thou comest into thy neighbor's vineyard then thou mayest eat grapes thy fill, at thy own pleasure; but thou shalt not put any in thy vessel. When thou comest into the standing corn of thy neighbor, then thou mayest pluck the ears with thine hand; but thou shall not move the sickle into thy neighbor's corn." In Leviticus, 23d chapter, 14th verse, the Israelites are told: "We shall eat neither bread nor parched corn, nor green

ears, until the selfsame day, until you have brought an offering unto your God." In the account of Pharaoh's dreams, in Genesis, 41st chapter, 5th verse, it is recorded: "And he slept and dreamed a second time; and, behold, seven ears of corn came up upon one stalk, rank and good." In Job, 24th chapter, 24th verse, it is said that the wicked, though they flourish and hold up their heads for a while, are "cut off as the *tops* of the ears of the corn."

Now, if one will study this matter closely and apply these passages to the operations of farmers in our own day in harvesting and using the crop, it will not be a difficult thing I imagine for him to come to a similar conclusion as did Cobbett. But Cobbett is not alone in assigning to maize an Eastern origin. M. Bonafous, a learned and ingenious native of Sardinia, about whom I can gather no personal information, but whom I find quoted in all the writings on this subject, wrote a work on the native country and history of Indian corn, which was published at Paris in 1836, in which he maintained that maize was of Eastern or Chinese origin; and although some of the most celebrated botanists and savans combatted this opinion—among them Humboldt and De Candolle—there has of late years been a growing belief in the minds of persons of authority that Bonafous was right in his conjecture, if not in his arguments. Modern botanists have advanced the opinion, that as neither North or South America possess plants allied to maize, and as Eastern Asia has them in numbers, and as it is true, as a general statement, that plants of allied families are quite sure to be found growing together, it has therefore been inferred—taken together with the fact that *zea mays* was first correctly described and illustrated in a Chinese work written in 1552—that the plant has an Asiatic origin. The inference to be drawn from the above is, that at a period so remote we have no record of it, America and Asia were connected by land with Behring's Straits, and over this old highway of an ancient civilization came a vast immigration from Eastern Asia, bringing to what afterwards became the New World, the maize plant, the seeds

of the Catalpa, Honey Locust and other seeds and plants. This coming from Asia to America might have occurred by other means than across Behring's Straits, since within the memory of man, there have been several shipwrecks and castaways of junks from China and Japan on the Atlantic islands —junks drifting with passengers, crew and cargo, safe and sound 2,500 miles from home, and landing on the northwest coast of North America. It should not be forgotten in considering this theory, that Columbus died in the belief that he had discovered the eastern extremity of the Continent of Asia or farther India. The possibility, therefore, of such an origin of maize, may become a probabilty, if learned antiquarians succeed in establishing the fact that America was discovered by Chinese Buddist priests, at least a thousand years before its discovery by Columbus, to which matter Mr. Leland's recently issued volume is devoted. Bock, a botanist who wrote only forty years after the discovery of America, asserts that Indian corn came from Arabia, and was called *wheat of Asia*, *great wheat* and *great reed*. Ruellius, who wrote a few years later than Bock (and whose assertions all modern writers deem worthy of high respect), asserts that the plant came from Arabia. Fuchsius, an ancient writer, also declares that it came from Asia to Greece, and thence to Germany, where it was called "wheat of Turkey," because the Turks at that time controlled all Asia. Crescenzi, the father of Italian agriculture, who flourished about 1250, and who is said to have given the best information about the agriculture of antiquity of any writer of his time—describes the method of cultivating this plant in his day, which is the same as that of cultivating our maize of the present day; and Sata Roza de Viterbo, a Portuguese writer, asserts that maize was known in the thirteenth century. Travellers who have visited the Asiatic isles, have inferred that it was cultivated about the equator, in that vicinity, from great antiquity, and that it passed from these isles into China, and thence to the interior about the Himalaya mountains. John Crawford, who lived for years in the island of Java, and who published an account of his travels, says:

"Maize is, next to rice, the most important agricultural product among the great tribes of the Indian Archipelago." Finally, Mr. Rifaud asserts that some kernels of maize were found, in 1819, in the sarcophagus of a mummy at Thebes, after the lapse of thirty or forty centuries.

Now a few words must be said regarding the statements of those who have believed that maize is indigenous to this country, and that to the New World should belong the honor of having given it to the Old. And here will be found the names of distinguished scientists who differ from the writers quoted above, concerning the origin of the plant, the difference being mainly a purely technical one, and turning on the point as to whether the plant described on an old chart of Incisa of the thirteenth century, as *meliga* or "wheat of Turkey," was identical with the *zea mais*. Gerard, in describing several kinds of Turkey wheat, which were evidently species of maize, says: "These kinds of grain were first brought into Spain and then into the other provinces of Europe, not (as some suppose) out of Asia Minor, which is in the Turk's dominions, but out of America and the Islands adjoining, as out of Florida and Virginia, or Norembega, where they used to sow or set it, and to make bread of it, where it groweth much higher than in other countries." M. E. Discourtilz says maize was introduced into Europe by the Spaniards, who brought it from Peru; and Thomas Nuttall, the old American naturalist, believed it to be indigenous to tropical America. Finally, Baron Humboldt says: "It is no longer doubted among botanists, that maize or Turkey corn is a true American grain. On the discovery of America by the Europeans, the *zea maize* was cultivated from the most southern part of Chili to Pennsylvania"—and he might have said to this section, for such was really the case. He then goes on: "According to a tradition of the Aztec people, the Toltecs in the seventh century of our own era, were the first who introduced into Mexico the cultivation of maize, cotton and pimento. It might happen, however, that these different branches of agriculture existed before the Toltecs, and that

this nation, the great civilization of which has been celebrated by the historians, merely extended them successfully. Hermandez informs us that the Otamites even, who were only a wandering and barbarous people, planted maize." Mr. Flint, who has investigated the early writers on this subject very thoroughly, and who inclines strongly to the opinion that it is of American origin, considered it a curious fact that maize is not mentioned by travellers who visited Asia and Africa before the discovery of America. These travellers, who were generally learned men, and were often very minute in their descriptions of the products of the soil, give no account of it until after the discovery of this country. It is true that it was universally cultivated on this continent at the landing of Europeans here. It constituted almost the only food for all the tribes of Mexico, Peru, Brazil, at the Orinoco and the Antilles. It served for money among the Mexicans, and its theft was punishable with death. In 1621 the Massachusetts Indians regaled some of the Pilgrims with bread called *mazium* made of Indian corn; the Five Nations or Iroquois made the planting of corn their business, and the Lenni Lennape (or original people), the grandfathers of other Indians, called maize the native grain. Those who believe with Humboldt that maize is a truly American plant, say it was on the return of Columbus from his first voyage in 1493, that he carried the first grains to Europe, and thence its cultivation spread into Portugal and the south of Europe. The Portugese, who were at that time the great navigators of the world, having previously doubled Cape of Good Hope, and discovered Java in 1495, introduced it along the African coast and into Java, and thence its cultivation spread into India and China, and Indian corn was—as has been stated, correctly figured and described in a Chinese work on agriculture as early as 1552. Now is it not as reasonable to suppose that this plant may have been indigenous to China, and have long been cultivated there, as to suppose that in the comparatively brief space of little more than half a century, it should have been transferred from America to Europe, thence to Java, thence to China, and

have been so generally understood and grown by that proverbially slow-moving and secluded people, as to have been figured in a book on the agriculture of the country in so short a time after its introduction? But I am satisfied those who have investigated this matter,—and which, notwithstanding the time I have given to it, is but the merest and most imperfect outline of the same,—must come down to just this conclusion; that maize may have originated in China, and thence a thousand years ago, have been carried to Peru; or it may have originated in South America, and been introduced to Continental Europe by Columbus, and thence carried into China and India by the Portuguese. Or in other words, our conclusion may take the form of a brief summary, something like this:

1st. The dissenting opinions of the botanists during the sixteenth and following centuries, about the origin of maize, do nothing but cast a heavy doubt on the Western or American origin which is attributed to it.

2d. If it were certain, as historians assert, that maize was cultivated in America when Europeans landed here, at the end of the fifteenth century, it would appear equally true that this plant was in full cultivation within India at a date previous to that.

3d. The treatise on Natural History written in China, towards the middle of the sixteenth century, marks the existence of maize in that country, within a time so close to the discovery of America, that this event must not be connected with the introduction of that plant into Asia.

4th. The maize found within a mummy's coffin at Thebes, would be a solitary but precious relic, proving that maize had existed in Africa since the earliest time.

Maize is now found in every quarter of the globe, and it is eaten by a greater number of human beings than any other grain except rice. On this continent it is more or less profitably grown from Southern Chili up the Pacific coast to Oregon, and from Canada down the broad stretch of the Atlantic to the mouth of the Colorado river in latitude 40 degrees south,

that being near the northern boundary of Patagonia in South America. It is cultivated, though to a limited extent, in China and Japan, and to a still more limited extent in India. It is a leading crop, second only to wheat and barley in all the provinces of the Ottoman Empire. The same statements may be made of Southern Russia, Hungary, Southern Austria and Portugal. In France it is grown in what is termed the "maize region;" in Germany between Heidelberg and Frankfort, while it is also cultivated in the West Indies and the islands of the Eastern Archipelago. In the British Isles, maize will not mature oftener than once in six or seven years, on account of the cool, moist summers. After extensive observation and inquiry, De Candolle assigns the growth of maize to the following limits: In North America, south of 54 degrees, north latitude; in South America, north of 40 degrees, south latitude; in Europe, south of latitude 54 degrees, north. Still, within this great general area there are sections, more or less extensive, in which, on account of soil, climate, or elevation, maize cannot be grown. Such for example are the dry coast lands in California, and the mountainous elevations of New York, Canada West, Northern Maine, Vermont, Wisconsin and Minnesota. It will not germinate unless the temperature of the soil is at least 48° Fahrenheit; has its most rapid development at 93°, and never germinates when it is above 115°. But when the mean temperature of the period of growth ranges from 60 to 80 degrees, Fahrenheit, maize accomplishes all the phases of its existence in from 60 to 150 days—soil, climate, and the variety cultivated making up for this wide difference in the time required. According to Boussingault, in Alsace in France, 40 degrees north latitude, with a mean temperature of 62° Fahr., maize matured in 153 days, requiring a total of 9.539 degrees of accumulated heat. In Jamaica, in latitude 18 degrees north, the average mean temperature of 71° Fahr. for 122 days, with a total amount of heat of 9.735 degrees, was required for maturing maize. On the elevated plains of the east side of the Andes, in South America, with

the low average of 58° Fahr., 183 days, and 10,697 degrees of accumulated heat were required. In Central Illinois, where the mean average temperature for May, June, July and August was 71° Fahr., a total amount of heat of 8.819 degrees was needed to perfect the crop; and in Massachusetts, the average mean temperature for the above named months being 64° Fahr., but 7.856 degrees of heat were obtained. What is true of wheat, is also true of Indian corn, in this particular, that it attains its maximum of production nearer its northern than its southern limit; and, indeed, even in those States where it may sometimes be cut off by extremes of temperature, as in Wisconsin, Northern Illinois, Michigan, Central New York, and Northern New England. Its period of vegetation is shortest where the average mean temperature is the most elevated; it demands from 6,500 to 7,000 degrees for the earlier varieties to fully mature, and it may be accounted a sure crop in almost every portion of the habitable globe, (with the few exceptions named), between the 44th parallels of latitude, north and south. This of course is a broad statement, applicable to the globe; but so far as Maine is concerned, it is true that we grow good corn up to 45° 20′, or along the line running from Flagstaff (Dead River), in the western, to Foxcroft in the central, and Carrol in the eastern parts of the State. Indeed, about Houlton, and even as far north as Presque Isle, 46° 40′, the small eight rowed or Canada variety matures almost every year, the farmers there growing a small amount for their own use, and harvesting at the rate of sixty bushels of shelled corn to the acre, on one-fourth to one-half acre. Assuming that the average time of planting corn in Central Maine is May 22d, and the average time of its maturity September 5th, a period of one hundred and seven days, Prof. M. C. Fernald of the State College, Orono, determines the accumulated heat for this period and locality to be 6.890 degrees. The late Dr. Holmes, in the Report on the Scientific Survey of the State, 1861, page 356, says: "the line which bounds the northern limit of Indian corn maturing in Maine is a very irregular one, as indeed

might be expected, coinciding as it does with the isothermal line and not with the line of latitude. Corn can be raised with certainty within a few miles south of Umbagog. It is raised with less certainty on the lake shores, and again with more certainty on the northern side, as the slope sinks down toward the shores of the St. Lawrence. The Penobscot extends into this belt, and hence, while in its lower sections corn is a safe and profitable crop, in its upper section we find it a precarious one; while further east, on the same line of latitude it is again found more certain." In the report of the Vermont State Board of Agriculture for 1875–6, it is stated, page 310, that Dutton corn planted May 10th, ripened August 11th, and produced 47¼ bushels per acre; while the Early Dent, planted the same date, ripened August 5th, and yielded 49½ bushels per acre. This it seems to me is much earlier than the average time of planting in Maine.

Indian corn, readily accepts the modifications of soil and climate, and surpasses all the cereals in the ease and facility with which it settles down to that particular kind of life and growth which the circumstances surrounding it imposes. The exhausted soil and tropical heat of Cuba produces a plant having a stout stalk 12 feet high, and an inch and a half in diameter at the ground, bearing, up as high as a man can reach, one or more tapering ears of flint corn, 6 inches long, 1½ inches in diameter, and containing 16 rows of about twenty kernels. The underdrained and well manured prairie soils of Illinois, produce a stalk 8 or 9 feet high, 1¾ inches in diameter at the ground, and yields an ear, as high up on the stalk as a man's breast, which will measure from 9 to 10 inches in length, 2 to 2½ inches in diameter, weighing when dry, 16 ounces, and containing from 22 to 24 rows, or nearly 1,000 kernels. The flint corn of New York and New England, has a stalk of from 5 to 6 feet high, from which ears from 6 to 11 inches long push from the stalk at from 18 inches to 2 feet from the ground, yielding from 50 to 100 bushels of ears to the acre. All who have observed the growth of corn, have noticed the strong tendency of any

variety introduced from abroad, after a few years of cultivation, to assume the form and shape common to the new locality—partly due to cross fertilization, or hybridization, and partly in conformity to the general law that every soil, latitude and situation produces a certain normal development, which is so positive that it cannot be overcome but with great difficulty. If the corn of Cuba was introduced into Illinois, it would rapidly change its form, increase the size of its ear, lessen the strength and height of its stalk, shorten its period of growth, and accommodate itself to the new circumstances. So, on the other hand, if the corn of Illinois was placed in the tropical climate of Cuba, it would speedily settle down in its new home, and in a few years so change as to be scarcely distinguishable from indigenous varieties. But it is true, notwithstanding this peculiarity of corn to change its characteristics to new surroundings, that while northern varieties will generally improve in size and productiveness if carried southward, southern corn, if brought north, will either not mature or soon degenerate. So, too, the varieties of New England, introduced into Illinois, often do well for a year or two, but it does not generally hybridize well with the common corn of the State, as the period of blossoming is earlier or later in the one case or the other, and finally loses its individuality and degenerates. Occasionally, too, Western corn, brought to New England, will in our longest summers, fully mature; but generally, in a few years its distinctive characteristics disappear altogether. There is a variety called Brazilian maize, with ears no longer than one's little finger, with kernels not larger than a mustard seed, while to the other extreme are the giant southern varieties, having a large cob, and kernels fully half an inch long. In one variety, which Bonafous describes as a distinct species, each kernel is enveloped in a miniature husk like a delicate wrapper, and while this variety is by some considered the primitive type, the kernels lose their husky envelopes by cultivation; neither has this nor any other form of maize ever been found in the wild state.

Of course, this flexibility in the character of maize, this ease with which it adapts itself to circumstances and location, causes almost innumerable varieties, which are occasioned by the differences of soil, climate, selection of seed, modes of culture, &c. M. Bonafous mentions one hundred and twenty varieties, as belonging to Spain; and Mr. Klippart describes sixty-nine as being cultivated in the State of Ohio. Mr. Enfield, in his general work on Indian corn,—which, though somewhat hastily prepared and rather unsatisfactory, contains much important information,—describes ten varieties of yellow corn, eight of white, and ten of sweet.

Varieties differ from each other in color; number of rows on the cob; form and size of the kernels; hardness and chemical composition of the grain; time of maturity; resistance to cold, drouth and wet; weight of the grain; tendency to keep, and their value as fodder. The most distinct of these, are the white flint, yellow flint, gourd seed, Guinea or pop-corn, and the sugar or sweet corn. The gourd seed is the variety largely grown throughout the South, and is very prolific; while the splendid yellow corn of New England is the most nutritious. Indeed, there is but one sort known more nutritious than our yellow corn, that is the corn of New South Wales, which is superior in this respect to any variety known, but is of little commercial value, being produced 14,000 miles away from food centres. There are also varieties that are red, blue and purple; but they are only regarded as novelties, and are never cultivated as a field crop. Concerning the sorts grown in our own State, it only needs to be said, in general, that we should aim to grow those varieties which have a small cob, good depth of kernel, mature rapidly, and thus accomodate themselves to our short summers. Such are somewhat dwarfish in their habit of growth, generally productive, and only occupy the ground for three or four months—some even less than one hundred days. The New England eight-rowed, Canada yellow, and Dutton are esteemed varieties in this State.

Considering the flexible nature of Indian corn, the ease with which it is managed, and the readiness with which it assumes to itself new characteristics, desired by the cultivator, it is strange that more attempts have not been made by our farmers at improving the varieties they now have, or of producing new ones better adapted to our needs. In this State, the desideratum is to increase the early maturity of a variety, without diminishing its productiveness. And if farmers realized how much could be accomplished in this direction by hybridizing, or a mixture of selected varieties; or even by great carefulness in selecting the seed of the variety cultivated, obtaining the earliest ears, and ears from stalks producing the largest number of ears—great results towards the desired end could be reached by a few years' persistent effort. But in this matter, as in a good many others, farmers are not unlike some other people, who often get indifferent and drift along in the old ways without inquiring for anything better. It is true, however, that the two simple matters of selection and culture, will do wonders in a few years towards a permanent improvement of the varieties grown. By applying the same principle of selection to seeds, which our best breeders follow in the mating of their animals, results equally as desirable may be gained. By this means Mr. Hallett of England, doubled the size of heads of wheat; and Mr. Baden of Maryland, established a variety of corn which gave him, uniformly, from five to seven, and frequently ten ears to a single stalk. If a farmer is curious to extend his experiments in this direction, hydridizing offers the surest mode of reaching the highest results. It would of course take a longer time, but it is a subject full of interest, and is so easy of accomplishment any farmer may succeed in it. First, decide what precise traits or properties you wish the new variety to possess, then obtain sorts well adapted to the climate, and such as produce its tassels and silk fibres simultaneously, giving the varieties while growing the best opportunity for development—good soil and good culture. From these varieties propagate the intended sort from the most perfect types

obtained, and by continued selection of the best ears from the newly obtained sort, go on in the same line of improvement until the variety is well established. It would not be easy to foretell the extraordinary results that could be reached in thus improving and multiplying the varieties of corn, through the united agencies of careful selection, judicious crossing, and thorough cultivation; and whoever will apply to this subject the needed care, judgment, skill and patience, will find abundant reward in the production of a quality of maize superior for his own locality to any yet known. And this compensation is open to any farmer who will engage in the work necessary to reach it.

I can hardly enter upon a statement of the chemical history of the plant without trespassing upon that division of the subject assigned to a gentleman who is to close this discussion; still, without a brief glance at it, my part would certainly be incomplete.

An analysis of maize shows it to be admirably adapted to sustain life, and to furnish materials for the growth of both human beings and domestic animals. Indeed there is hardly any other grain which yields so much for the support of animal life. It contains 10 per cent. of albuminoids or flesh forming materials; 68 per cent. of carbo-hydrates—starch, sugar, &c.; 7 per cent. of fat, and from 1 to 2 per cent. of ash or mineral matters. The large amount of oil or fatty matter is noticeable, varying with the kind of corn, from 6 to 11 per cent.; the hard flinty varieties or northern localities having the most, and the starchy varieties the least. Wheat contains but 1½ per cent. of fatty matter; and as compared with wheat for human food, 138 pounds of corn would be equivalent to 100 pounds of wheat. Corn is a highly concentrated nutriment, and is capable of serving as it does in some tropical countries, as almost the sole food of the population. The cob, though but slightly nutritive, contains some materials which aid in the formation of flesh and bone; and the grinding of the entire ear as a food for cattle, is to be recom-

mended. A more minute analysis is as follows; (authority of Dr. Playfair, Kensington Museum, London):

Water,	14.0		Water,	14.0
Gluten,	12.0		Flesh and force producers,	12.0
Starch,	60.0			
Sugar, Gum,	0.3	Or	Force producers,	73.0
Fat,	7.7			
Woody fibre,	5.0			
Mineral matter,	1.0		Mineral matter,	1.0

On the authority of Dr. Sturtevant of Massachusetts, a bushel of grain, with its corresponding cob and stalks (stover) would remove from the soil on an average, as follows:

	Grain, lbs.	Cob, lbs.	Stover, lbs.	Total.
Nitrogen,	.89	?	.38	1.27
Phosphoric acid,	.31	.02	.30	.63
Potash,	.18	.03	1.33	1.54

Now if this table represents the actual exhaustion of the soil by the removal of a crop of corn, the question comes up, why will not the application of these amounts of these constituents on any land favored by temperature and moisture, produce a bushel of grain? But the answer comes, and it comes only after the results of repeated and careful experiments have been noted:—It is an easy matter to supply the chemical elements found in our crops, to the *soil*, but not so easy a matter to supply them to the *plants* we are growing. So much depends upon the variety of seed, the peculiarities of the season, the influences of other surrounding circumstances and modifying influences known and unknown, that it is impossible to prophesy the amount of grain of a certain kind which a given quantity of chemicals may grow. If this were possible, the agricultural millenium would be here, and the agricultural millenium is a good ways off. To accomplish it there would positively have to be no variation in soils; no difference in varieties; an unvarying and unchanging round of season, temperature and all climatic conditions; chemical manures of undoubted purity, and man so perfect as to make no mistakes. Until these conditions are reached, we must do

the best we can with finely pulverized soil, the best selection of seed, good cultivation, and plenty of fine, old, well decomposed, barnyard manure. All these properly mixed with strong arms and willing hearts, will bring results so far above disappointment, that the farmer need have no cause for complaint. Still, efforts in the other direction are both honorable and to be encouraged; and no one, perhaps, in our country, has done more to bring practical formulæ of this nature to the assistance of practical men, than Prof. Stockbridge of the Massachusetts Agricultural College, whose name has been brought quite prominently before the farmers of the country in this connection, during the past two or three years. His experiments have led him to promulgate a formulæ for the production of fifty bushels of the grain of corn, and its natural production of stalks to the acre, more than the natural yield of the soil, as follows:

Nitrogen,	64 lbs.	In the form of	Sulp. ammonia, 24 pr. ct.	dry salt 320 lbs.
Potash,	77 lbs.		Muriate potash, 80 "	" " 154 "
Phosphoric acid,	31 lbs.		Superphosphate, 13 "	sol. acid 248 "

His formulæs have been pretty generally experimented with by the farmers of New England, and while it is believed he has struck the key note to much practical truth, it must also be said that in many instances the results have been such as to make the trials very unsatisfactory.

You will be glad, I know, that I have but one other point to mention; that a dry and uninteresting one, which I have reserved for the last, and which can be disposed of in few words. I refer to statistics;—and if at the first we were bewildered with the labyrinth of conflicting facts and opinions regarding the origin of this plant: at the last we are certainly bewildered by the array of figures which indicate the wide extent of its culture throughout our country, and the vast quantities produced, consumed, and exported.

Before the American Revolution, maize had not only become an important staple crop of home consumption, but was also largely exported; Virginia alone, in a single year often sending abroad 600,000 bushels. The immense and rapid increase

in its production dates back, however, only forty years, and is largely due to the gradual extension of settlements westward, and the development of means of transportation. In 1840, corn first appeared in the returns of the National Census, with 377,531,875 bushels; in 1850 it had reached 592,071,104 bushels; occupying 31,000,000 acres of land, and yielding a value of $296,034,552. This was a gain in ten years of 57 per cent., while the increase of population during the same period was but 35 per cent. At that date it formed three-sixteenths of the whole agricultural production of the country, occupied more than three-tenths of the improved land, and amounted to more than 25½ bushels to each inhabitant. In 1860, it had reached the enormous production of 838,792,742 bushels; its highest annual yield—as it had fallen to 760,944,549 bushels in 1870; due largely to the increased production of wheat and the occupation of the land with this crop. Of this amount eighteen States produced over 14,000,000 of bushels each; Illinois occupying the grand position of yielding 129,921,395 bushels in a single year. The exports of corn from the United States, chiefly to Great Britain, for the year 1873 alone, amounted to 38,541,930 bushels, valued at $23,794,694; besides 403,111 bushels of corn meal valued at $1,474,827: being equal in amount to the entire quantity exported by the United States for a period of twenty-three years, from 1825.

Our own State does not make a large showing in this magnificent schedule, the last census giving us credit for only 1,089,888 bushels, or about 2½ bushels to each inhabitant. Oxford county leads off in this list with 181,319 bushels; the second rank being taken by York, with 175,924 bushels, and the third by Cumberland, with 154,360; while Washington takes the lowest place, with only 953 bushels. Aroostook, which is generally set down as a county that does not produce any corn worth speaking of, added to the above total the very respectable amount of 4,242 bushels. With the most favorable conditions for growing this crop in its greatest excellence; with a record showing that our average production

per acre is 33 bushels—a yield of but ten bushels per acre less than that of the great corn producing States of Illinois, Iowa, Indiana, Missouri, Kentucky and Ohio;—it is a fact which shows heavily against us, that we only produce 2½ bushels to each inhabitant, or that our 56,941 farmers grow but nineteen bushels each. By just doubling this amount in 1877, we shall produce 1,179,776 bushels, and save to our State in this item alone, more than $600,000 which now goes out of it only by many hard knocks, to purchase western corn. I appeal to you if it is not time we made a strong effort to become more independent of corn cribs three thousand miles away?

A word may be said of the specimens of corn here presented. I wanted to have made a collection which should have embraced varieties from every county in the State, and thus have been somewhat representative and educational in character. But I failed to get specimens from some sections, and am sorry to say that in cases where samples were done up in paper and transmitted by mail they were badly damaged, and in a few instances—which is an unwelcome confession—the rats in my office went through some such packages, which came by express, and got their part, before I had time to arrange the collection. Still, all who responded to my call for samples are entitled to thanks, and myself to censure for not providing strychnine and rat traps. But while the collection is only a fragment, it is not without interest, and I am sure will impress all farmers with the exceeding value which attaches to collections of natural objects of an economic nature. I can think of no one thing more likely to interest the intelligent young farmer, than the making of a collection of grains, seeds, soils, insects, grasses, plants, woods, &c., to be found in his own locality. Such a collection would add an interest to his business and his home; while I am sure this work should be undertaken by every farmers' club and agricultural society in the State, and a perpetual museum of such things be established in connection with their exhibitions and meetings.

I should like to give you a picture of the value and importance of this grand crop, this princely grain, this king of the cereals: of its surpassing beauty in its early growth, waving in the clear air of a July morning, or rich with its heavy fruitage when ripe for the sickle, in the bland, mild days of early autumn; of its vast use as food by a larger number of the human family than consumes any other single grain, except rice; of its importance in the economy of the food supply of the nations, which renders it next to wheat, a better standard of value than even gold itself; of the hope it gives to the heart of the farmer as he looks at a crib full of its golden, life-giving ears—but I have not the time nor the ability, and if I had you would not care to hear me. During recent years I have many times been invited to visit the farms and homes of farmers, who had something nice upon which the pride of their heart was set, and which they have wanted to show me. Generally, it has been a neat stable, with its first-class and always costly fixtures and appointments; its horse wardrobe and furniture of the best make; a good stepper or two, nicely bedded down in box stalls, and half a dozen prospectively fast colts in a luxurious play-yard. This is well enough in its way, for those who have plenty of money, but costly and exhaustive in the end, and not at all adapted to farmers generally. When the system changes, and instead of a large excess of this kind of stock the farmers of Maine take pride in their flocks of sheep and dairy cows; when they show with real satisfaction their bins of wheat and cribs of corn, things which bring to wife and children the positive assurance of daily bread, and to the farmer himself a wallet in which he can manage to keep a few pieces of Uncle Sam's currency that he is not obliged to pay out for flour and corn—then will greater comfort and happiness come to our people, and our State will have entered upon a new term of prosperity and independence.

II. Preparation of the Soil and Fertilizers.

By B. M. Hight, Skowhegan.

The legitimate object of Agriculture is the conversion of inorganic substances into animal tissues; and no animal of importance lives who does not receive a large proportion of his food directly or indirectly from the vegetable kingdom. The way in which nature seems to accomplish her work, is to produce a germ endowed with life and supply it with properties or facilities for reaching a suitable place to grow. For this purpose some are provided with wings, by which they find their appropriate soil, as the seed of the thistle and maple; others are enveloped by a pulp to induce animals to swallow them and carry them where they could otherwise never go, as the apple, cherry, &c. In this manner it is obvious that the chances are very largely against the germ ever reaching a proper soil in a sound condition.

It is believed, that since the Creation no substance has been added to or taken from our earth and atmosphere. The transformation of inorganic elements, to vegetables and animal tissue, is but one side of the great circle of life existence—the other of which consists in death and decay: the continuance of either half of the circle being absolutely necessary to the existence of the other. The inorganic would supply the successful vegetable germ with food upon which it grows and comes to maturity; the mature plant then dies, decays and is resolved into its original elements to resume their places in the inorganic world, ready to again assume the vegetable form when summoned by the living germ. The introduction of animal life into this circle, serves to increase its activity by facilitating the resolution of the mature plant to its inorganic element.

The profoundly mysterious principle which we call vitality, which enables the germ to select from surrounding elements

its proper elements of nutrition, and to appropriate them to its growth, and which is furnished by Him only who breathes into the nostrils of man the breath of life, sustains about the same relation to the activity of this circle which the heart in animals sustain to the circulation of the blood. The activity of this circle in no sense depends upon the efforts of man, for it has been in active operation ever since the creation, and it is believed that it will continue until the end of time. But as nature is no respecter of persons, and bestows her aid upon one plant as readily as another, and as all plants are not available to supply the wants of man, it is for his interest to introduce into this circle a large proportion of such as are, and this is the province of agriculture.

Suppose it seems desirable to our farmers to secure a crop of Indian corn; the first thing to be attended to is the selection of a suitable soil. This, among the farmers of our State, who for the most part I apprehend select their ground and cultivate their soil quite as much with a view to future crops (grain or grass) as with a wish to secure a maximum crop of corn, is a matter of secondary consideration; in other words, instead of selecting a soil for the crop, they select the crop for the soil, and that because the cultivation of the soil adapted to secure a crop of corn is the best preparation of that soil for future crops. But supposing we are after the present crop only? To guard against cold, we secure a spot protected from northerly winds. The soil should be that best adapted to "draw the sun." This indication will not be answered, very evidently, by clay or wet land, but as rocks are, other things being equal, well adapted to this purpose, we will have some modification of sand, which is only pulverized rock. Our soil should be porous, to allow moisture and gasses to ascend from below and admit of absorption from above; our subsoil should not be loose gravel, lest the heavier compartments of our fertilizers soak down to a hard pan, unite with water and run away, if on inclining grounds, to our neighbor's land, or get so low that it shall not return in season to benefit the present crop. We would not object to

gray clay, or slate ledge, with soil enough above to indemnify against ordinary drouth. The soil proper should be of the finest sand (which is rich in silex) reddened somewhat with iron, darkened with decayed organic matter, and all so proportioned and mixed as to constitute what has been called a cling-soil of sandy loam. Such a soil is too adhesive and heavy to blow away, and too porous to bake at the surface after being wet. To prepare the soil I would commence in the season before planting, by plowing in from six to eight inches deep a heavy crop of clover or coat of vegetable dressing. This I would do early enough in the season to allow decomposition of the vegetable coat to fairly commence; then I would spread broadcast my barn dressing—(and I will say in parenthesis, I believe that two loads applied in the fall is worth three in the spring). I would then commence the work of pulverizing and mixing my soil down to the vegetable dressing. And here allow me to explain what I mean by pulverizing and mixing:—My ideal of pulverizing and mixing would be realized by placing soil and fertilizers in a painter's mill, and grinding them together as he would paints of contrasting colors, until they should blend in one perfect color. But, as most farmers have not the conveniences to use a painter's mill, I would have them come to the point nearest to that which is practicable, and that is a Randal pulverizer, a most useful farm implement. Imperfectly pulverized and mixed soil and manure are as unsucessful in securing a good crop as a surface covered with badly ground and mixed paint is in pleasing the eye. Here will be a lump of manure that nothing but a witch-grass root can penetrate, and our delicate corn rootlets must be content to suck up what little they can get of nourishment on the surface, and leave the lumps after the crop is matured to waste their usefulness on the autumn air, there being no roots in the soil to be nourished by its decomposition. Every lump of soil is so much land laying waste, and in many corn fields they constitute a proportion of the soil, larger than can be afforded, to say the least.

It may be objected to the practice of raising a clover crop to turn in, that it is just returning to the soil what it took to grow it, and nothing is gained for your pains. But such objectors do not bear in mind that the plant in its growth receives much from the atmosphere which is thus conveyed to the soil. The soil being properly prepared and manured needs no dressing in the hill, and hence no holeing, a scratch to indicate where the corn is to be dropped is sufficient.

Now, a few words concerning the fertilizers to be selected. It is impossible, I believe, to take a matured stalk of corn and by an exact chemical analysis ascertaining the ingredients of which it is composed, and thence to deduce what are the exact elements required to grow and mature another stalk like it. This experiment does not even approximately show us what inorganic elements have been used simply to maintain its vitality and then discharged from the plant; any more than an accurate knowledge of all the elements with their exact proportions in an adult animal will give you the quantity and kind of feed it took to grow the animal.

I am inclined to make two principal classes of fertilizers, viz: stimulant and nutrient. To give my opinion of the operations of the first class or stimulant fertilizer, let us suppose that my soil is prepared for a good crop of corn, that it contains all the elements for producing such a crop, and in proper proportions, and that when the crop is matured there will remain a fair amount of the elements in reserve, as will be the case when the soil produces its crop easily, if I may be allowed the expression; but I am anxious for an extra crop, so I obtain from the chemist's laboratory a supply of all the principal elements for the growth of corn, and apply this to my soil. This stimulates my plants to an extra growth, but in order to retain the proper proportion of the elements in the plant it must draw from the soil what should be held in reserve of those elements which I failed to get at the laboratory, and my soil is in a much worse condition than it was before using the stimulant fertilzer; for by unduly stimulating the soil they directly tend to exhaust it; so that after a

few years of extra spasmodic activity, the soil will gradually refuse to respond at all. Stable or animal manure, being more moderate and even in its action, and withal a natural product instead of an artificial compound, will never exhaust the land. If the soil and the human system are affected alike by the use of stimulants,—and there is no good reason that we know of why they should not be analogous in this respect—then the doctrine is undoubtedly correct. Every farmer who has had experience, knows that the use of artificial stimulants of whatever kind, never yet really proved a lasting benefit to nature in any form. They spur nature up to do more than she naturally would do but for the stimulants; but every particle of extra strength thus put forth is subtracted from the original stock which she has on hand. Now it will not require a very brilliant mathematician to see that this process carried on for a series of years will surely use up all the original stock on hand. Am I now advised that I should submit my soil to chemical analysis and supply this want? But my learned friend, I have neither the facilities or the education requisite to analyze my soil. I well know that if I should send you a quart of my soil, you would for a consideration give me an analysis; but even then that quart of soil would be about as likely to represent my whole field as a mad Congressman would to represent his constituency.

By nutrient fertilizers, I would be understood as meaning those ingredients, from whatever source derived, which furnish to the soil all the elements which the soil is expected to furnish for the growth and maturity of the desired crop. That this class of fertilizers cannot be found in decomposed animal matter I am quite well persuaded. I have been informed, that many years since the catch of alewives in Taunton, Mass., was so great that they were used for enriching the soil. This was done by placing one fish in each hill. The result was wonderful Enormous crops were raised,—but in a few years the soil failed them, and it was with the greatest difficulty that it could be reclaimed. Now, it can hardly be said that all that animal compost can do was not secured in

this case, for the fish decaying in the soil must have imparted to the soil their whole force.

In the solid and liquid excrements of farm animals we have nearly all of the vegetable matter they have consumed over and above what they have assimilated or converted to the formation of the various tissues of which their bodies are composed, in addition to the effete matter resulting from the constant wearing out of those tissues, which are simply a modification of the assimilated portions of the eaten vegetables. I would have my stock of animals well fed, and not over-worked; their feed should draw liberally from the grainery, especially from the corn crib. I would place all the refuse products of my last year's corn, and all cereal crops, where it would be mixed with all the excrements (fluid as well as solid) of my animals. If this refuse is not sufficient to absorb and hold all the liquids from my stable, I would supply the deficiency with other vegetable matter, the preference being given to those most nearly resembling corn in their composition. While this mass is undergoing the process of decomposition, I would—if my soil is disposed to the growth of sour, cold vegetation, as sorrel, ferns, or moss—use liberally of wood ashes, and keep the whole constantly stirred, (and for that purpose as good a machine as I am acquainted with is to be found in the swine's snout), until the whole is perfectly rotted and thoroughly mixed. And I ask no better fertllizer than this thoroughly mixed with my soil, for the soil must be made mellow and porous by deep and searching process of pulverizing, often repeated. For we all know, that nearly all the large crops we have any account of have been produced to a large extent by thorough tillage. It cannot, then, be too frequently or forcibly suggested to the agriculturist of Maine, that the more he contributes to break up, crush, grind and subdivide the particles of the soil, before planting, so much more does he co-operate with nature, and assist her generous efforts to return him a liberal yield.

In thus dwelling, with some repetition, upon what is deemed an important subject, we may perhaps weary the patience or provoke the severity of some critical reader; yet such is the consequence of this principle, and such the extent of its influence, that if we could thereby impress it more effectually on the minds of our cultivators, I would not hesitate to employ yet a dozen more terms to express the same ideas, did I have the ability to find language to convey them; for there is no reason to doubt that if a more thorough system of tillage were practiced by every one of our four million farmers, it would add to the corn crop of this country in a single season thousands of bushels of corn, and leave the soil in good condition for that most useful and most valuable production of the vegetable kingdom—grass.

Discussion.

Mr. Chase of Carmel. I consider corn the most profitable crop I can raise. I have raised it for thirty-five years, and have never failed of getting a crop. I can raise it for fifty cents per bushel. I generally plant about one acre. I have a small farm and do my work by my own hands mostly. About twenty years ago, when I farmed in a different part of the town from what I do now, I had a small piece, and got about 100 bushels of shelled corn per acre, as near as I could measure. Awhile after that, I had a piece which contained about an acre. It was measured by uninterested parties, and the yield was 90 bushels of shelled corn to the acre. About twelve years ago I raised, by measure, on one acre, 91 bushels and some quarts of shelled corn. Since that I have not measured my corn, but I can make a very fair estimate by seeing it in the chamber that I have measured it out of. This last year the violent wind which we had in the month of July injured my corn more than I ever had corn injured before by the wind. The drought also injured it somewhat, yet I harvested from 150 rods of land 160 bushels of ears of corn. You may say that I have told some pretty large stories, but I

am prepared to say, that one hundred bushels of shelled corn can be raised to the acre, with good manuring. I have raised ears of corn 13½ inches long; and I have, I don't know how many bushels of corn at home, as good as this which I have exhibited here. Now you want to know how I do it.

You readily understand that we cannot all farm alike. All soils are not alike, and it needs judgment to tell what soil is best adapted to produce corn. Now, to begin at the starting point, I have a good barn cellar which saves all the liquid manure, which I consider to be worth more than the solid. I use little new manure in the spring. In the fall I select my piece, which is generally where I have raised potatoes. My soil is what would be called a gravelly loam—light and dry. After I have harvested my potatoes, I haul out my manure, leave it in heaps, and at the proper time I spread it evenly. I don't measure it, but put on what I suppose will produce a good crop of corn. Then I put in the plow with oxen and horse, and turn it over about seven inches deep. I plow immediately after I get my dressing spread. In this way the manure is well taken care of, and I do it at my leizure. In the spring I make an examination, and if the cultivator going over it will make it light, I use the cultivator, if not, I take a small one-horse plow, and harrow it down well, and then my ground is ready to plant. I put no barnyard dressing in the hill, as farmers generally do. I have planted as early as the 29th of April, and had it do well. This year it was the middle of May before I got ready to plant. I take such materials as I can collect about the buildings—hen manure, ashes, leached or dry, as the case may be, anything of that kind, then I mix them with well rolled sawdust or chip dirt, or loam or muck, putting them layer upon layer, and pile it up as high as I can. In about four days it will be warm; then take a spade and spade it over into another place; let it lay about three days and then pitch it over again, and it is ready for use. This I take in a wheelbarrow, and put on the piece, making marks with a hoe to indicate where I want the corn dropped. I put in from half a pound to a pound of this

fertilizer in a place. A man will lay out in this way an acre a day without much trouble. In making this fertilizer, I have to use judgment; if I put in too much ashes it may turn the corn yellow. When I drop I put my foot in the earth to make a place for the corn, and cover it from half an inch to an inch deep. I generally plant it about three feet apart each way. I think I used this year from seven to eight cords of well rotted manure. Besides my corn, I raised eight loads of nice pumpkins—my cart holds about fifty bushels of potatoes.

This is my way of raising corn. If I were going to try and see how much corn I could raise on an acre, I would plant three kernels of corn within 18 inches of each other all over the piece. I tried an experiment one year, making two trenches within a foot of each other; then left a space of three feet, then another double row, and so over the piece. Then I planted three kernels saw-teeth fashion, 18 inches apart, in these rows. It grew very stout, and was the corn from which I got 90 bushels to the acre. The hens scratched over a a small piece of it, and where they scratched it was left thin enough, but I didn't see that the corn was any better on that part of it. I plant no beans with corn, and where I plant so close, no pumpkins. I would always run my rows north and south, because you get more sun than you do when they run east and west. I never hill my corn—have the ground as level when I harvest as when I plant. You know that the leaf of corn is a sort of spout; suppose we have a dry season, with occasional showers, then the rain runs down those leaves to the roots of the corn; and as I have no manure in the hills to dry up, the corn gets the full benefit of it. If I had a lot of dry manure in the hill it would take a good deal of water to wet through that and do the corn any good. In haying time all I do, is simply to keep the weeds down. When the corn gets up, you will find the roots running a foot and a half each way. I have been very careful in selecting seed in the field—taking the largest, nicest, and earliest ears, from the smallest stalks. I have been at work on this seed for the last twenty-five years. My seed was

originally the Dutton corn. That is earlier and will produce more than the larger varieties. It had short ears when I began with it, but by constant selection and improvement they now measure twelve and thirteen inches. I cut the top stalks off, and think they will pay for the labor of raising the corn, giving the fodder its relative value with hay, which I think about $10.00 per ton. I cut the stalks, bundle them, carry the bundles on the grass land, and let them stay two or three days if the weather is good. I have poles in the barn where I can straddle these bundles, and they will keep green. I let my corn stand until it is what I call ripe, but I don't let it get too dry. If corn fodder is musty, cattle will have nothing to do with it. I don't believe in selling hay and buying corn. I produce what I raise, and don't buy fertilizers to do it with. I ask no favors, and if the Good Master gives me good seasons I can earn my living from my farm.

Mr. PATTEN of Newport, who had on exhibition a fine trace of eight rowed corn with somewhat shorter ears than that shown by Mr. Chase, but very uniform in size and of excellent quality, being called, responded:

I beg leave to differ somewhat from Mr. Chase's theory. I acknowledge that he raises very good corn, but I claim that I can raise good corn too, and this which I have here is a sample of what I raise every year. My method is this: I plow my ground in the fall, and after plowing haul on my manure and leave it in heaps. In the spring I spread it over as much ground as I think is necessary to get a good fair coat of dressing. Then I plow and harrow two or three times, until I get the ground suitable to work. Then I mark the ground with a potato marker, which marks three rows the first time and two after that. I plant four feet in the rows and three feet in the hills. I am under the necessity of buying fertilizers. I buy the Cumberland superphosphate, which I think is the best in the market, and if we are to patronize such institutions it is best to patronize those in the State. I put about a barrel of superphosphate to the acre in

the hill, and cover about 1½ inches deep. As soon as the corn comes up, I want to put in the horse and cultivator, and I don't care how much I go over it from that time till the time of the second hoeing, if it is every day. I hill up a little, and keep the weeds down between the rows till after haying. In this way I can raise good corn and do it every year. I regard it as a profitable crop, and am surprised that so little of it is raised.

In answer to questions: I have used superphosphate some three or four years. I think it does not injure the ground in the least. I put no other dressing than the superphosphate in the hill. I raised this year some fifty bushels of shelled corn to the acre. I cover over the phosphate perhaps half an inch before planting, so that it shall not come in contact with the seed. I plant on old ground. I consider that it makes no difference whether it is after potatoes or corn. I leave the manure in heaps, because it is easier than it is to shovel it out; perhaps it would be just as well to spread it from the cart in the fall.

III. Planting, Culture and Harvesting.

By I. E. Mallett, Topsham.

It does not seem to be a great job to raise a crop of corn, after the ground has been thoroughly and completely prepared to receive the seed; but let us consider the subject for a moment: First, there is the kind and quality of seed, the proper time for planting, with the processes; then its culture at the various stages of growth, and then the securing of the crop in the best possible way or manner to have both corn and stover of the greatest value. I am glad that my friend who has preceded me, has not prepared any except suitable soil

for the planting of corn; for I am one who believes to some extent, at least, in the eternal fitness of things, and therefore I would not plant corn in a soil not intended by nature for the successful growing of this crop. The planting of corn in soil not adapted naturally to the growing of corn, reminds me of an anecdote I once read somewhere of a fellow who wanted to borrow a shilling to get him through Sunday with, and upon being asked if a sixpense would do, replied, "Well, perhaps I could get along with it, but then, what kind of a Sunday would it be?" So with corn on soil not adapted to its growth, it might produce *some* corn, but what kind of corn would it be?

I am unable to say which kind or kinds of corn will succeed best in the different localities in this State, but I do not believe in a very large variety for general cultivation. Although there may be some seasons that may be sufficiently long and warm for the larger varieties to grow and ripen, yet I think it to be the wiser course to accept and cultivate a smaller and earlier variety, one that will be pretty sure to mature sufficiently before the frosts of early autumn. I find there are some hundred or more distinct varieties of corn raised, but I believe the small and large eight rowed, and the Dutton, so called, are the varieties most extensively cultivated in this State. I am aware that nearly all, if not quite, have their preferences as to variety grown within their knowledge, and I presume that different localities, different kinds of soil, and perhaps of manures existing or being used, may produce these differences in preference. As it is an established fact, I believe, that different varieties of corn give different results when analyzed by the chemist, it is proper to conclude that different varieties will succeed better in different localities and under different treatment, at least so far as the soil and manures may affect the crop. Indian corn is very flexible in its nature, and readily accommodates itself to surrounding circumstances, (no courtier or politician being more so) but while it equals them in general flexibility, it possesses some

fixed principles which are immutable under any and all circumstances.

My idea of the proper time to plant corn is very much like that of the aborigines of this country, which was (as probably all of you are aware) when the leaves of the birch have attained the size of a mouse's ear. I think a great mistake is made by many in planting too early in spring before the heavy rains and cold nights have passed, and any rule that may be adopted to govern as to time of planting that nature furnishes, although it may not be infallible, yet it will be as sure to give success, if followed, as any that we can adopt. Some people are so superstitious that they will plant corn only when the moon is growing. There may be something in that superstition, but I would not wait a great while, or plant a week too early, merely for the sake of planting on the moon's increase. It is said that corn requires a higher temperature of the soil than rye, wheat or grass, or in fact most other crops; and when the soil is warm and sufficiently dry, I should advise to plant corn, using for the purpose, one of the most approved corn droppers, putting four or five kernels in a hill. I think that four stalks are enough to remain in a hill, but the worms generally want at least one in each hill on the average, therefore it is well to put in one kernel for them, and if they see fit, from their great considerateness to leave them untouched, I would take out the surplus stalk or stalks when hoeing. In an ordinary corn soil, I would cover the corn from one to one and one-half inches deep, although I was once told by as successful a corn grower as ever lived in Sagadahoc county, that he never wanted more than one-half inch of soil over his corn at planting. I presume it is the nature and locality of the soil that should govern in this respect.

As soon as the blades of corn are up sufficiently to mark plainly the rows, I would introduce my cultivator, (a good one) and if the weeds or witch-grass have started considerably, I would go through or over it at least twice, and each way at that, being sure to throw but very little soil about

the stalks or blades of corn. When the corn is about four inches high, or perhaps a little sooner, I would go for it again with my cultivator, and after stirring the soil thoroughly with this implement, take the hand hoes and go over after it again, stirring any soil or removing any weeds that the cultivator might have missed, and also if there should be too many stalks in any hills, take out the unnecessary ones. I would endeavor, yes, persist, in keeping the soil free from weeds, until the corn is large enough to take care of itself. I believe if I had a good corn soil that I should glory in trying to raise a good lot of nice corn, and a small crop of weeds.

Different varieties require different periods of time in which to grow to full maturity. While some will ripen in sixty days from planting, others may require two hundred days to mature, those common with us requiring, I believe, from ninety to one hundred and fifty days in which to mature; and as our seasons are flanked by frosts at each end, it becomes us to strive to force and coax our corn along as fast as possible.

Now, then, if we have a field of corn ready for harvesting, or the indications are such that we expect a frost very soon, the question arises, How shall we harvest it in order to secure the best result in regard to fodder as well as corn? I am aware that we all have our own notions as to the best way to proceed in harvesting this crop, but I believe that the course generally pursued by the farmers of Maine, is to cut up at the ground and stook it, which course I would certainly recommend as the better one to pursue generally, although the method of cutting the top stalks has its merits. I believe if the frost does not come before the corn begins to turn or ripen, and you have a sufficiency of fodder so as not to need the butts (as we term them) for fodder, the corn will be heavier than to cut it up at the ground, at the time of cutting the top stalks. But it becomes us to make the most of our *time* as well as of our fodder, and if we have an eye to these, I think we would choose the method of cutting our corn at

the ground the *first time*, at or near the time the kernels begin to glaze, or the husks begin to loosen about the ears.

I am sure I need not occupy your time in arguing the point, that it is less labor to cut the corn at the ground than to cut the top stalks, and it will require but little more time to stook the corn and fodder than it will to stook the top stalks; and my course would be this: When I cut up the corn I would lay it in bunches of about six hills each, binding these bunches into bundles with stalks of corn or other material; then take my stooking-horse (as we term it), going between two rows of bundles, putting from eight to twelve bundles in a stook, being careful to place the bundles out sufficiently at the bottom to have the stooks so braced on all sides as to be able to withstand the winds of autumn; then bind these bundles securely at or near the top, with a good stock of corn or a withe. Some use for this purpose rope-yarns, which are perhaps as good as anything, if easily procured. When this is accomplished, the corn may remain in the field until we wish to husk it. Then take the team and go for it, and by taking off the band from the stook we have bundles of convenient size to handle easily with a pitchfork, if we wish to handle it in this way, or take it in the hands and place it upon the cart; unload it carefully, standing it up in the barn floor. My manner of husking would be this: Lay a bundle on the floor, breaking the ears from the stalks, keeping the stalks relieved of the ears of corn separate from the others, throwing the ears in a pile to be husked after disposing of the stalks, which we can place in any part of the barn we may wish, for convenience. I would have a good corn barn, expressly for the curing of my corn, made in such a manner as to give the air a good and free circulation through it; and after husking the corn, leaving three or four good husks upon a plenty of the best for seed for myself and some of my neighbors, I would husk cleanly the residue, putting all of the soundest in a crib, of from two to three feet in width, along the sides of my corn barn; where I have no doubt it will dry nicely. And within one month's time I would have

one of the nicest old-fashioned Indian puddings (such as my old sainted mother used to make), and a loaf of the old-fashioned, *brick oven* brown bread! Why, my mouth waters, even now, at the thought of such luxuries! I sincerely hope that we as farmers of Maine, may give the corn crop more attention in the future than we have done in the past, and not be obliged to get our corn, or so much as we do now, from the West, which is quite inferior in quality to Maine grown corn.

I did not expect to advance any new ideas in regard to the raising of this most excellent crop,—as I think, the *most valuable* of hoed crops; but, if by the reiteration of some of the different modes of cultivation, &c., one individual may be aroused to new and increased energy in the cultivation of this important cereal, I shall feel well repaid for my efforts in this direction.

IV. Uses and Value of the Crop.

By Lyman H. Winslow, Nobleboro'.

To the mind of every intelligent inquirer into the various agricultural products of this country, is presented the fact that the people of the entire continent bear uniform testimony in favor of the palatableness, the healthfulness, and the economy of Indian corn as a food crop. That corn possesses all the advantages we here claim for it, is proved, not only by the universality of its consumption, but by a comparison of its nutritive properties, as ascertained by chemical analyses, with those of other grains from which bread is made. The consumption of corn by the human family, and by nearly all domestic animals, has greatly increased within the last few years. As an article of food it is unsurpassed, and in the opinion of many unequalled by any other grain or plant,

combining as it does in suitable proportions all the essential and valuable elements required for healthfulness and nutrition. It appears from analyses that Indian corn contains more oil and starch than wheat, with less gluten, and, therefore, while scarcely inferior to that grain in nutritive value, far surpasses it, as well as the other cereals, in its fattening properties, which amount to nearly eighty per cent. of its composition. In point of nourishment it is second only to wheat, and even here the superiority of the wheat is rather nominal than real; for if due allowance is made for the loss sustained by wheat in grinding and bolting, it will be found that a pound of corn yields quite as much nourishment as a pound of wheat. It is four-fold more nutritious than the potato, which has long been the great staple and staff of life with a numerous class; and it has been proved by experiment that corn meal will sustain a working man longer, when fed upon it alone, than any other grain. The *American Agriculturist* says, that for the colder half of the year the oil and starch of the corn are better adapted to the wants of the body, than the large amount of gluten in wheat. It is also to this peculiar property of corn that it largely owes its unrivalled excellence for fattening purposes. All domestic animals are easily and rapidly fattened when judiciously fed with corn meal, and what is of still more importance, the flesh thus acquired is firmer and better than that produced by any other grain. By the analysis of Dr. Dana of Lowell, Indian corn contains of

Fat forming principles, gums, &c.,	88.43
Flesh forming principles, gluten, &c.,	1.26
Water,	9.00
Salts,	1.31
Total,	100.

A glance at this analysis will show how greatly the fat forming principles predominate. We may, therefore, safely say, that Indian corn is a most profitable crop, especially as we may add to the uses thus far named all the different forms and variety of ways in which it is now used, being not only

used as a necessity by millions of the human family, but also when made into corn starch for the preparation of blanc-mange, puddings, &c., for which it is better fitted than the flour of wheat. It is not only a food of very high nutritive value, but in some of these forms becomes a luxury. Being also rich in nitrogen, it is a stronger and more stimulating food than any of the other cereals. In proof of this, it may be said that horses which consume it are enabled to perform their full share of labor, are exceedingly hardy and need but little care; and the inhabitants of countries where it forms a large share of their food, are for the most part strong, healthy, and long-lived.

Its flexibility of organization makes it very easy of adaptation to climate and soil. On every part of the globe where the hand of civilization has broken turf, this beautiful and useful grain receives a large share of attention. There are varieties of it which can be raised in tropical climates, at a height of more than nine thousand feet above the level of the sea. The warmest region of the torrid zone produces Indian corn in abundance, where three crops can be taken in a season; and also the short summers of the northern climates have their varieties; so that it is raised from Canada to Patagonia, through almost every climate and people, and over an extent from north to south of more than seven thousand miles. From the extent of its cultivation, and the immense production, it may be considered as the most valuable of all the grains, and the best adapted to the support of animal life. It has been said that what the potato is to Ireland, Indian corn is to the world.

As an article of food it enters into daily use in many of our New England families; nor does the cheek flush with the crimson blush, when our hardy sons and daughters are told that they are "corn fed." It is our great native cereal, of which we are justly proud; and we may say that *corn* is king, when we consider the vastness and value of the crop, the immense amount of animal food yearly produced by its use, and the measure of wealth and comfort which it furnishes to

mankind. The importance of the corn crop cannot be overrated. According to returns from the Department of Agriculture for the year 1870, the amount of corn raised in the United States was 1,094,255,000 bushels. Indeed, there is hardly a man in the whole community, who has the imagination to conceive of the vast amount of this crop. We are told, too, by the same report, that the average price per bushel for that year was 54 9-10 cents, making the value of the crop $601,839,030. We hear a great deal about our national debt, but the value of our corn crop for less than four years would wipe it out. Now, let us suppose that by increasing our care, by paying more attention to the wants of the crop, we should raise two bushels of corn where we now raise one (and I believe this to be possible), what a mighty impetus would be given to the nation! If by this five hundred millions were added to the income of the farmers of the country by the increase of the corn crop, the whole community would feel this wonderful impetus, everything would respond in the most magic manner to this increase. Now, if these vast moral and physical results will follow from this increase of our crop, is it not worth while for us to try to stir up our sluggish brains and lazy bodies to higher aims? If we should do this, if we shall only commence to-day, the labor and expense of these meetings will be most abundantly paid.

As an article of export, a very small per cent. of our corn is sent abroad directly, but is indirectly exported in various forms more remunerative to the farmer, and more profitable for the country. Indian corn enters in a larger or less degree into nearly all the beef, pork, mutton, butter, cheese and lard products by the entire farming community. These products are not only in great demand for domestic consumption, but are all of them, with the exception of mutton, largely exported. The beef shipped to Europe from the port of New York during the last three years, amounts on an average to forty thousand barrels and four thousand tierces per year. The pork shipped during the same time, exceeds one hundred and forty-seven thousand barrels, on a yearly average; and

other meats exported, amount to over one hundred million pounds a year. But far the largest consumption of Indian corn is by our own people, the market for which is now easily reached, is vast in extent, and constantly increasing in its demand.

Not only as a direct article of human food, is this grain largely consumed at home, but also, and to an almost incredible extent, as provender for the immense number and variety of our domestic animals. In a general view then of the use of corn, we discover how great a proportion of the crop is used for conversion into other kinds of food, and how largely it is fed out for this purpose on the farm where it is raised, thereby tending to increase the prosperity of the farmer by improving his soil. And herein lies another great advantage of this cereal over wheat, the result in the two cases is very different—the corn which the farmer converts into other products may be sent abroad or sold in any market without reluctance and with advantage, for it leaves an enriched soil behind it, and brings back wealth to the country; but when the wheat crop is sold, whether at home or abroad, an integral part of the farm is sold with it.

Another profit of the corn crop over other grains, is, that when the offal is properly managed there is no other crop that returns so much to the ground. It is a fact that it may be cultivated longer in succession than any other grains. When we speak of corn offal or fodder, we mean the corn stalk, husks and leaves. Some of our best farmers are of the opinion that the corn fodder grown upon a rich soil, will pay for harvesting the crop; that it is better food for cattle than wheat or oat straw, and worth as much or even more for milch cows and young cattle than hay.

The value of corn fodder is in fact greatly under-estimated; but that value, it should be borne in mind, depends very much upon cutting it at the right time, curing and housing it well before its strength or juices are washed away by our heavy autumnal rains. The fodder of the Indian corn has come to be a large and valuable item in American husbandry.

Its nutritive value for feeding purposes, and the amount yielded per acre, render it intrinsically and practically an important crop. When to the various forms of the stalk crop is added the immense supply of sweet corn, cultivated by the farmers for table use, we have still another addition to the aggregate yield of stalks, as well as further contributions of grain to the general stock, thus exemplifying the manifold utilities of this cereal, which through so many and various channels pour annually into the storehouse of the husbandman its munificent supplies of food for man and animal. The intrinsic worth of corn stalks to the farmer for feeding purposes, and its nutritious quality as compared with straw, hay and other forage, may be determined by a comparative view of the constituents of each, and also more reliably, by a series of trials or experiments in feeding. The experiments of enlightened cultivators places the corn-stalk far above the straw of the other cereals in nutritive value, and justly ranks it, when properly cured and rightly treated in feeding, as equal to most kinds of hay.

The stalk crop of the country, including all the fodder of corn raised for all purposes, amounts to about forty million tons. There is no regular market price for this fodder, but its value is not any less for this. There is a difference of opinion in regard to the value of corn-stalks; we will assume that they are worth four dollars a ton on an average, but when turned to the best advantage they are worth nearly or quite double that amount. Taking the grain then at seventy-five cents per bushel, and the fodder at four dollars per ton, the total value of the corn crop for 1860 will foot up as follows:

838,792,740 bushels of grain at 75 cents - -	$629,094,549
40,000,000 tons of stalks at $4.00 - - - -	160,000,000
Total value of crop - - -	$789,094,549

Maine, in 1875, is estimated to have raised 1,300,000 bushels of corn. Rhode Island, Oregon and Nevada are estimated below Maine, and eighteen States produce more

to the acre, while twelve States produce less than Maine. Less than one per cent. of the crop is raised in New England, yet the New England States have increased their crop the last year 300,000 bushels; indeed, Maine alone should have done this. If southern corn is worth 85 cents per bushel for us to feed our stock of any kind, corn of our own raising is worth one dollar per bushel, as by reason of its superiority over southern or western it is worth 15 per cent. more. Now, is it not easier to raise our own corn than to buy it? The farmers buy seventy-five per cent. of the corn that is bought in the State. We are seldom at the depot when the freight train comes in, when we do not see a car load of corn left; and when our rivers are open every flood tide brings a cargo into the State somewhere. Reliable estimates show that not less than three and a half million bushels are imported into the State, at an average of 80 cents per bushel; which would aggregate the enormous sum of $2,800,000.

Now we *must* raise corn to stop this enormous importation of it into our State, or if we will import it, we must raise *something else that we can export* to offset it. Let us export $200,000 worth of honey; let us export $200,000 worth of eggs, in addition to what we are exporting now; and then let us scrape the coop and raise all the egg-fed corn we can. Let us produce $100,000 worth of maple sugar or syrup, if not for export, to stop our enormous expenditure for imported sugar and molasses. If that does not give us sweet enough, let us raise sugar beets, which we can do every time, and turn them into sugar. Let us send back every car that brings a load of corn into the State, loaded with the best varieties of our late-keeping apples, which from their solidity of texture bear shipment better than any others, and by their rich flavor make a market for themselves in any part of the world where we send them.

We can hardly imagine the amount of money that Maine pays out yearly for corn. This ought not to be so. We have too long remarked in this wise: "We must sell a little hay to buy some corn; we must sell a few potatoes to buy

some corn; I did not raise any corn last summer, and I must cut and haul some cord wood to buy some." Let us change this old song and get a new one, which shall be like this: "We will raise our own corn; we can do it; we can double the amount raised on an acre, and we can double the number of acres—thus saving our hay, potatoes and wood, to be turned to money for some other purpose."

I appeal to you, brother farmers, to this give subject your earnest attention. Upon us, more than others, rests the duty of making our State what she might be. Let us agitate this matter until the old worn out and inefficient system is dispensed with, and something better adopted in its stead.

Before closing, allow me to say that Indian corn is one of the most beautiful plants that grows in New England. One unaccustomed to it, is struck with its symmetry and beauty; and were it less common, we should never pass it without paying it the homage of our admiration. The tall, glossy stalk, tapering from its roots, strengthened by joints at regular intervals, adorned with long, graceful leaves from every joint, and ending with a tuft of tassels at the top, slightly bending under its own weight; the ears projecting from the joints just at the height from the ground as not to endanger the plant; covered with their bright green husks, and displaying their silky threads to catch the pollen from the tassels and fructify them—what plant has claims to greater beauty? Look at its roots, projecting every way to support it. The ripe grain—How beautiful the full ear, glowing in varied colors—the pearly white, the golden yellow and the ruby red; protected by the encircling husks from the rain and frost! To the farmer's eye it has other beauties. It is his crop of crops. None more certain, none more productive; none that will better repay him for extra labor and care; every part has its use, from the butts which slowly yield to the great law of decay, to the stalks, the leaves and the ripe grain—the last furnishing food acceptable and nutritious to the inhabitants of all portions of the world.

"There shall be an handful of corn in the earth, upon the top of the mountains; the fruit thereof shall shake like Lebanon, and they of the city shall flourish like grass of the earth."

Discussion.

Mr. Gilbert. There are one or two points which have been brought out which deserve further consideration. One of these is, that under proper management corn is a sure crop. This is an important fact. Has it presented itself to your mind as the discussion has progressed, with sufficient force? I believe that in a large part of the State of Maine, and on the larger part of its farms, that corn is as sure as any other crop that can be grown, with the possible exception of the grass crop. When you are endeavoring to raise corn you are pretty sure of success, provided you act well your part. That is an important thing and leads directly to another point. What are the conditions of success? They are plain and within the reach of all. The first is a proper selection of the soil. What is, then, a good soil for corn? A good warm soil, with porous undersoil, so that the surplus water may be carried off, and no excess of water remain on the soil after the seed is planted. This condition of the soil does not lie wholly with Nature. If your soil does not possess these characteristics, you may modify it by taking off the surplus water by artificial means—by drainage, so as to get a warm soil. Loamy soil is good corn soil. The alluvial soils which we find along some of our rivers, are good corn soils. My friend from Franklin county can tell you of splendid crops grown on the intervales of the Sandy River. The latitude is high, the snow deep in the winter, but they grow splendid corn. So it is with the intervales of the Upper Androscoggin and the Saco. In these valleys the temperature runs higher than upon the hills near by, and so where the conditions are equal, the corn in the valleys will be driven forward and succeed better than that on the hills. A good warm, well-drained soil then is the first condition; and next

(and this has been brought out quite prominently) make it rich. You cannot grow ninety, seventy-five, fifty, or even forty bushels of corn to the acre, without supplying food for it. We do sometimes have existing in the soil when we commence to handle it, corn food enough to grow a light crop, but to get a good big crop, you must make your land rich. You have the means at your hand to a far greater extent than most people are wont to suppose, to do this. There is little danger of making a soil too rich for corn. Corn will bear very heavy manuring and pay well for it, and if more is supplied than the crop can appropriate you will hear from it in the subsequent crops.

Having the land rich, here in the State of Maine we must start the crop early if we would secure a crop every year. We have short seasons, and corn growing here is a different thing from corn growing in Illinois, New York or even Massachusetts. I know this, for I have grown corn in Massachusetts as well as in Maine. Their seasons are longer than ours, and consequently methods that may be laid down for growing corn in Massachusetts, will not produce like results every time in Maine. It becomes, then, absolutely necessary to have the plant start vigorously as early in the season as possible. I do not mean by this that we should plant very early. Never plant corn until the soil is in proper condition—warm and pliable, if you do you will retard your crop instead of hastening it, because neither temperature nor soil will be fitted for it. This raises the question, How may we be absolutely certain of starting our corn early in the season? The answer is very simple—Give it something to feed upon at once; something that it can appropriate as soon as it germinates. Let a kernel of corn germinate in a cold, lifeless, unfertile soil, and what is its condition? There is no plant food within its reach and it cannot grow, and remains just where it is. By and by, late in the season, the manure becomes decomposed, and a portion of it reaches the plant; but, alas, it is too late to insure a crop. You have not done your duty, and therefore failed. But if you had started it

early in the season, it would have grown throughout the season, and you would have had what you were reaching after—a good yield.

Corn wants, then, some thoroughly decomposed fertilizer in and about the hill. It makes no difference to the plant where you get it—whether you buy it, or obtain it about your premises. I care not where you get it, but get it somewhere and apply it. If you don't care to purchase, there are many fertilizers which you are allowing to go to waste, and which if appropriated in this direction would insure you success. If you prepare it, you see the necessity for having it thoroughly fined and decomposed, and highly concentrated. But, whether you will buy or purchase is your affair. It does not require a large quantity of it; if you have manured your soil well, the corn will appropriate your cruder manures, but not in its earliest stages; and for these the application of a small quantity of this available plant food is absolutely essential to success. Now, these are the main points in growing corn; and every one of you who owns such land as is required for corn, can go home and by observing them can grow, the coming season, a good crop.

I want to add a few words upon another point which has not been particularly impressed upon your minds—the importance of a thorough pulverization of the soil. The secret of a great deal of the want of success which attends much of our farming operations, lies in the slipshod manner in which we prepare the soil for seed. Our seasons are short, and we are anxious to get as much done in as little time as possible. Nevertheless, we should take time to prepare the soil so that the roots may have a good mellow bed from which to draw their nourishment, and in which they shall meet no obstacle in their search for it. The soil should be thoroughly mellowed, and if it is a good strong soil the deeper the better. It is also essential frequently to stir the soil after the plant has started into growth, and this stirring should be commenced as soon as the rows can be followed; I have done it many times before the corn was up. Now, what are the reasons for this?

Many of our soils will bake so that the sun's heat cannot penetrate readily through the crust, and consequently the progress of the corn is greatly retarded. There are other reasons to which I will not refer: this one is enough. Don't be afraid to cultivate early and often. I am very old fashioned in much of my farming, and many of my ideas, but there is one old idea that I always was at war with, and that is, that it injures corn to run a cultivator through it after it has attained any considerable height. I had something of an experience at hand hoeing when a boy, and learned then to be at war with this idea. You know it is rather dull business for a boy to take a hand hoe and follow a man, and do it not only to-day and to-morrow, but the week through. Nothing will drive a boy off a farm quicker than such an experience as this. Then don't be afraid to put your cultivator through your corn if you do disturb a few roots. You are doing good; if you don't believe it try it on one part of your piece and watch the results.

Mr. FARRINGTON. I wish to allude to the principle that enters into the mechanical cultivation of the soil. I think one speaker said, yesterday, that after a certain time he would not put a horse and cultivator between the rows of his corn, because it would break off the roots. Now, I believe it has been demonstrated that you may break off some of the roots, not only without injury, but with actual benefit to your corn. As soon as the corn shows itself above the ground, it commences to throw out its little rootlets, and as it grows sends them further and further into the space between the rows. As you run the cultivator through for the first time, you cut off several of these rootlets, and from each of these ends will be sent out a number of little rootlets. By the next hoeing the roots will have grown longer and the implement should be set narrower so as to run further from the hills, and in this way you will again increase the number. Thus, if at the first hoeing each root cut off sent out five roolets and at the second each of these sent out five, you have twenty-five mouths availing themselves of the fertility that

you have worked into your soil. This proposition was enunciated as long ago as the time of Jethro Tull, and looked upon as one of his vagaries. It is now being brought out by Dr. Sturdivant on his farm, and he regards it as a very important matter. It may be said that this will exhaust the soil. But this is what you want to do. What do you put the fertilizer in there for, but to feed the plant? You want to adopt such a mode of cultivation as shall make it most immediately available for all our crops.

Mr. HARRIS. Is not the tendency of this cultivation to increase the corn rather than the stalk, consequently giving a larger crop of corn in proportion to the stover?

Mr. FARRINGTON. I should answer that question in the affirmative. The reason is, that the stalk is principally fed by the nitrogenous element, and by cultivation we render the mineral part accessible in greater proportion than the nitrogenous, and so increase the grain in greater proportion than the stalk.

Mr. CHASE. The gentleman has introduced a theory which conflicts with mine. I would ask him how near, how often, and how long continued the cutting should be, to secure a good crop of corn?

Mr. FARRINGTON. Any principle carried in practice beyond reason, may become destructive. It is one of the beauties of agriculture, that you cannot lay down a law of practice that shall govern every one. You can lay down general principles, and from them every man must deduce his own practice. The farmer, if just to himself, is a man of reading, of thought, of mental culture. I have no doubt that taking the general principle I have laid down and practicing upon it, every man will come to such a system of practice as shall for himself be the best. Allow me to ask you, gentlemen, never to say to your brother farmer, "This is the way you must do." You don't know it. His conditions are different from yours. Tell him, then, the principles upon which the thing is based, and let him work it out for himself.

Mr. STUART of Newport, being requested to give his method of raising corn, said: If you are going to make a

large amount of gilt edged butter, you must first procure a good cow and then procure good feed for her, or you will fail. If you have a colt which you are going to bring to 2.20, you have got to take care of that colt or you will not be successful. So if you are going to raise corn, you must have good ground and prepare it well and feed it. The selection of the soil is no small thing in the cultivation of corn; there is as much difference in soils as in methods of cultivation. Years ago I raised considerable corn, with good success. I do not raise as much as I used to, but I think I have learned as much by observation as I did by experience. I think the old practice of laying out so much labor can be done away with. I would prefer to manure the ground in the fall if we have the manure to apply at that time, but many of our farmers don't have it. I am of the opinion that manure applied in the fall is better for the following crop, but that it does not do so much good for future crops as it does in the spring when the manure is newer. If I were going to prepare a piece of ground for corn, I would break up a piece of greensward. My ground is nearly flat—you would call it quite level—and naturally very wet. It is not much use to try to raise corn or anything else on land that is wet. By underdraining I have got my ground so that I can cultivate it very well; most people would call it dry enough. I would take my ground about the middle of May, and would plow it very deep and well. I would put on manure enough so that after taking off the crop and a crop of grain the year following, I could cut two and a half tons of hay to the acre. By putting on manure and having the whole well pulverized, I am sure of a good crop every time if I take good care of it. I think the cheapest way of managing, is to take a potato marker and lay the rows about 3½ feet apart. Scratch it so as to make the marks plain, and then apply some kind of fertilizer—it makes no difference to me where I get it, if I only get it. I apply but a small amount in the hill. It has always worked well with me when put on top. I don't want to put the seed in less than four inches deep. I plant with a

corn-planter. I want my ground dry and warm before the seed is put in. I don't care how soon the cultivator is put in, nor how much you cultivate, but be sure to cultivate enough to keep down the weeds. It is very necessary to stir the ground if it bakes, but with me if the corn is covered four inches deep the ground don't bake, and in that case I don't see that cultivating has any effect except to keep the weeds down. I would recommend the use of a cultivator that don't hill the corn. So far as cutting off the roots is concerned, if the ground is sufficiently drained I would risk it, but there should be a sufficient amount of roots to sustain the corn if the side roots were all cut off. But if the ground is wet so that the roots are compelled to keep on the surface of the ground, I don't think it would be well to have them cut off. If the ground is dry I will risk the damage, and I concur with the opinion of Mr. Farrington, that it would be a benefit. I think the practice of manuring in the hill takes too much labor. Last year I put Bradley's phosphate on manure for about seventeen rows; then I planted some on stable manure alone, which did not do as well. Then I tried a few rows with nothing but Bradley's phosphate in the hill, and it was as good corn as any on the piece. I would recommend, if your ground needs draining and you cannot underdrain it, that by all means you should surface drain it.

Mr. FLINT. I am very forcibly reminded of the cranberry discussion at our last session, from which half a dozen went home with their pockets stuffed with cranberry vines. Now if we will make the same rush for this corn, go home, plant it, and take care of it, I think it will be a good thing. There is a question as to the cost of raising. From some experiments made by myself and a neighbor of mine, I am satisfied that it can be raised, and raised profitably. Figuring everything, my own cost me less than fifty cents per bushel, and my neighbor, purchasing his manure, and knowing just what the cost was, got his for less than thirty-five cents. These experiments have proved to my satisfaction that corn can be raised for less than fifty cents per bushel.

Mr. WINSLOW. I dislike to disagree with any one, but there is one point which I should like to have ventilated a little more, and that is in regard to cutting off the roots. I think we are all agreed that we cannot stir the ground too much, but the desirability of cutting off the roots is another matter. I notice that when we cultivate late and cut up the roots, the corn stands still for a week. I want to know whether it is going by and by to make up for this stand-still. Sometimes the frost comes early and kills the corn before it is matured, and this makes the matter a very important one. Some one has said here that corn puts out roots two or three feet long. A few years ago one of my neighbors raised corn on a steep side hill. A heavy rain came and washed the corn out on some of the land, and there it was with roots at least six feet long all over the land. If you have never seen for yourselves, you would'nt imagine how long roots corn has.

Mr. SMITH of Freedom. If you cut off a rootlet from an apple tree with a sharp knife it will put forth others, but if you break it off it will not. So if you take a hill of corn and cut the roots off these little spongioles will be sent out, but if you break it off with the tooth of a cultivator it will die, just the same as the rootlet of the apple tree will if broken off.

Mr. DAVIS of Corinna. We see readily that this question of the roots is a vital one. Our seasons are short, and we cannot afford to lose two weeks' growth at the first and two weeks at the second hoeing. If we do we may get a large ear and good stalk, but there will be a deficiency of corn. We have to drive our corn with fertilizers to succeed in raising it, and if we lose this time the frost will come before the corn is ripe, and it will be nipped in the bud. The theory of the gentleman would be a very good one if the seasons were long enough, but we must take all the conditions into account. I have been raising corn for thirty-two years. It is the best crop I have. I have raised fifty bushels to the acre, but have not succeeded in going much beyond that. I did this by buying fertilizers, but that costs a good deal. It is hard for poor farmers to get money to buy fertilizers to raise corn.

We want to know what dressing to apply to different kinds of soil. We cannot learn without experimenting, and it takes so long to experiment that we get tired of it. I cultivate my corn the first time with a cultivator, and hoe with a hand hoe; the second time hoeing I use a horse plow between the rows, because I don't want the large roots cut off. I think four inches is about the right depth for planting. Generally, we do not cover deep enough. More corn is lost by drying up than is killed by covering.

Mr. HARRIS. My experience has been different from that of the gentleman. I cultivate nothing but sweet corn, but I suppose that the practice would be the same as with other varieties. I have raised $100 in money value from an acre. If your land is in good condition it will do no damage to keep stirring the ground between the rows. The stalk will be smaller, but the grain is what we go for. I believe in level planting, and pretty deep covering. There is another thing which I have never practiced, but should not hesitate to. That is to take a smoothing harrow, where the corn is planted on a level surface, especially if it were covered four inches deep, and harrow until it was four inches high, and not mind the rows.

Mr. STUART. I plant with a corn planter; if I planted by hand I should not want to plant so deep as four inches.

Mr. L. L. LUCAS of St. Albans. I think that more farmers will succeed by adopting certain rules, than by any theory. These are the rules that I would lay down: First, thorough pulverization; second, the addition to the soil of a sufficient quantity of barnyard manure and other fertilizers necessary to produce the maximum crop; and lastly, clean cultivation. Here I am reminded of a rule for this clean cultivation—"Never pull up any large weeds." I would recommend planting just as many hills as will grow on the ground, and not shut the light out from it, and that will depend on the number of kernels you put in a hill. I think the rows will be from three to four feet apart. Do all these things and you will raise corn, and I don't see how you can without doing

them. They are all necessary—thorough pulverization, so that every particle of plant food shall contribute to the growth of the plant; thorough manuring, so that every plant may have sufficient food, and that the labor of cultivation shall not be wasted on an inferior crop; and clean culture, that the nutriment available may all go to the support of the corn which you want to produce. The idea of cutting the roots off for the purpose of increasing the crop, I cannot adopt. I can hardly believe that more fibrous roots grow from a hill of corn than is necessary. I believe the less we disturb the roots the better. I don't mean to say I am right, but it don't seem to me there are any more roots than are needed there.

Mr. MARSH of Newport. On this root question we want to go to the "root of the matter." The man who formerly lived on the farm I now live on, I first saw at work cultivating among his corn. He had a horse and plow, and had been half a day he told me training his horse to plow. He was plowing eight inches deep, and about four inches off from the corn-stalks. He turned a furrow from each row—turned the two furrows together, and the roots were hanging down where they had been cut off. He told me that that was his practice, and had been for years, and I have been told that he raised the best corn in this section. The soil was a heavy one—clayey loam. In regard to the corn which I have here, said to be a new variety, I will say that I got it of Isaac Chase of Corinna. He said it was sent to him from Oregon, and I think it is a valuable kind, superior. Almost every stalk has two ears. I commenced planting this year the 10th and finished the 14th of June, and cut it up from the 20th of September to the 1st of October. It can be raised anywhere in the State, if the land be well manured.

Mr. FARRINGTON. It seems to me that the point I made in regard to basing individual practice on a knowledge of general principles, has been illustrated by the statements of the gentlemen here in regard to the depth at which they are most successful in planting corn. We know that it is a scien-

tific fact that the corn crop must have sufficient moisture for its growth. Now, if I as a farmer, conclude that it is best for me to apply manure in the hill, I introduce a factor in my practice different from that of my neighbor who spreads his manure. The difference is this: the manure will dry up more readily than will the soil about it. So if I plant corn over that manure I must cover it sufficiently to retain the moisture which my corn must have; and so we have cultivators planting in this way, who find it best to cover four inches. If, however, I conclude it is better for me to spread my manure, I don't introduce that factor, for if I plant on a surface that retains the moisture, I don't need to cover so deep. If I should the kernel would be saturated with wet, and would rot. If the man who plants in the hill were to adopt my plan of covering one-half inch or one inch deep, his corn would dry up and would'nt germinate. Now don't you see that what we want is to know the laws that govern growth as applied to our condition, and adapt our practice to them. In regard to the effect of cutting off the roots, I have never tried it myself, but it has been tried by most reliable and careful experimenters, and I have as much confidence in the result of their experiments as I should if I had tried it myself.

Mr. REYNOLDS being asked to state his method, responded: I break up in the spring and sow oats. The next year I haul on well rotted manure. In the spring I plow and spread the manure. I do not often manure in the hill. I have put on phosphates with good results, and sometimes they have proved a failure. When I have my soil thoroughly pulverized, I make my rows four feet apart and put the hills three feet in the row. I drop my corn right into the dirt, and cover it about an inch and a half—though the depth depends something upon whether the soil be wet or dry. There has been but two years in the last thirty but I have raised a good crop. One of these the frost killed my corn; the other was the grasshopper year, and then I raised some good corn, though only about fifteen bushels from two and a half acres.

ON SOME OF OUR INJURIOUS INSECTS.

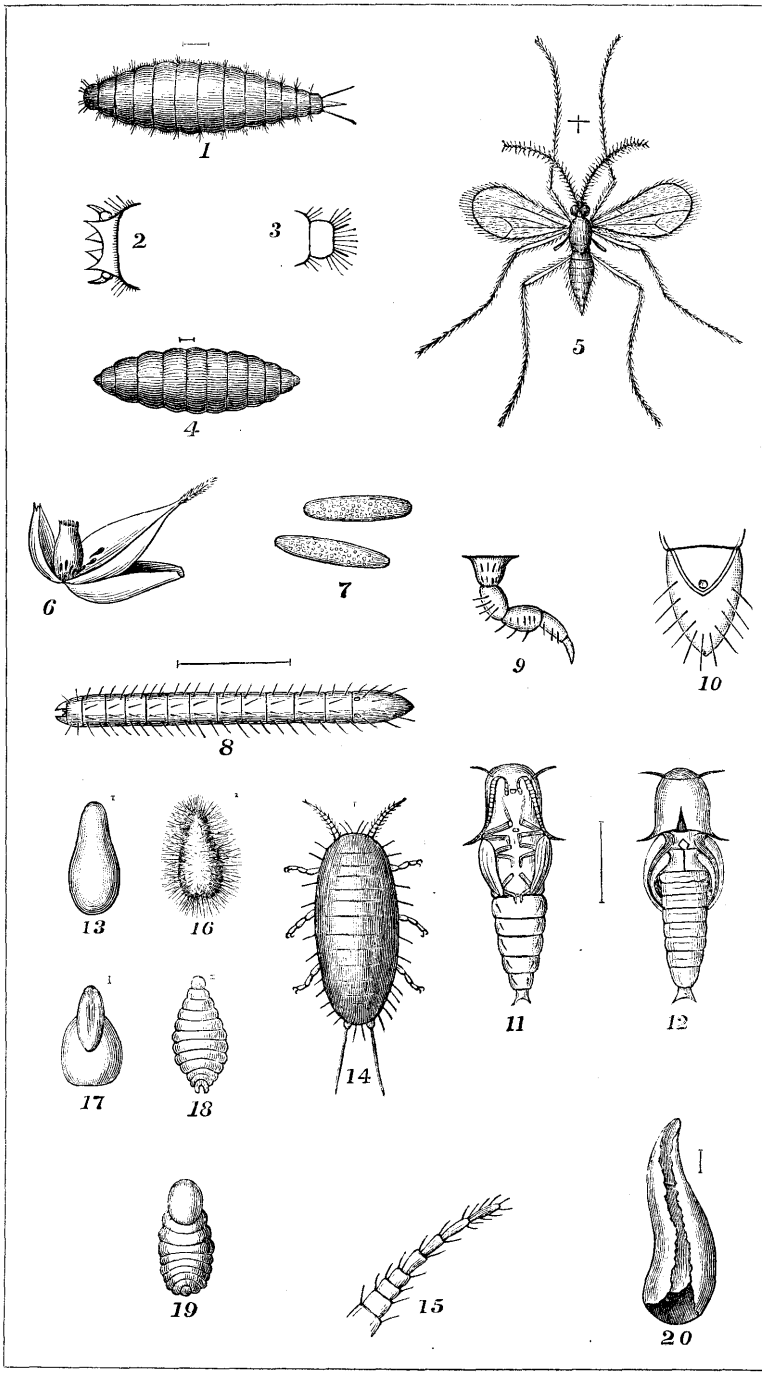
By Prof. C. H. Fernald, Maine State College, Orono.

Of the various insects with which the farmers of Maine have to contend, I have selected the following, giving as fully as I have been able, with the time at my command, their history and the methods of checking their ravages, so far as I know them.

There has, perhaps, been no insect which has caused so great destruction to the wheat crop in this State, as the wheat midge or weevil, (*Cecidomyia tritici, Kir.*) This insect was first reported in this country from northwestern Vermont, in 1820, though it was not until 1828 and 1829 that it became so numerous and destructive as to cause any serious alarm. Prof. Glover, in his "Manuscript Notes on the Diptera," states that this insect made its first appearance in 1830, in Canada, from the emptying of a straw bed by a Scotch emigrant, and spread in a circle of about thirty miles in a year at first. What his authority is for this statement, I am not able to say.

The Rev. C. J. S. Bethune of Ontario, thinks it probable that the midge arrived in this country some few years earlier than 1820, when it was first reported, and was introduced at Montreal or Quebec, in some wheat imported from Great Britain. Dr. Fitch of New York, states that the wheat midge made its appearance in northeastern New York in 1830, and in 1832 it had so multiplied as to completely destroy the crop in many fields. In 1834 it commenced its ravages in Maine, and has been an abiding though unwelcome guest with us ever since.

The earliest account of this insect in England, dates back as far as 1740. Again we have some account of it by Gullet, in



SOME OF OUR INJURIOUS INSECTS.

EXPLANATION OF THE PLATE.

1. Larva of the wheat midge, as seen crawling on a wet surface, with its horns fully extended.

2. Hind end of wheat midge, with sharp teeth protruded to aid in moving.

3 Forward end of wheat midge when attempting to crawl on a dry surface, its head partly withdrawn.

4. Larva of the wheat midge, as seen in repose.

5. Wheat midge, female.

6. A flower of wheat, showing the larvæ of the wheat midge.

7. Eggs of the wheat midge, greatly magnified.

8. Larva of the wheat wire worm.

9. Leg of the same.

10. Last segment beneath.

11. Pupa, under side.

12. Pupa, upper side.

13. Egg of the Oyster Shell Bark Louse.

14. Larva as it appears running over the bark.

15. Antennæ of the larva, highly magnified.

16. Larva after having become fixed.

17. Appearance of the scale after the second plate is formed.

18. Form of the louse soon after losing its members.

19. Form of the louse when full grown, and about to deposit its eggs.

20. Fully formed scale, containing louse as it appears from the under side when raised.

the "Philosophical Transactions of the Royal Society" for 1772, and again by Marsham, in the "Transactions of the Linnean Society" for 1795; but no scientific description of the midge was given till Kirby took the matter in hand, and described not only the midge but three of its parasites, and published the same, with illustrations, in the 4th and 5th volumes of the "Transactions of the Linnean Society." Kirby there named the midge Tipula tritici, but the genus Tipula has since been divided into several groups or genera, because it contained an inconveniently large number of species, and the genus in which the midge has been placed, is known by the name of Cecidomyia, and the insect in question is known to entomologists by the name of Cecidomyia tritici, Kirby, but to the farmer by the name of wheat midge, and sometimes it is called the "weevil;" but since this insect is no weevil at all, but belongs to an entirely different order of insects, and still further, since there are already more than 20,000 different species of the true weevil tribe known to entomologists, of which the *true* wheat weevil, pea weevil, bean weevil, plum weevil, and some 400 more, are common in this country, it is better to use the more correct name, wheat midge.

The wheat midge may be found in its winged or perfect state, from the last of June to the last of July, flying about everywhere in search of wheat fields. The sexes probably pair soon after the insects come out of the ground, for only the females are seen flying about; in fact, Mr. Kirby had never seen the males when he wrote his description, and Mr. Curtis in his essays in the "Journal of the Royal Agricultural Society of England," and also in his work on "Farm Insects," gives illustrations only of the female, and states that he had never seen the male, but Dr. Fitch has been more fortunate, for he has seen them and published a description of them.

The female midges proceed to deposit their eggs in the crevices of the wheat blossoms wherever a chance is found, working upon the wheat heads only during warm, damp evenings, or cloudy days, hiding themselves near the ground

in the shade of the plants during the time the sun is shining brightly, for they flourish best in damp weather, while a dry atmosphere seems to be extremely unfavorable to them; hence wheat fields on low damp lands are more liable to be injured by the midge, than those on dry uplands. The eggs, which are deposited, sometimes to the number of thirty in a single ear, hatch in about a week, and from them issue tiny footless maggots, quite transparent and colorless at first, but afterwards they become a bright orange color. The larvæ feed upon the juices of the grain, causing it to shrivel.

In the early part of August the larvæ are full grown, and leaving the wheat descend into the ground, mainly during rainy or damp weather, for they are able to crawl along the stem while completely immersed in water, better than when dry, for in the latter case they become dried so that it is difficult for them to move. It is stated that they sometimes gather the little globules of moisture together in their downward course on the stem, till so large an amount has been gathered that it will slide down by force of gravity, when they let go their hold on the stem and ride down in the drop of water. At other times they contract themselves suddenly and are thus thrown off the plant, and fall. After they have reached the ground, they work their way down about an inch below the surface, where they form delicate filmy cocoons, glued to the surrounding particles of earth, in which they remain during the winter unchanged. Late in the following spring they change into the pupa state, and emerge from the ground as perfect insects, during the last of June. Quite a proportion, however, of the larvæ do not leave the ears of wheat, but remain in them during the winter, or in the winnowings of the wheat, retaining their vitality so as to produce the perfect insect in the following June.

In England the ravages of this pest are so comparatively unimportant, that the insect attracts but little attention. Mr. Kirby estimated that the amount of wheat destroyed there in a single season was five per cent. of the whole crop. In 1828, when it was unusually destructive in Scotland, it was esti-

mated to have destroyed about a third of the late sown wheat. But whenever it has so multiplied as to become very destructive in Europe, it has very soon subsided, so that it has scarcely been heard of for a long time. Here, on the other hand, it has continued without those intervals of absence followed by the presence of the insect.

Mr. Kirby has described three different species of parasitic insects, that deposit their eggs in the larvæ of the wheat midge in England, and also a species of fly that seize and destroy the larvæ. It is well known that each of these parasites deposits a large number of eggs, and since the parasite is about the same size as the midge, only one egg is deposited in each larvæ, so that each parasite will cause the destruction of a large number of the midges.

The reason why the midge in England is common during certain years, and then will rarely be met with for a long time, is due no doubt to the abundance of its parasites in that country; for these parasites increase to such an extent during the years when the midges are common, that in the end there is scarce a midge that does not receive the egg of a parasite, so that the following year there is scarce a midge to be found, but a superabundance of parasites, the greater part of which finding no midges to deposit their eggs in, of course die leaving no issue, so that the parasites themselves in turn become scarce, and the midge after a time becomes abundant again. The same explanation may also be given to account for the abundance of the army worm, the forest tent-caterpillars, grasshoppers, and many other insects in this country, on certain years, and their scarcity on others. With so many parasitic enemies in England, the midge has never proved so destructive an insect there as it has here; and why measures have never been taken by our national government, or by some of the States where millions have been lost because of this minute insect, to introduce those parasites into this country, I cannot understand. When we consider the habits of this insect and of its parasites, we must see how slight a

chance there is for the parasites of the midge to be brought over by accident.

It has been estimated that the amount lost by the ravages of the wheat midge in one year (1854) in New York State alone, amounted to $15,000,000. It surely seems as though every means should have been tried to stop such a fearful leak, yet I am not aware that one dollar was ever appropriated by any State or society for the purpose of introducing the parasites of the wheat midge, or those of any other injurious insect introduced into this country from Europe. The parasites of the midge may by some chance be brought over, and yet a century may pass by before some clod of clay from an English wheat field, containing the larvæ of wheat midges with their parasitic insects enclosed, shall be brought over with all the conditions preserved, which shall ensure their existence in a healthy condition, with both sexes represented, and all by chance. Dr. Fitch says in his report for 1861, "I can state this fact with confidence, we have no parasites in this country that destroy the wheat midge." Dr. Packard in his "Guide to the Study of Insects," says that Platygaster error, Fitch, is the chief parasite of the wheat midge, but Dr. Fitch himself states that it is not a parasite of the wheat midge, but an egg parasite on a species of Nabis, an entirely different insect. I wrote to Dr. Packard concerning the matter, and he informs me that he was in error in his Guide concerning the parasite of the midge, and that he knows of no parasite on it at the present time in this country. I have not been able to learn from any source that any parasite has as yet attacked the midge in this country. In the absence of any insect friend to help us hold the midge in check, I can only repeat the well known artificial remedies; burn all the winnowings of the wheat, as these contain many of the little yellow larvæ which would live through the winter, and produce flies for another crop if not destroyed. Plow deeply in the fall any field that has been attacked by the midge during the previous summer, and plant it to some different crop the next season. Sow as late as is consistent, that the plant may

not come into blossom till after the operations of the midge are over. Sow wheat only on high or dry ground, as wet land is favorable to the midge.

OYSTER-SHELL BARK LOUSE, (*Aspidiotus conchiformis, Gmelin*). There are two kinds of bark lice infesting our fruit trees, but by far the most common, and hence the most injurious, is the so-called oyster-shell bark louse. The young hatch out in this State during the last of May and the first of June, when they distribute themselves over the trunk and branches, and if they are abundant, on to the smaller twigs and leaves. These diminutive little insects have their mouth parts formed into a long horny tube, which they thrust down into the bark and draw up the sap upon which they feed, and there remain stationary ever afterwards. In a few days they are covered with a white waxy secretion, which issues from the body in the form of very fine, delicate threads. Soon after this they lose these fine threads, and the shell begins to be formed at one end, which gradually extends and covers them. During the latter part of August the bark louse lays its eggs, its body gradually shrinking beneath the shell as the eggs are laid, till they are all deposited, when the body of the louse is scarcely perceptible with a lens, and without doubt soon dies.

The oyster-shell bark louse produces but one brood a year, hence the eggs remain under the scales for more than nine months. If the scale be carefully lifted in July or August, the true louse may be seen; but if it be examined in the fall, winter or spring, a mass of whitish colored eggs may be found, some twenty-five in number. I do not need to tell you that these insects are injurious to the trees, for with their proboces stuck into the bark they suck up the very life sap of the tree, and when they occur in great numbers they must greatly weaken and even destroy it. Since the scales form so complete a protection for them, it is reasonable that they may be most easily destroyed after the young hatch, and while they are distributing themselves over the trees, or about the first of June.

Of the various washes that have been recommended, some do no good whatever, others kill the lice and also the foliage, still others kill about half of the lice and injure the foliage to some extent, but a strong solution of soap is said to kill them without injury to the trees. As the eggs do not all hatch at the same time, the application would need to be made for a number of days in succession. It should be remembered that these insects hatch out early or late, according as the season is early or late, and it will be well to examine the trees with care to see just when they begin to come out from under the scales, and then apply the remedy. The late Mr. Bennoch of Orono, was accustomed to sprinkle wood ashes over his trees which were infested with bark lice. This was done in spring before the leaves put out, during wet or rainy weather, so as to wash down over the branches and trunks of the trees. He informed me that in this way he never failed to destroy the lice, without doing the slightest injury to the trees. It seems to me that a more judicious course to pursue, would be to sprinkle the trees thoroughly with some alkaline wash, as strong soapsuds, just after the young lice have hatched and escaped from the old scales, and before they have secreted any protection for their delicate and tender bodies. Some kind of an atomizer would be useful for this purpose, and could also be used to distribute Paris Green water over potatoes.

Dr. LeBaron discovered, in Illinois, a minute insect about one twenty-fifth of an inch in length, which proved to be a parasite upon the eggs of the bark louse. It is to be hoped that they may so increase and distribute themselves over the country, as to hold these lice in check.

Cut-Worms. There is a large number of moths in this State, the larvæ of which are called cut-worms, on account of the destructive habit they have of cutting or entirely severing the plants on which they feed, just above or just below the surface of the ground, during the night, and hiding during the day beneath the surface of the soil near the plant. Some of these insects attack only low growing plants, while others

ascend shrubs and small trees, to feed on the leaves or buds. These all belong, so far as I know, to some one of three genera, Agrotis, Mamestra and Hadena, of which there have been enumerated two hundred and seventy-two species in the United States, over seventy of which have already been observed at Orono, but the natural history of only half a dozen of these has as yet been learned. It is not an easy matter to raise them in confinement so as to learn their habits, for as soon as they find themselves imprisoned they refuse all food, and crawl rapidly around the breeding cage, and as Dr. Fitch truly said, they literally travel themselves to death.

These insects come out in the perfect state as moths mostly in June and July, flying only in the night, and concealing themselves in the day time. After the sexes pair, the females lay their eggs, according to Dr. Fitch, on the surface of the ground around the roots of grass or other herbage. The worms hatch and feed on the most tender vegetation they are able to find. Grass seems to be their favorite food, and probably supplies them through the fall and early summer till they have acquired nearly their full growth, when they resort to corn and other crops during the remainder of their larval existence. When the cold weather of autumn arrives, they are usually about half grown, and then work their way down into the ground several inches, where they hollow out a cavity in which they remain till thawed out by the genial warmth of the next spring.

Of remedies for this cut-worm there are none, probably, so effectual as the parasitic insects that prey upon them. There are several of these known in this country, some of which are very small, so that a large number is raised from one cut-worm, while others are larger and only a single egg is deposited in each one. It happens with these, as with many other injurious insects, that there are times when they are abundant, and other times when they are scarce because of their parasites. Besides these most useful parasites there are other insects which are carnivorous in their habits, and prey upon the cut-worms, but these never multiply to such a

remarkable extent as do the parasitic insects. There are certain species of the genus sphex which destroy cut-worms. Last spring, while at work in my garden, I spaded up a cut-worm which I put in a safe place, as I supposed, till at leisure to take care of it; but presently a large sphex espied it, and pouncing down dealt it a sting, not in a mortal part, but in the nervous cord, so as to paralyze all action and yet to retain life; then the sphex started with her cut-worm, or rather mine, but as it must have weighed several times as much as she did herself, it was no slight task for her sphex-ship to remove it. At first she seized it in her mouth and began to back off, dragging the worm after her, but the dirt gave way so under her feet that she made rather poor progress, and so tried another method; this time she stood astride of the cut-worm and seized it in her mouth at about one-fourth of the distance from its head, and lifting that end of the worm while the other end dragged on the ground beneath and behind her body, she made off with it at quite a fair rate of progress. By this time I was deeply interested in the performance, and left my garden work for observations in entomology. I was well aware that the entire family to which this sphex belonged laid their eggs in other insects, and I had repeatedly seen certain species seize upon spiders in this same manner, and bury them in the ground after having laid their eggs in them, but I had never before observed them taking so large an insect, comparatively, and one so generally injurious to the crops; so I followed at a respectful distance, feeling that if I had been robbed of my cut-worm, I would at least see what disposition was made of it finally. The sphex dragged it off to a somewhat sandy place, when she dropped the load, and with her fore feet began digging a hole. When she had dug down so far that she could no longer throw out the sand with her first pair of feet, she used her second pair also, and finally all of her feet. After she had dug the hole down some two or three inches she placed the cut-worm in the bottom, then depositing her eggs, she filled the hole and left, feeling assured, no doubt, that when her young should hatch, they

would have an abundant supply of suitable food still living, sufficient to last them during their larval state.

The climbing cut-worms, those which ascend fruit trees by night, and destroy the leaf and flower buds, may be prevented by putting a wide strip of coarse, stout paper covered with tar or printer's ink around the trunks. This will also prevent the ascent of canker-worms, and many other insects. For those which attack corn and other field crops, I know of no better remedy than digging them up and killing them. Ashes, lime and other substances have been recommended as preventives, but they will burrow down in these as readily as in sand, and so far as I can see, it has as little effect upon them. It has been suggested, to make holes in the ground about the hills of corn, into which they may fall, and thus become entrapped till they are found in the morning and killed; also, to run a furrow around the corn field before the cut-worms leave the grass lands to attack the corn, having the perpendicular side next the corn, and thus prevent their crossing. I do not know how reliable this may be, but it seems to me, from what I have seen of them, that they would hardly be stopped by any furrow that could be run by a plow, however perpendicular and unbroken the landside might be. It might easily be done upon one part of the field, while it is omitted upon another, then the result would give some idea of the value of this method.

Wire-worms. The wire-worms are also enemies to our cultivated crops as well as to our grasses. These are the larvæ of the different species of the great family of elaters (*Elateridæ*), or snapping beetles, of which Crotch in his check list enumerates five hundred and twelve species in this country, some of which are wonderfully numerous in individuals, and where they feed on our crops must do a vast amount of damage. So abundant are they at Orono, that in swinging the collecting net over the top of the grass in crossing the field, three or four of the perfect beetles have been aken at each sweep. We meet with these wire-worms in

very different situations; some of them are found under the ground feeding on the roots of living plants, while others live in and feed upon decaying wood. While most insects feed upon one species of plant only, or at most on one natural order, the wire-worms are quite omnivorous, feeding readily upon nearly all kinds of plants, and the amount of injury they do is almost incalculable. Of the natural history of the wire-worm much has yet to be discovered. Bjerkander, a Sweedish observer, states that they spend five years in the ground in the larval state; and Curtis, Westwood and Packard have all copied this statement. Mr. Walsh has bred the larva of one species of elater in rotten wood in two years, and Dr. Fitch gives it as his impression that the larval existence of most of our field wire-worms, at least, is but two years, since he has discovered only two sizes in any collection he has made. Wire-worms are not easily raised in confinement; all my attempts in this direction have thus far proved futile, but I hope to be successful yet.

Mr. J. Pettit of Ontario, however, has succeeded in raising one species, which he calls the wheat wire-worm (*Agriotes mancus, Say*), in confinement, and perhaps it may be well to reproduce his account. Mr. Pettit writes as follows: "In the fall of the year 1870, so unusual an amount of damage was inflicted upon the wheat crops in this vicinity by this wire-worm, that I was led to try and breed it to the perfect state, with a view to ascertaining what species it was the larva of. By digging about the roots of the wheat plants, I obtained about a dozen specimens, which were placed with a few wheat plants in a large flowerpot, where they were kept supplied with food by planting occasionally a small quantity of wheat. With the first cold weather they ceased to eat, and were then placed in a sheltered situation until the return of warm weather, in spring, when they were restored to the breeding cage. They soon gave evidence of being alive, and possessing unimpaired appetites; their rapid consumption of the wheat plants rendered it necessary to renew the supply quite as often as before. They were fed in this way until the month

of July, when my absence from home caused them to be neglected; on my return there was not a vestige of food left. Thinking that the worms had probably died of starvation, I paid no further attention to them until the 26th of August, when on removing a part of the earth from the pot, a pupa was disclosed, and on the third of September the first imago appeared, which proved to be a specimen of Agriotes mancus, Say. As only two more specimens came out during the remainder of September, I turned the earth out of the pot and carefully examined it; the inspection revealed seven specimens of the imago in the little cells in which they had transformed, and one larva.

Among the larvæ collected, I had noticed one less than half the size of the others, and evidently much younger, which would account for the one still in the larval state. It had attained, however, a size fully equal to that of the others when first brought in during the previous autumn; and hence I have formed the opinion that the larval state does not last longer than three years. This opinion has since been strengthened by the observation of a large number of larvæ, which appeared readily separable into two sizes, corresponding to those originally collected for breeding. * * * I am of opinion that our species is by no means so long lived, (as has been stated by Bjerkander) but that it attains maturity in three years—a period quite long enough, the agriculturist must think, in which to inflict damage upon the crops."

Wire-worms occur in almost every kind of soil, but as a general thing, low, moist, cold grounds, adjacent to marshes and streams of water seem to be favorable situations for them. Grass appears to be the most attractive and palatable to them, but wheat, corn, barley, oats, garden vegetables and flowers never seem to go amiss. Since they show such a fondness for the different varieties of grass, and as they have nothing to disturb them in their work in grass lands, it is to the crops grown on land the first year or two after it has been broken up, that the greatest amount of noticeable injury is done, though without doubt the injury to the grass crops has been

as great but not so appreciable. If newly plowed lands could be planted the first year with some crops upon which the wire-worms could not feed, then they must starve or migrate to the adjacent fields, and of course only those along the border could so migrate through the soil before they reached the starvation point; but just here our knowledge is limited, for it is necessary to know which one of the five hundred species is infesting our land, also what crops it can, and what it cannot feed upon, then we are ready to make our selection. White mustard and buckwheat have been mentioned as crops which effectually secure the succeeding crops against these insects. Salt, lime, and rape cake have all been recommended, and on the other hand have been reported as utter failures. These conflicting statements seem to indicate that different species of wire-worms have been operated upon, and that what is destructive to one species is by no means so to another. Underdraining cold, wet lands infested with wire-worms, will, without doubt, so change the conditions as to diminish their numbers. Till we become familiar with the history and habits of the different species of wire-worms, we cannot expect an absolute specific for each one of them. I would be glad to learn at any time of experiments and their results. When we possess the information already mentioned, and have before us the life history of each of the wire-worms, with the various plants upon which each species will feed, as well as those upon which they cannot feed, we have then only to collect from the field we desire to cultivate, some of the perfect elaters we find in abundance upon the grass, as without doubt these represent the wire-worms under the ground, and determine the species, or, if we are not skilled in this work, send them to some one who can do it, so that we may know what we have to deal with; then, knowing what this particular species can and cannot feed upon, we shall know what crops to plant that the wire-worms may be destroyed in that portion of our field at least. To work out the life histories of the thousands of insects preying upon the crops in this country, about which at present little or nothing

is known, will require the time and patience of a large number of the most accomplished in this department of natural history, with the most delicate appliances in many instances, and since the naturalists are not the persons directly benefited by such observations, we have had thus far but little done in that direction in this country. There should be a scientific commission established by the State or national government, comprising a sufficient number of the most noted in the study of insects, and also others as noted in the study of those parasitic plants, as rust, smut, mildew, etc., which are injurious to our crops, whose duties should be to make the most thorough and searching investigation into the history and habits of our injurious insects and plants, and conduct experiments upon them for the purpose of ascertaining the most feasible means of holding them in check. Such a commission would be quite expensive, but the saving to our crops, in a long series of years, would be so great that the cost would sink into insignificance.

Discussion.

Prof. Fernald being asked for some information about the Colorado potato bug, said: I have never seen a living bug, myself, and hope I never may, but if I stay in Maine I suppose I must. It has not been naturalized here, like many other pests, but is a native of America. It originated on the eastern slope of the Rocky Mountains, where it would have remained if we had remained away. But our people went there and carried the potato with them. This beetle fed on a plant of the genus *Solanum*, and when he got a taste of this new species of the Solanum, he rather liked it; and when he found that it was planted further east, he commenced to travel eastward. There is a northern limit beyond which they cannot go on account of the cold, and a southern beyond which they cannot go on account of the heat. I believe they have been divided into three divisions; the northern division cannot travel so fast as the others. They have reached Maine.

I cannot tell at what points, but I know of them as far east as the Kennebec; and having gone half way across our State in one season, there can be little doubt that they will pass over the other half the coming season.

I believe no better remedy has been found than Paris Green, which is very poisonous, so that it must not be put on at its full strength. It may be mixed, twenty pounds of flour to one of Paris Green, and sprinkled on dry when the leaves are wet. Flour is best for the purpose because it is sticky. This will kill them, whether in the perfect or in the larval state. Another method of applying, is by stirring up a table-spoonful of Paris Green in a pailful of water, and sprinkle on the plants. If applied in this way one can take his own time, if applied in flour one must do it when the dew is on.

QUESTION. Will not the lines on the potato bettle serve to distinguish it from any other?

ANSWER. In the larval state, when they do the most injury they look for all the world like the three-lined potato beetle, which has been so long in the State, though an entomologist would tell the difference at a glance. I don't recall any beetle that can be mistaken for the perfect beetle. Full grown, the size would distinguished it from the three-lined beetle; it is more than three times as large. There is one of about the same size that is found in the woods, but it is not found on the potato. I have brought here specimens of all the insects that prey on the potato: the Colorado, the three-lined, and the so-called Blister beetles, four different species. I have had them all sent to me from different sections of the State, to know if they were the Colorado beetle. That shows how little idea the people have of what they are to expect. Some were sent me from the town of Lincoln, that had caused considerable alarm, until I sent them a specimen of the Colorado beetle.

Mr. DUNHAM. Are there parasites which destroy the beetle?

Prof. FERNALD. Yes, there are a large number which are figured in the books. Besides parasites, there are insects that kill them, which would not be regarded as parasites. The

lady-bug, for instance, and some other species, will destroy them at once. It seems to me that our children might be taught the difference between these injurious and friendly insects, so that they might gather those that are beneficial. There is one disadvantage in using Paris Green, that we kill the friendly insects with the injurious ones.

Mr. LELAND of Sangerville. I would like to inquire if bark lice can be seen by the naked eye by lifting the scale in August and September?

Prof. FERNALD. There is a great difference in people's eyes. I have used my eyes so much for these purposes that I could perhaps see them when a person unaccustomed to look at insects could not. I think they could be seen with the naked eye if looked for at the proper time. They look like little pieces of cotton.

The PRESIDENT. You have stated that the wheat midge might remain in the kernel and hatch next year. Can they hatch without going into the ground?

Prof. FERNALD. Yes; this has been proved. Why some do go into the ground and some do not, is more than I can answer.

QUESTION. What is the relative size of the full grown midges?

ANSWER. The length of the body of the perfect miller is about the same as the length of the larva.

Mr. GILBERT. How are we to account for the fact, that in certain localities in the State, where formerly the midge was so destructive that wheat was not grown for many years, that they have not been troublesome for a series of years unless some parasites have been at work there?

Prof. FERNALD. I expected that question. I have asked a great many farmers about it and read a great many authors. Some have thought it might be accounted for by the fact that not so much wheat is grown as formerly. I know 25 or 30 years ago my father had to give up raising wheat. I don't think there has been any wheat raised on Mt. Desert island since, so we might expect that the midges would become

extinct. But in those localities where wheat has been grown right along, if there are such localities, it would seem as if there might be parasites. The authorities on the subject are agreed that so far as is known at the present time there are no parasites, but that does not say there are none.

Mr. LELAND. Is it not quite possible that the farmers have learned to avoid it by early or late sowing? I believe it to be a fact that they sow at certain periods to escape the weevil.

Prof. FERNALD. I think the insect is as bad as ever it was, and that if he had a sufficient amount of food he would be as plenty as ever.

QUESTION. Do they feed on any other plants than wheat plants?

ANSWER. I think they feed on grass plants. I spend a great deal of time in summer evenings attracting insects into my room by a light, and a great many of these hover round my windows the last of June and July, and for about a month they are found on the grass.

Mr. LELAND. Is the midge found on red clover the same as the one found on wheat? It has the same appearance to the eye.

Prof. FERNALD. I don't know that there is any midge that feeds on red clover; it is a plant of a different order from wheat, and I should not think the wheat midge would feed on it.

Mr. GILBERT. On the farm which I occupy, there has been an effort made to grow wheat every year since I became large enough to harrow. There was a series of years, about twenty-five years ago, when those efforts were almost fruitless in results. But not liking to be overcome by that insignificant insect, we persevered in sowing it, and finally the midge entirely disappeared, so that it requires very much search to find a single specimen.

Prof. FERNALD. Do you sow early or late?

Mr. GILBERT. When the ground is suitable—sometimes early, sometimes late. I don't regard the midge at all. I

prefer to sow early when I can. I think I don't average sowing earlier than I used to. I have never been able to see any particular difference in their ravages on different kinds of wheat. There was a variety introduced supposed to be midge proof, but it did not meet with much favor in consequence of its making an inferior article of flour, and the sowing of it has been entirely abandoned.

Prof. FERNALD. It is just possible that the gentleman has parasites in Androscoggin that are not distributed over the State. If on investigation it should be ascertained that there are parasites there, so very small that they have not the power to distribute themselves, it might be a paying operation to distribute them over the State. I know that the parasites of the cabbage butterfly are more abundant in some parts of the State than others. We have them at Orono, while they are not found at Mt. Desert. I had it in mind to send some there last season, but did not succeed in doing so.

Mr. ROGERS of Stetson. I would like some information in regard to two enemies of our orchards. One is the little green louse that preys on the green leaves, the other is the borer.

Prof. FERNALD. In the paper read by me at Portland, before the united societies, printed in the Secretary's Report for 1875, Appendix, page 17, I have spoken of the borer. I take it the common borer is meant. The beetle of this species has white stripes alternating with brownish ones. There is another one that preys on our trees, that is termed the flat-headed borer. I have not, within a few years, had a chance to get them. I think I should recognize them in the larval state. I have here a specimen of the larva of a species of borer that is as abundant in the Western States as the common borer is with us here. Both should be dug out of the tree and destroyed, and to prevent the beetles from laying their eggs an application of soap to the trunk of the trees in May is recommended.

With regard to the green louse, I have never seen them abundantly. They are not on the leaves of our trees in

Orono and vicinity. It secretes a greenish, sweetish, liquid. There are gnats which like this liquid, and at the proper seasons these gnats are found going out on the leaves and twigs where the lice are, and when they are ready to exude the honey-dew the gnats take it, and if they do not respond readily the gnats reach round with their antennae and tap them. If any insects injurious to the plant-lice are round, the gnats will drive them off and protect the lice, so that they are called the milch cows of the gnats. I don't know as they do any damage.

Sec. BOARDMAN. The borer is so destructive an insect, that any suggestion or device likely to help us bring it under control is of interest to fruit-growers. Mr. Hooker of Gardiner, has placed on exhibition in my office, a contrivance which consists of a piece of sheet iron brought about the tree and its edges fitted into pieces of wood, which are secured together by clamps so as to form a water-tight, tunnel-shaped cylinder, with the bottom an inch or two below the surface of the ground. Into this a pail of water is poured, which, Mr. Hooker tells me, will remain two days before it is absorbed by the atmosphere. He has tried it as yet only on a limited scale, but he says the borer is invariably killed—drowned out. The device is not patented. For myself, I doubt if it fully accomplishes the end desired.

Mr. SMITH of Freedom. In certain parts of Waldo county we have the borer, in others not. I have never known them in Freedom, and I think they are seldom found there. The tent-caterpillar has been very destructive with us. I should like to ask if any one has observed that an insect enemy has been preying upon them the past season. I should think that with us nearly a quarter of the leaves were of a golden color, and were infested with cocoons. I noticed that there were holes in these cocoons, and on looking inside I found that the insects were destroyed. I should think at least nine-tenths of them were destroyed in this way.

Prof. FERNALD. There are parasites of the tent-caterpillar. There are two kinds. I have brought them both. I have

brought the eggs about the twigs, the full grown larvæ, male and female, of a number of sorts, with species of cocoons. We usually have them in breeding cages, so that our classes in entomology may study their habits. I would remark that the moth remains in the pupa state but a short time before it makes a hole in the ends of the cocoon and comes out.

Mr. SMITH. These holes were in the side of the cocoon.

Prof. FERNALD. I should want to be sure whether it was a parasite or the escape of the perfect moth leaving the pupa behind. The moth always escapes through the hole in the end, and if the hole was on the side it is the work of an enemy to the species. With the parasites there is one trouble, they have parasites that kill them.

QUESTION. Do all kinds of caterpillars lay their eggs on the branches they infest?

Prof. FERNALD. There are about 500 different kinds of caterpillars. I presume the reference is to the varieties of tent-caterpillars. They both lay their eggs in belts around the twigs of the tree, but they may be distinguished by the fact that the eggs of the common tent-caterpillar form an oval ring rounded at the end, while those of the forest tent-caterpillar are square at the end. You are very safe in getting off all the tents of either kind and burning them.

Mr. STUART of Newport. Last summer, just before haying, I turned my eyes to my field, and saw what looked as if some one had been mowing my grass and hauling it off. There was, I should think, an eighth of an acre where the grass was completely killed. It looked something as our worst fields did the caterpillar year. I don't know what it would be best for me to do with the piece, but I shall plow it up. I think I did not get twenty-five pounds of grass from the eighth of an acre.

At the suggestion of Mr. Gilbert, the members of the Board were called upon for reports as to whether the Colorado beetle had been observed in the different counties during the past season. Mr. Gilbert stated that it had been found in

Androscoggin county, in several localities, but not in sufficient numbers to do much damage.

Gen. BROWN. I cannot give the names of all the localities where it has been found in Cumberland county. I had an opportunity to examine it pretty carefully, and I don't think I should ever mistake it for anything else in the world, or that anybody would after having seen or known it. It is reported to have made its first appearance in our county, at Deering. Two or three days after that, talking about it at my office in Portland, it occurred to me to go to a large potato patch in the city belonging to my father, where the beetle had not been observed. In five minutes after going in we found scores and hundreds of them. My brother, who had a garden not forty rods from this, never had a beetle during the whole summer. Soon afterwards I found them on my farm. We found them on a prolongation of the line from where they were first seen in Deering, and they did not seem to leave that line. It seemed as if they had been projected from a cannon and dropped all the way along. I fought them with Paris Green from their first appearance. This seemed to destroy them, and I suffered no serious damage from them. They were in great numbers. I suppose I killed thousands of them.

Prof. FERNALD. Can you inform us the line of direction taken by them?

Gen. BROWN. The direction of the track from Westbrook to my place was pretty nearly due east.

Mr. KYES of Franklin. They have been found in two or three places in our county—in Jay, and one or two other towns.

Mr. BODWELL of York. It has been reported in one or two localities in our county.

Mr. REYNOLDS of Oxford. They have been reported in Oxford county.

A gentleman reported them as having been observed in Palmyra and St. Albans, in Somerset county.

Mr. MALLETT of Sagadahoc. I discovered this beetle in very limited numbers on my potato patches. I made considerable inquiry, but did not learn that it was found at any other points in the county.

Mr. AYER made a similar report from Waldo.

Mr. LELAND of Piscataquis. They were found very near the station at Dover, and were recognized there by a gentleman who had been familiar with them in Minnesota. It was thought probable that they had taken a ride on the cars. In Foxcroft they were found in fields at considerable distance from the station.

These embrace all the counties where the bugs were definitely reported as having been observed.

BOOK-KEEPING FOR FARMERS.

By John Marshall Brown, Falmouth.

One of the most entertaining books I have ever read, is a small yellow covered volume, bought at a London book-stall, and entitled "How to farm profitably, or the sayings and doings of Mr. Alderman Mechi." The title, I suspect, will convey to your minds the impression that the writer was a talkative, opinionated and somewhat bumptious person, and, in fact, I believe he was; his book, however, is full of wise suggestions, and records very much valuable experience. Mr. Mechi was, if I am not mistaken, an ironmonger in London, and by dint of energy and prudence acquired a fortune, and rose to the position of alderman of one of the city wards, a title which means far more in England than we, with our notions of aldermanic dignity in American cities can readily understand.

Having acquired a fortune and a position, Mr. Mechi resolved to gratify a longing of his youth, and satisfy an ambition, which, to the honor of our cousins over the water, almost invariably accompanies the possession of wealth. He purchased an estate in the country, and carrying to it his experience and methodical habits, entered upon a plan of great magnitude for the renovation of the exhausted land. The farm proper consisted of 130 acres of heavy clay, and cost him in 1844, £3,250, or $16,250. The latest report of his operations, contained in the book referred to, is dated 1859, up to which time he had expended, in addition to the purchase money, £6,200, or $31,000. With this money he had thoroughly underdrained the land, with between 80 and 90 miles of stone and tile drains, 12 feet apart and 32 inches deep; had cleared off all timber, crooked fences and ditches; had made new roads, erected new buildings of brick and iron and

slate; built his own residence, put in steam machinery, had pumps and tanks and pits, so that every pound and pint of manure was saved, and was able at last to say that his investment had been remunerative, and his property, on the English basis of ground rental, trebled in value by actual appraisal.

I instance this case, because here was a man without previous experience in agricultural pursuits, and who entered upon this new life as he would have engaged in any other business, laying aside for it such capital as he deemed necessary, and managing it in accordance with those sound business principles which had been the secret of his previous success. His maxim was, "Book-keeping on a farm is as necessary as in a warehouse."

There are few in our own State, perhaps none, who are likely to follow our London alderman's example, and yet it conveys a lesson which every one of us ought to heed.

How many of our farmers look upon farming as a business, just as manufacturing is a business, or buying and selling merchandize is business? How many look upon it as a makeshift to keep soul and body together? How many carry into their farm work the careful system of accounts which the manufacturer and the merchant find a condition precedent to their success? How many having managed to keep soul and body together, rest there and ask for nothing more? Mr. Mechi used to say that he never asked a farmer how many bushels of corn he raised, but how much it cost him to raise a bushel of corn. How many of our farmers could answer that question? Lord Fortescue, who like many another English nobleman was an enthusiastic and practical agriculturist, used to say, whenever applied to by one who wished to lease a farm, of which he had scores, "How much money have you? I will suit the acres to your purse." How many of our farmers think of making a proper apportionment of land to capital? Labor when *employed* is the best of capital, when *wasted* what a pitiful and miserable waste it is. How many of our farmers waste upon ten acres, the energies which would make one acre teem with abundance.

The census of 1870 gives the entire male population of Maine, between the ages of 10 and upwards, as 245,704; of this number, 33⅓ per cent. are reported as engaged in agricultural occupations, 82,000 in all, and of this number 9,570 are represented as having been born in the United States. This large percentage renders it absurd to speak of farmers as a "class" in the community. A body of men engaged in the same pursuits and numbering more than one-third of the able-bodied population—numbering, indeed, if we throw out of the account the large cities and manufacturing towns, three-fourths of the community at large—ought to be considered not a "class" but the community itself, and if there are different classes within this community, as of course there are, it is in obedience to the irresistible laws of equilibrium, which alone mark the social distinctions in a free land like our own, where every man is the peer of his neighbor before the law. So long as truth is better than falsehood, industry than idleness, thrift than wanton waste, knowledge than ignorance, virtue than vice, there will be different strata in society, and farmers cannot be excepted from the rule.

A natural subdivision of the farming community would seem to be:

1st. The farm laborer who works for his stipulated wages, having no interest in the work beyond and sharing none of the risks of the venture.

2d. The farmer who by the accident of inheritance, or by purchase, finds himself the owner of a farm, and is satisfied if by half-hearted labor he can keep his family from want, simply this and nothing more. Into his selfish soul enters no thought of his neighbor; he provides for himself and allows others to do the same. I am sorry to say, that of this class I have many in my mind to-day, and I doubt not the picture is too familiar to you all. He is usually a man of few pleasant words, morose and complaining, a hard father and unloving husband; the light has long since burned out of the eyes of his faithful wife; his children are impatient for release from the parental control. His life is a wicked failure and waste;

his example is a reproach, he is a hindrance and stumbling block in the way of all development and growth.

It is true that agriculture is the first step in civilization, but it is also true that a very high degree of physical culture is possible without it; that without it, even, there may be a high degree of national life. Nomadic races have played a prominent part in the history of the world. Witness the Tartar tribes who swept like a scourge through Asia to the west. Witness the years of wandering in the wilderness. Witness the aborigines of our own State, who, without permanent homes, made themselves a daily terror to our forefathers. But the Tartar and the American Indian were simply men in a state of nature, swayed by passion and interest. Without culture of the soil, no culture of the mind. But when it was found that one man could, by his industry, produce from the abundant earth food for five, it was also discovered that four men might be spared for other labors, so there came to be inventors and manufacturers, and sailors and merchants, and scholars and statesmen, and law and literature and good government, and at the bottom of all and bearing it all on his brawny shoulders, the *farmer* with his mattock and his spade.

This leads me naturally to the third and last class of farmers, who may be briefly described as those who make of farming a business, expecting from it not only sustenance but profit, producing more than they consume, and making non-producers dependent on them and tributary to them.

It is to this class of farmers that any remarks on the subject of book-keeping must be addressed. Some know enough about it already, but to many, I fear, it is new both in theory and practice. How many—to repeat the question asked before, know what it costs to produce a bushel of corn, or oats, or potatoes, a pound of butter, or cheese, or pork? I know many a farmer who has done well in the world, at whose feet I would gladly sit and learn, who could not answer one of these questions; who would say as some have said to

me, "Confound your book-keeping, it will do for shop-keepers and bankers and merchants, but I am too old to go to school. I know that I pay my debts and make money, and that is enough; none of your new-fangled notions for me." Now it is very hard for a young farmer who is just learning the business, and whose carefully kept account books tell with inexorable accuracy that he has been losing money all the time, to reason with a successful veteran who thinks book-keeping a nuisance. But, in fact, in this is the gist of the whole matter. It is of more benefit to the community of farmers that one man should lose money if he knows and can show by his books how and why and when he lost it, than that another should make money if he cannot show how and where he made it. My account books are light-houses to warn others of the rocks and reefs on which my ships have gone to pieces, but my neighbor's success is the *ignis fatuus* which lures the ignorant plodder to his destruction. Imagine such a man who at the end of the year is able to say, I owe no money, and I have more money than I had twelve months ago. Ask him how made it, and he will probably say that there was a fortunate turn in the market, and potatoes advanced, or hay or something else, because there was a short crop. He has kept no account with his crops, and some may have failed miserably, but he cannot give the reason for it. Some day or other the market may turn the other way, but he cannot profit by his experience, because book-keeping, which is a reward of experience, has had no place in his farm economy.

Now, all business operations are but the investment and manipulation of capital; and capital, as has been truly said, "may consist in valuable resources, such as real estate, live stock, merchandise or cash, or in productive power, such as professional ability, technical training, physical endurance or industry, or in both." Again, the prime object of business is gain; and the substantial proof of gain is increase of capital. How thoroughly this applies to the farmer's occupation, and how necessary it becomes that the farmer should adopt such a system of accounts that he may know at the end of his

year's labors whether there has been gain or loss, and be able to mark the cause of it, and if there has been disaster to put a buoy on the rock as a future warning to himself and others. In book-keeping, the unfailing evidence and test of success and prosperity is the balance sheet; no business is safe without applying this test systematically and regularly, and it is impossible to apply the test without a rigidly accurate system of accounts. "Book-keeping is the faithful and systematic record of business transactions."

All business transactions consist in an exchange of values; hence book-keeping is the science by which these exchanges are recorded and their results shown. Of this science there are many text-books and many teachers, but I do not think the farmers need waste much time on either; none that I have examined seem to meet the necessity of the farmer's case; and, indeed, I think that any man of intelligence, with a knowledge of simple arithmetic, and such limited technical instruction as may be gotten from any elementary treatise on book-keeping by double entry, can devise for himself a system of accounts.

And now, in the short time remaining, let me leave theories and come to the more practical details of the subject. I do not suppose it was intended that I should attempt to interest this Convention in book-keeping. I certainly should shrink from such an attempt, knowing that the result would be a ridiculous failure. All that I can do is to give some hints for your guidance. And when I assume that not many farmers keep a careful set of accounts by double entry, so-called, indeed, that very many keep no account at all, I trust that those present of whom this is *not* true, are so sensible of the importance of this subject that they will listen patiently to the somewhat dry details which follow. My suggestions are derived from my own experience and have been tested by time.

As a necessary preliminary, ascertain what capital is available for the business. Therefore make a careful inventory, stating accurately and in detail the valuable resources of the

farm, the number of acres of cultivated land, woodland and pasture, with its market valuation, the amount of stock of all kinds, crops on hand, manure in store, farm tools and implements,—neglect nothing that has value; and note in the inventory what the value of each item is. Have an accurate map of the farm drawn to scale, by an engineer if possible, showing the location of roads, the divisions of fields, situation of buildings; if there are underdrains mark carefully their position, so that they can easily be found. The small amount of labor involved in this preparation will be pleasant work, in which the whole family will cheerfully engage. If you have a herd of cows, and breed your own stock, prepare a herd register, whether the stock is thoroughbred or not; name every animal, and in the herd book enter the name, date of birth, distinctive marks, name and residence of her breeder, name of sire and dam, date of purchase and price, and when sold the date and price and name of purchaser. This method is absolutely essential to good breeding; it makes the herd a part almost of the family, and it is amazing to notice how much greater is the interest felt by all persons on the farm in this most important branch of husbandry. I do not hesitate to assert, that a collection of such cattle pedigree running through a series of years will result insensibly in the production of vastly improved stock, and a corresponding advance in market value.

These preliminaries settled, a map, a herd book, and an inventory, and we can begin our book-keeping. The blank books necessary are a day book, journal and ledger; these are necessary for the simplest forms of double entry, and are all that are absolutely necessary for the most complicated accounts. They can be furnished by any stationer for a small sum, and will last for years. In my own practice, and I strongly recommend its adoption by all, I use instead of the day book proper an ordinary office diary, of the folio size, with spaces for three week days on each page, ruled for dollars and cents, and with the usual tables, almanac, and blank leaves. In this book should be entered, daily, under its

appropriate date, a record of all the operations of the farm, no matter what their character; specify each man's labor, how and where performed; note the time of plowing, cultivating, sowing, planting and harvesting; specify the fields and crops on which this work is done; enter all contracts and promises that are to be fulfilled in the future, all cash receipts and disbursements. Note the weather, the wind, the variations of the thermometer and the barometer, if you have one, and you ought to have one. All this will require no more than five minutes each day; and as the days go on the book will become a *vade-mecum*, a household treasure, to be constantly referred to in the future as a record of past errors and successes, each with its vital lesson. The blank pages at the end of the book can be profitably devoted to many uses—An account of family expenses, an analysis made weekly or monthly of the labor account, debiting each field or crop with its proper number of hours or days at the money value; a gestation account, supplementary to the herd book, giving date of service and time when due. A digest of market reports may be added, weekly, showing prices at the farm and in the market; and at the end of the harvest a summary of the crops by weight or measure, and then, finally, another inventory, item by item compared with that taken at the beginning of the year. The time involved in all this will be infinitessimal, the pleasure derived from it will excel your fondest expectations, and the ultimate advantage of it all to the farm and family immense. I am bold enough to say, that if this simple plan could be conscientiously carried out by every one of our farmers of the better class, (I accept of course those who do something of the kind already), there would be an immediate and lasting improvement in our agricultural prospects.

But all this, vital as it is, is but part of book-keeping; and here I must deal with dry technicalities, and I shall be as brief as possible. In the system of double entry, every person or thing which enters into a transaction is designated by a name in the books which is called "an account," and every

transaction, as the phrase implies, is twice entered, once to debit and once to the credit of the proper account. The day book is the book of original entries; it is the record of transactions from which any accountant can readily make all other entries. The journal is the intermediate volume, in which these entries are made in appropriate business language. The ledger is the book which shows under each account all the debit and credit entries, the difference between the sums of these entries in the balance of the account. If the books are correctly kept, the sum of the debit balances will exactly equal the sum of the credit balances, and thus give a picture of the operations of the year. With the assistance of the inventory a balance sheet can be prepared, which will be an absolutely accurate statement of gains and losses, and show at a glance whether there has been failure or success. Perhaps one or two illustrations may make this sufficiently plain.

The diary shows that on a certain day four men and two teams ploughed for barley. Barley is an account and labor is an account. The entry on the journal is: Barley debtor to Labor so much, whatever the money cost of the labor may be. In the ledger there is a double entry. Barley is debited for Labor, and Labor is credited for Barley.

On the 31st of May, $30 was paid to one farm hand. The journal entry is: Labor debtor to Cash, and in the ledger Cash is credited with Labor and Labor is debited with Cash. On another day 100 bushels of barley are sold. Barley is credited with Cash and Cash debited with Barley. A horse is bought and paid for with a thirty day note. Journal entry, "Horse stock" debtor to notes payable. On the ledger, Notes Payable is credited with Horse Stock, and this amount, so long as it appears in the credit balance, is a "liability" until the note is paid. The journal entry is then Bills Payable debtor to Cash, and in the ledger the entry appears on the credit side of cash and debtor side of notes payable, which account now balances, and is cancelled because the liability no longer exists.

The application of these principles is a matter of no difficulty. If the diary has been faithfully kept, the assistance of any elementary work on double entry book-keeping will enable any farmer or farmer's son or farmer's daughter to keep account of all the varied transactions incident to agricultural pursuits. It is impossible, gentlemen, to overestimate the benefits which the entire community would derive from the general adaptation of this practice. But if one, only one, is led into the way of order by these hastily prepared remarks, I shall feel that the labor has not been in vain.

The proud motto of Maine is *Dirigo*. More than a third of our active population is engaged in agriculture, and yet, to our shame and reproach, we are not even classed among the agricultural States. Here are vast resources undeveloped, I might say undiscovered; rivers wasting their powers in their fruitless course to the sea. Here are thousands of citizens living out their weary lives in labor without gain.

Farmers of Maine, turn over the leaf of history whose record is completed to-day, make a new entry on the fair page to be opened to-morrow. Make of your occupation a business; engage in it as the business of your life. Keep account of it as every other prudent man keeps account of his business. Do this and you will not have long to wait for your reward. The balance sheet is wofully against us now. Do this and we will soon have the balance on the credit side.

COMMERCIAL ASPECT OF POULTRY RAISING.

By W. W. Harris, Portland.

Poultry raising during the last decade has received more attention than ever before in this country, and to-day we see a marked change in the quality and quantity of stock raised, compared with what it was ten years ago. The improved condition noticeable in both quality and quantity is not confined to our own State, but the interest in this branch of stock raising is wide-spread, extending all over our country; and to-day almost every State in the Union has its State society, and many like our own, its County societies, devoted to this interest. To the influence of these societies, by their annual exhibitions, to the efforts and example of leading members, to the poultry journals, and the agricultural press, we are in a great measure indebted for the increased and growing interest in this branch of stock raising, and our annual poultry exhibitions have shown a large variety of very choice stock, and received a generous support and hearty approval from our citizens.

It was thought ten years ago, that very little attention was necessary to bestow upon the poultry yard. Poultry houses were then not thought of; any old shed, if it had an apology for a roof, with an old hay-rack, sleigh or pung for a roost, was considered ample provision, and the hens were expected to provide eggs and chickens for home consumption, and a generous surplus for market. No thought or provision was made for feeding, except in winter, and then only occasionally, sparingly, and irregularly. To-day a marked change is apparent. The breeder of to-day, first of all provides good, light, warm houses, ample yards, supplied with pure water, with grass in its season, and after ample provision has been

made for the health and comfort of his stock, he makes his selection of such kind or kinds as he wishes to breed from, and always buys the best.

In the selection of his stock he has regard to the object sought, whether fancy stock for exhibition and sale, eggs for market, or eggs and poultry combined; and the intelligent breeder goes about this with as much faith in results to follow as he who plants corn. The man who plants corn has no expectation of raising a good crop without tending and caring for it. So with the poultry breeder. He knows that the old starving-out system will not pay, it has been tried and proved a failure, and that only under the best conditions in all respects, will he be morally certain of success. Consequently, he made ample provision for the comfort and health of his stock, so far as house, yards, etc., are concerned. He has got pure blooded stock, and he carefully attends to their wants, gives them a variety of food, and feeds liberally. Thorough ventilation and cleanliness are his watchwords, and he *expects* success.

Poultry raising at first thought seems a very small matter, and of no account commercially, and yet when we take into account the amount of cash received in our State for eggs and poultry sent to Boston in one year, we are astonished at the figures; I am sorry I am unable to give the amount. Then add to this the amount of eggs and poultry consumed in all the cities and villages in our own State, and we have an aggregate so large, could I give the figures, few of you would believe me.

The French have long been noted for their faculty of turning small matters to individual and national gain. It has been said of them that a French family would live sumptuously on what an ordinary American family would waste, thus showing their propensity of turning every little thing to some account. They, to-day, are far ahead of any other nation in the profits realized from poultry, and seem to have carried this saving propensity of theirs into the management of their poultry as well as other matters.

In raising poultry they have always had a definite object in view, and that was, to produce varieties of birds that would for the food consumed, be the most prolific, and when killed and dressed for market would be of good size, and give a small percentage of loss in dressing, and they have succeeded admirably. While American breeders have turned their attention to the production of egg producing birds, as the white and brown Leghorn, which as egg producers are superior to any and all other breeds, the French have endeavored to produce varieties that shall not only be good layers and non-setters, but in addition to these good qualities, they must also combine size when dressed for market; and to-day, if they never produce another variety, the Houdan in its native home stands unequaled, and a positive evidence of their success. This variety has been imported into this country and England, and the same success is expected with it that the French have had. But we must not expect that French birds alone will give us the same success the French have had, but we must have some of the French management to go with them. Already the breed has begun to deteriorate, for the reason that Americans and Englishmen have begun to sacrifice its economic qualities for merely fancy points of color and shape.

Some idea of the importance of poultry raising to France may be given, by stating that England, in 1871, imported from France eggs to the value of over six millions of dollars; add to this the value of eggs and poultry consumed at home—and the French as a people, are perhaps greater egg consumers than almost any other nation—and we get some idea of what poultry raising and the profits resulting therefrom, are to the French people.

Various and many theories have been advanced in regard to space for a given number of birds, some contending that eight or ten could be kept wholly under cover, in a coop 6x12 feet, in two compartments, but I have never known birds to do well in such quarters. From one extreme they have gone to another, and Mr. Wright, an acknowledged authority in

England upon poultry matters, claims that in order to make the business profitable, not more than one hundred birds should be quartered on one acre of ground. In our own country opinions differ, and perhaps we may well accept Mr. Stoddard of Hartford, Conn., as good authority, whose system is a mean between the two extremes referred to, and more especially adapted to the production of eggs than either the English or French idea. Perhaps I may as well say something here in regard to the management of poultry to make the business successful.

In the first place it is necessary to have suitable houses. They need not be fancy or costly. They must be light, dry, warm and free from drafts of air. I have in my mind a case illustrative of the necessity of the last point. A breeder of fancy poultry laid himself out and built a model house, to his mind. He built it two stories high, making a roosting place in the upper story under the roof. There was a large amount of glass in the roof, and in cold weather, (the exhibition season) he warmed the house by fires in the lower story. The result was, the warm air ascended to the upper, came in contact with the glass in the roof, became cold, and descended to again be heated, thus keeping up a continual circulation of hot and cold air. At just the time he wanted his birds at their best, he found them at their worst; for from the drafts of air they were sick with a cold or the roup, and unfit for exhibition. As I have said, it is not necessary to have an elaborate or costly house. No matter how cheaply or roughly constructed, provided it has the requisites for the health and comfort of your birds. I have seen as good birds raised in houses that cost but a few dollars as could be raised in one that cost a thousand. After you get the house, be sure and keep it clean and free from vermin, as no fowl can be healthy and do well if they or their house are infested with lice, as they surely will be if not kept clean. How often we hear people asking, "What ails the chicks?" If they will catch one and examine it, nine times in ten, the trouble will be found to be lice bred from confinement in filthy quarters.

There is another consideration why poultry houses should be kept clean, and that is, the value of their droppings, which if properly cared for are of great value. I have seen it stated, that one bushel of hen manure moistened and thoroughly fined and mixed with fine muck, ashes or loam, was equal to an average load of barnyard manure. No one who keeps a large flock of hens, and has attended to their droppings, and composted it with suitable material, will need advice upon this point.

A word as to feeding. Do not over-feed; remember, fowls require a variety of food and will not do well if restricted too much in their diet. They require green or vegetable food, which can easily be supplied in summer by allowing them a run on grass, and in winter a liberal supply of cabbages; mangolds, or other roots, will be relished by them, and will well pay for the trouble of raising. Fowl require green or vegetable food, and a variety of grain, changing their feed as often as practicable. By over-feeding with grain, especially with corn, they become fat inwardly, and then good-by to eggs. The best rule in feeding, is to feed as long as they will run eagerly for the food when thrown to them, and when they do not hurry to pick up the grain, that is the time to stop—they have got enough. An important point to pay attention to, is to watch your hens, and do not let them get older than you are. When a hen has passed her third laying season her time of usefulness as an egg producer has passed, and no matter how patiently you may watch for eggs, as a rule you will be disappointed. Sort out and kill off the old ones, and supply their places with young pullets, which will furnish you with an abundance of eggs, and at the time of year when they will bring the largest price. I do not propose to give you glittering figures, showing profits to be derived from poultry raising; that all depends upon the skill and good management of the breeder, and we all see enough of this in the agricultural press. One man will say a bushel of corn, costing 70 cents, will keep a hen a year, and she will lay from one hundred and twenty to one hundred and fifty

eggs during the same time, which at 20 cents per dozen would give a profit of $1.30 to $1.70 per hen; which perhaps might not be far out of the way when kept in small flocks; but don't keep four or five hundred in close quarters in one flock and expect the same profit per head, for you will be disappointed.

Hens will not do well in large flocks. It has been tried time and again, and always proved a failure. How often you see in your agricultural papers inquiries as to the business of poultry raising on a large scale, and as often read the answer that it very rarely pays, and mainly for the reason that too many are crowded into small quarters. I am satisfied, however, that if you give them plenty of room, with a good run to grass, and pay attention to the seemingly small points in their management, to which I have alluded, you will find the business profitable. There is money in keeping hens for eggs alone. There is money in raising them for the meat. When spring chickens are worth 40 cents per pound in June, 35 cents in July, and 30 cents in August, as they are every year, and will be for years to come, there is money in raising them, when you make them weigh 2½ to 5 pounds each, at four months old. It does not require much figuring to find a profit in this, and it can easily be done. Do you think the prices named, high? I know one hotel keeper who will contract any day to take three thousand chickens during the months named, at these prices, and he is only one of many who would do the same. There is always a market for early spring chickens at high prices, as the market is never overstocked. Then there is money in fancy poultry, just as there is in raising fancy stock of any kind. I have known of a single bird being sold for a price that would buy a good horse. I know one breeder of fancy poultry whose sales for months in succession have averaged fifteen hundred dollars per month. One breeder in our own State, last year made five hundred dollars raising poulty; and he had seventy-five dollars for a single bird. The breeder who understands the requirements of his birds, and meets those requirements with

proper care and attention to his stock, and combines in his business, breeding for eggs, meat, and fancy for exhibition and sale, will find, I believe, a larger percentage of profit upon his investment than in any other branch of stock raising in our State.

One branch of poultry raising I have not spoken of, which I believe is the most profitable of the whole poultry tribe. I allude to turkeys. They require but little attention, and if a good breed, attain large size and are always in demand. The first two or three weeks it is well to look after them, and if early in the season, keep the little chicks from the wet grass and sheltered from rains; but very soon, if left to themselves, will take care of themselves, and no attention need be paid to them till fall, when you want to feed and fit them for market;—for cost of feed and care, they pay better than any poultry I can raise. Two of my turkeys last spring went out in the pasture, laid their eggs and hatched their chicks, and were two weeks old when we first saw them. They never came to the house and there was never a crumb fed to them till October, and these young ones were as large, and in as good condition as those hatched at the house and well cared for early in the season, and I sold them alive (twenty in number) for two dollars each, and think it paid.

Now, after this random talk, I will say, if any of you propose to raise poultry extensively, or more than ordinary farmers raise, ask yourself if you know the habits and requirements of the kind or kinds you propose to raise. If not, don't do it; but first acquaint yourself with the business, and the best way to do this is to commence in a small way, and as you learn their habits and wants, you can increase your stock to any amount your circumstances will permit, always remembering that plenty of room, and in winter warm rooms, variety of food and perfect cleanliness, will insure you healthy stock, and plenty of eggs, consequently good pay for your care and feed. One other thing. Don't keep too many kinds. Start with the best stock of whatever breed or breeds you keep, and so manage and care for it, as to improve it

and make it better year after year, and you will always find customers who will purchase for breeding purposes, and pay fancy prices. No man can afford to raise or keep poor stock. It costs as much to keep an ill-bred animal as a good one, and when an ill-bred scrub will not sell at any price, a good one will command a good price.

Any farmer can keep a stock of poultry, larger or smaller as his circumstances will permit, and hardly know or feel the cost, and if he has children as every farmer is supposed to have, and they are encouraged to do so, will take kindly to it, and care for it, and if allowed a share of the cash received for eggs and chickens sold, they will be sure to keep the hens laying, and you will be agreeably surprised at your income annually from this branch of stock-raising.

THE CULTURE OF FLOWERS.

By James A. Varney, North Vassalboro'.

I am fully aware that the subject assigned to me this evening, embraces too broad a field to admit of anything like a full and complete treatment in the time allotted me. I shall endeavor, however, to present some practical hints that may serve to enliven our interest and tastes in this interesting branch of horticulture.

In no country in the world, probably, has such rapid progress been made in the art and science of horticulture, as in our own during the last few years. We deem it a happy indication that the love of flowers is increasing every year, and that the interest in their cultivation is becoming widely disseminated among all classes. No longer does the old idea prevail, that owners of large estates, or the wealthy alone, can afford to cultivate flowers. To-day the cheerful and refining influence of flowers is felt beneath many an humble roof. Here in the lowly cottage as well as in the costly and elaborate conservatory of the rich, their beauty and fragrance are justly appreciated, and though starting from some rude box or pot upon the window-sill, they are none the less a source of constant joy and sunshine. Few people among us are so poor as to be deprived of their companionship.

The days when the prosperous farmer could be satisfied with his broad acres and well filled barns; his numerous flocks and herds, while his family dwelt in a hovel, with little of comfort or convenience within, and absolutely nothing to please the eye in its surroundings without, may well nigh be considered among the things of the past. Convenience and coziness, permanence and prettiness, pleasant situations and pleasant surroundings, all enter into the account in appraising

the real value of our home. Our homes! How dear that spot should be to all, in city or town, in wealth or in humbler walks in life, for out of it spring the issues which are to exert a lasting influence over all our subsequent life. Father, mother, son and daughter, each in their appointed sphere, form a component part of home, and contribute individually to its weal or woe. Parents sometimes forget that once they were children, often to the utter exclusion of all that tends to strengthen the ties of childish endearment to the sacred name of home. There is little music for the boy in hoeing corn or potatoes from the rising to the setting of the sun, and he becomes weary with his hoeing. You had forgotten, perhaps, or never learned, that an hour with the guitar or violin would have helped him out with an extra row of corn. He loves his pet birds or flowers, but those, perhaps, are hidden away in some nook or corner unobserved by you. Aid him in caring for these a few moments occasionally, and see then how lively the cart and the plow will speed over the farm the balance of the day. Give the children a nice croquet ground, plenty of well prepared space for a flower garden, everything neat and tidy about your premises, and my word for it, you will find them less anxious to get away from the dearest spot on earth—home. I trust I shall be pardoned here for reference to some personal recollections of the past.

When a boy, I remember that my father caused the ample front yard to be plowed, and instead of planting out shrubbery and flowers, it was filled with bush beans. I have not been partial to beans since. If flowers had been planted in that yard instead of beans, who can tell but I might now be able to eat as many of them as—Mrs. Partington!

Another reminiscence of my boyhood days, and I will proceed to the more direct text in hand. I was sent on horseback on an errand, some 35 or 40 miles away. It was a hot, sultry day in the latter part of the month of June, and after riding a long distance through a wild, woody section, I came out to a log cabin. Being thirsty, I dismounted and pro-

ceeded to the cabin for some water. Beside the narrow pathway were two pretty beds of common flowers, their little blossoms shining in the sun, and seeming to say to me: "This is the way to our humble, happy home, walk in." A rap at the open door brought out a smiling lass of some twelve or fourteen summers. She bade me enter and be seated, while she ran to the spring for some fresh water. Like many a Miss(?)taken youth before, I made a proposal in haste and was as hastily rejected. It was to go and get the water myself. But I was left to look at the inside of a log house. The mother and a little brother of the pretty maid of the spring were present. Everything about the premises was of humble design, but exquisitely neat and clean. Two small sized window sash furnished light for this humble cabin, in one of which sat a box containing a Hydeangea Hortensis in full bloom, and one or two smaller dishes of flowers. The young Miss called the little boy, washed his face, combed his curly locks, and after printing a sweet kiss upon his cheek sent him away to school. Well, I confess it, I half wished I might be sent to school too. Night approaching, found me in the highway in front of a farm-house where I had been instructed to tarry over night. The yard in front of this well-to-do farmer's house was literally crammed with last winter's bod-sleds and long sleds, old carts and hayracks, a tumble-down corn-pot, the remains of an old-fashioned leach tub, cords upon cords of wood from old trees just as they were felled in the forest, down to the half decomposed pigsty that leaned against an old appletree in the corner opposite the corn-pot just referred to. I do not now think of half of the names of the things that adorned (?) that front yard; enough, however, to make a first-class fire, not including the building. I was plucky for one of my age, as you may well judge, to find my way through all this incongruous mixture to the door of the house. A few raps with my knuckles failed to attract the attention of the inmates, but a long and loud one with the butt of my whip stopped the continued buzzing of a number of spinning-wheels, and brought a strapping, great long, bare-

footed girl—lass I should say—to the door. I introduced myself as well as I could, all the while wading about in a general scramble of pigs, turkeys, geese, and ganders too, hens, chickens, and what not; all making a grand charge upon the same door with me—I forgot to include several pet lambs in the above hash. This was a wealthy farmer's home. Four big daughters, all barefooted, and all spinning. They were corn fed, looked very strong and healthy, and promised much of endurance, but little of refinement and culture. The inside of this home compared well with the outside. What a home! Is there now, anywhere in Maine, such an apology for a home? If so, I would like to send them a copy of this paper, together with a copy of my catalogue of fruits and flowers, to whom I would make a special offer to furnish them with a stock of flower seeds gratuitously—provided they will put fire into the front yard, at a proper time, and plant flower seeds on the ruins.

I do not propose to enter the field of landscape gardening, or the laying out of extensive flower gardens, for those in want of instruction in this direction, will find many publications treating these subjects in detail. Let me say, however, first of all, look to the proper preparation of the soil as the basis of the successful cultivation of flowers, as in all horticultural operations. If you have a stiff, clayey soil, you have probably beneath it a hard clay subsoil. Let this be well underdrained, worked deep and fine with the plow or spade, or both, and well enriched. If you have a sandy loam, with a coarse sand or gravel beneath it, there is less necessity for underdraining. If so light and sandy as to be liable to suffer with drought, work into it a liberal supply of clay and muck, with your dressing. As a rule, there is little fear of making a flower garden too rich. Aspect is of minor importance, provided plenty of sun and air is obtained. Avoid too much shade, and grounds where the soil is crowded with roots from adjacent hedges and trees, for these are continually extracting from the soil those elements essential to the plant growth. In most cases in rural towns, a convenient and

attractive location may be found, and if it be only a small one, well arranged and properly cultivated, is far preferable to an extensive one devoid of such care. In the arrangement of the flower garden very much depends on the selection of varieties. For the want of a better knowledge of the kinds of plants and flowers best adapted to our climate, and best suited to our wants, the amateur often meets with a most serious repulse at the onset. Too often is he misguided by the glowing descriptions of plant and flower in the catalogues now sown broadcast over the land. I do not regard the distribution of these documents as a public calamity, neither would I be understood to say that they do not contain very many useful suggestions, and much practical information; but I would say, that many a worthless thing is made to look well upon paper, as some of us have learned to our regret.

Any of these farmers can tell the beginner what crops are most safe and profitable to plant, and the kinds of tools best adapted to his particular uses. Let him rely solely upon the advertisements of sellers of agricultural seeds and tools, especially if they come to him from some distant locality, and he will reach the conclusion that these farmers know but little, to say the least. It is safer, then, to rely upon the opinions and experience of your neighbors, rather than upon the assertions and recommendations of those whose use of the English language is only guaged by the quantity and variety of stock they put upon the market. A reliable seedsman in Maine is of more value to you than one elsewhere, for the reason that he is supposed to understand the wants of the people better than a stranger, and for the additional reason that it would be folly, only, for him to sell you stock of no merit. This rule will hold good in the general sense. If you are not posted with regard to the kinds of flowers and plants with which you wish to produce certain results; or, to be better understood, if you wish to plant flowers on a given space of land, and are unable yourself to select the kinds and quantities most desirable, then take the advice of some good gardener, or your nearest reliable florist, in preference to

reading up the catalogues to make your decision by. This of course is meant more particularly for amateurs, though the most experienced will yet find something he had not learned. The most of our country homes have been located with little regard to ornamental surroundings and adornment, so that it now becomes the only alternative to improve and beautify the grounds about the dwelling as best we may.

The vegetable garden takes first rank, too often, in point of location, while the few flowers in cultivation are crowded into some out of the way corner, or beneath the shade of the dwellings and trees. Now let the vegetable garden fall to the rear, and after locating the walks and drive-ways to the house and stable in the best and most convenient localities, then arrange the flower garden, or neatly cut your flower beds in tasteful and symmetrical designs, in the surrounding lawn. And just here, I wish to remind you that the lawn must be kept neatly shorn, or the effect of the choicest arrangement of beds and flowers are most seriously impaired. Once in two weeks, at longest, let the fine grass be clipped in all well kept grounds. Make the entire surface of the lawn, and the edges of all the foot and carriage ways, even and smooth, so that the lawn mower or scythe will cut close and even. Are there spots about the premises infested with noxious weeds, choking out the grapes? Uproot them, grade and smooth the surface, roll in a plenty of grass seed, and after a little time you will be well repaid for the effort. I would not advise the planting of beds of flowers in the lawn, unless you are prepared and *decided* to keep the grass closely cut as above noticed. If this is well done, and you have been successful in the selection of flowers and arrangement of beds, in no other manner can a finer effect be produced. Many of you, doubtless, noticed at the Centennial Exhibition those charming beds of plants, leading out from the west end of Horticultural hall. Some of the most beautiful among them, were composed of common foliage and bedding plants adapted to our climate, and easily obtained, such as Golden Feather (Pyrethrum),

Alternathera, Colens, Centaurea, Achyranthes, Calladium-Esculentum, Canna Stabria, etc.

Where beds are cut in a newly sown lawn, the edges of the grass around them should be well and firmly sodded with turf cut a foot in width and two inches in thickness. With this style of beds it is not necessary to have any walks around them. A very pretty edging for such beds is golden feather, the bright golden foliage forming a striking contrast with the deep green of the surrounding lawn. Alternathera, bar, Thyme, or Sweet Allysum, make a pretty, low edging, and Centanceas if taller plants are desired. There is a wide difference in tastes, as to the most desirable modes of massing flowers in open beds as above. Some prefer to mingle distinct colors of foliage, plants, and different varieties of plants, in the same bed, in groups; others a single kind only. When different varieties are used, care should be taken to place the taller ones in the centre, interspersing the colors so as to form an agreeable contrast in shades.

In border beds, i. e., where they are to be viewed from one side only, the tallest should be placed in the background, so that the shorter ones may not be hidden. Another very effective and desirable method of planting, is termed ribbon gardening, and consists in planting distinct colors in foliage or flowers, in lines around beds of any form, or upon the edges of walks and drive-ways. For a ribbon bed beside a walk, Achyremthes Gilsonii, and Centancea Gymnocarpa, the former a beautiful carmine leaf and stalk, the latter a downy white plant, are very pretty and great favorites. Cut the ribbon bed three feet in width, sink the edges two inches below the surface, and raise the centre four or six inches above. Plant two rows of Achyremthes upon the outside, and one row of Centancea in the centre, serrated at a distance of fifteen inches from plant to plant in all directions. Colens of different shades makes a beautiful ribbon border or ribbon bed. In massing flowers, care should be taken to plant only those which have showy foliage, or are of free blooming habit, so that at no time during the season it shall fail to be a thing

of beauty. These should also be so thickly set as to entirely cover and hide the surface of the ground. There are many varieties of plants that are suitable for massing, or for mixed beds. Bright scarlet geraniums, either double or single flowered, are admirably adapted to this purpose. We give preference to the single flower, as it is a more profuse bloomer, provided you obtain the best varieties. Petunias, phlox drummondii, pansies, portulaccas, stocks, helitropes, zennias, asters, candytuft, dianthus, nasturtium, sweet peas and verbenas, each are of various colors, and are also all suitable to plant in like manner, with pleasing effect.

When beds of one kind only are used they show to much better advantage if raised a few inches in the centre. Most of the above named varieties will succeed well if grown from seed; others will prove more satisfactory if procured from the florist. Verbena seed, for instance, will often disappoint you, and must be started in heat early, in order to produce bloom a long season, and a large percentage will prove of poor colors, while a basket or two of choice plants from the florist should never fail to please you. Sow verbena seeds in shallow boxes, in some light, sandy soil, or leaf-mold, covering them one-twelfth of an inch in depth, and in the absence of the propagating-house or hot-bed, place them in a sunny window, or over fire heat, maintaining as even temperature and moisture as possible. Transplant in similar soil, in about four weeks, about two inches apart. Plant out thickly, say eight or ten inches apart, so as to pull three-quarters of them when they show bloom. Good thrifty verbenas will cover the ground when set from two to three feet distant. The larger part of plants grown from seeds, do better when sown in a hot-bed or seed-box in the house, and transplanted. In this way tender annuals and vegetables of all kinds may be forwarded some weeks earlier than if sown in the open air. There are a few varieties of flowers, however, that will do best when sown where they are to grow, as candytuft, convolvulus, larskspur, mignonette, sweet pea, (sow these last two inches deep), poppy, portulacca and some others.

It is a difficult matter to give directions how to propagate all kinds of plants by seeds, in a paper like this. The farmer understands that it is time worse than lost to plant his corn and beans at the beginning of spring planting in this climate. He waits until the advancing season has produced the proper humidity and temperature of the soil and atmosphere before he plants these. So, too, the florist has learned, that if amaranths, zinnias, portulaccas, etc., are sown while the soil is yet cold and damp, they will not germinate readily, and if they do, will produce only feeble and sickly plants. He waits until the thermometer indicates an average of 55° or 60° in the shade, to obtain a healthy stock of these plants. Again, if panzy, calceolaria, primula, or cinneraria seeds be sown in the hot and dry weather of July or August, disappointment—no, failure is the result. These he will sow in early spring, or better, in the middle of September to October 1st. The want of knowledge of these facts is often the real cause of failure, while the amateur has been inclined to place the fault at the door of the seedsman. As good a general rule as I can give, to cover flower seeds in the garden hot-bed or window, is about twice their own depth, in light, sandy soil, or leaf-mold from the woods, sifted on through a fine sieve, gently and evenly pressing the surface to prevent the air from drying up the seed. Seedings are soon ruined if neglected or left to suffer for moisture; a fine rose sprinkler, or the fine spray from a wet brush-broom answers well for this purpose. In transplanting from the seed-box, choose a late hour in the day, and if the season be dry leave a depression around the plant, water well, and afterward draw in light soil to prevent the baking of the surface. In watering large plants, also, it is well to do this, always wetting thoroughly, so that the roots may drink a full supply. This is much better than frequent partial watering, which serves to crust over the surface, while the roots of the plant are still thirsting for water. Withhold water, then, until you see that your plants are thirsty, then give a liberal supply, which will be sufficient for several days, even in a dry time. This matter of watering

plants deserves further notice. It is a subject that requires much study and careful attention, more especially in the cultivation of pot flowers. More plants are ruined by the improper use of water than from all other causes combined. Place a calla lily, or a lobelia in a tightly corked pot, or keep the pots submerged in water, and they will flourish and blossom profusely. Withhold water from these, as you would treat a cactus at this season of the year, and they would become sickly and show no bloom. Place any other of the long list of house plants in water in like manner, for twenty-four hours, and they are ruined beyond recovery. Now, so long as the soil in your pots looks damp and feels damp by the touch of the finger, give no water, though it be for a week, or a month, even. But a few weeks since I sold a lady some plants from the green-house, among them a Rex Begonia and some primulas. Thinking it might do no harm to volunteer a word of caution, I said be careful about watering these. "Oh, yes," said she, "I will water them well every morning and evening with warm water; you do this don't you?" "No," I answered, "once a week, probably—referring to the two kinds named—and with water from the very bottom of this well," laying my hand upon the pump; and continued I, "if you should water these plants as you have said, they would die within one week." So, my hearers, you will now infer that I am not particular about the temperature of water for my plants. Such is the fact; and if you have any doubts about growing healthy stock with the use of water at just 40° Fahrenheit, go with me and I will convince you, for our houses are full of such. If I wished to force a calla into bloom, I would give it hot water freely.

I am aware that nearly all the writers on floriculture recommend these two things as being essential to healthy plant growth, viz: rain water, and temperature the same as that of the atmosphere in which they grow. These may both be well enough, but in the absence of both of these conditions for several winter seasons in succession, I have clearly demonstrated the fact, to my own satisfaction, that neither

of these conditions are absolutely essential to success. Of course, plants grown in a dry and over-heated atmosphere in the dwelling, will require more frequent waterings than is necessary in the moist and humid atmosphere of the green-house. It only needs a little careful, patient watching, to understand the wants and necessities of most of the plants we grow. Indeed, they will tell us what they desire, if we will but listen and hear. If it is sunlight they wish, you will find them turning toward the side from whence they catch the sunbeams, and eagerly stretching forth their shining leaves for more light. If satisfied with their lot, they will remain at ease and seem contented. When supplies of water and other plant-food fails, their leaves begin to wither and fade; they reach down and droop till relief is found, or lie prostrate in death upon the dry and parched earth.

HOP CULTURE.

By Thomas Reynolds, Canton.

The hop is a vine with a perennial root from which spring up numerous annual shoots forming slender stems, angular and rough to the touch. These stems climb spirally upon poles to the height of twenty or thirty feet. The vines produce numerous arms or shoots from six to forty inches in length, upon which are grown clusters of cone shaped burs or catkins. It is for these catkins which grow only on the female plant that the vine is cultivated. They consist of the scales, stems or nuts, and lupuline grains. The lupuline is an aromatic, resinous substance of yellowish color which covers the scales at their base, and which constitutes about one-eighth of the weight of the dried catkins, and contains the greater portion of the valuable qualities. The strength or richness of the hops depends upon the amount of lupuline or pollen which it contains.

The hop is found wild in the Eastern States, and on the banks of the Mississippi and Missouri, also in several European countries. Its cultivation in Germany can be traced back to the ninth century. Great Britain first learned of its qualities of preserving beer from fermentation and imparting an agreeable bitter flavor to the liquor, about the year 1524. That country now cultivates the hop very largely and to a good degree of perfection. The county of Kent alone, has thirty thousand acres appropriated to hop growing.

In the United States its cultivation is of recent date. A few farmers in the State of New York were the first to introduce hop growing; and as the German immigrants increased in this country, the demand for their much loved beer also increased. To keep the beer from fermenting, hops were

necessary, hence their cultivation extended into New England, Ohio, Indiana, Illinois, Wisconsin and Iowa, as well as California and Oregon. The sunny slopes of hills which are well protected from severe west and northwest winds, where the soil is light and loamy, or gravelly with a dry subsoil, are the most desirable situations for hop gardens.

In setting a yard, three or four seedlings should be placed in each hill, and the hills and rows of hills should be from six to eight feet apart. After the yards or hop gardens have been set one year, each hill should be provided with three or four poles fifteen to twenty feet high. The ground for hop-growing should be as carefully prepared as for a vegetable garden. It should be frequently cultivated and kept free from weeds and grass. Plants do not produce a full crop till the third year after planting, and their production is always precarious, as they are subject to blight from mould or rust, and from the devastation of the hop louse, this insect not unfrequently destroying half, or even three-fourths of the the entire crop. The fruit should remain on the vine till it is fully matured. When ripe, the hops will be of a brownish color, and the lupuline grains will have concentrated about the hop stem. In gathering the fruit each hop or stobile should be picked off by itself. All foreign substances, such as leaves, stems and dirt, should be carefully kept from the hops. Pickers should reject all burs and immature hops, and those that have trailed upon the ground; for by mixing these with the mature hops, the value of the stock will be greatly impaired. The quality and flavor of the American hop is nearly if not quite equal to that of England or Germany, when the fruit is allowed to ripen, and is then gathered with care and is properly cured. The present year has clearly shown to the American hop growers the disadvantage of slovenly picking of immature fruit. The German crop was short, and this country alone could have used all our surplus at *full prices* had the fruit been allowed to mature and been properly picked and cured; while she now refuses our hops *at any price*. Hops that to-day (Feb 9th,

1877) find a *slow* sale at 15 to 18 cents, might, with suitable care, have been finding a ready market at 30 or 35 cents.

After the crops have been well picked, then they must be carefully and properly cured. Nature may have done her part well, and the grower may have secured a large, cleanly picked crop of superior quality, yet by inexperience in the art of curing, the hops may be ruined, either by over-drying or not drying them enough. Hops that are highly dried and scorched, lose their rich flavor and aroma, while those insufficiently dried are liable to heat in the bale and become utterly worthless. If the hop is allowed to get ripe on the vine, there is no use of sulphur in curing. It is important that hops be put up in the best possible manner. Shaggy, loosely packed, irregular shaped bales, are almost invariably rejected by the inspector.

There are several patent presses on the lever plan, now in use, but the one which meets with the most favor is the Waterville or New York press, which gives bales of uniform size, namely: 4½ feet in length, 2½ feet in width, and 18 inches thick. Bales of this size should weigh as near 200 lbs. as possible. Small or slack pressed bales do not command full price, while bales that are compressed so as to exclude the air entirely from the hops, are liable to heat. The sacking in which the hops are baled should be 22 to 24 ounces in weight to the yard. None but the best three-ply twine should be used in sewing the bales. The most favorable time for baling is on a rainy day, as the hops are then more pliable and less likely to break up. Men should never be allowed to "tread down" the hops in the press, for by this means they break up the hops and the pollen and aroma are lost. Make the sides of the presses high enough to hold 200 lbs. without the "stamping" process. In sending hops to market each bale should be plainly marked. No grower should be without a stencil plate bearing his full name or the initials of it. In no case should kerosene oil be used. A large amount of hops have been rejected in the London market on account of the use this oil with lampblack as a marking material.

The unpleasant odor of the oil spoils the natural flavor and aroma of the hops. Turpentine with lampblack makes a very good marking material.

I give here a table which shows the relative production of hops in the largest brewing countries of the civilized world:

Country.	Production in Pounds.	Consumption in Pounds.	Production more (†) or less (*) than consumption in Pounds.
Germany	47,711,100	32,150,000	† 15,561,100
England	38,409,000	60,000,000	* 21,591,000
Austria	9,253,200	10,000,000	* 746,800
Belgium	9,750,000	1,500,000	† 8,250,000
France	4,800,000	4,800,000	–
Rest of Europe	845,400	2,500,000	* 1,654,600
Total Europe	110,768,700	110,950,000	* 181,300
North America	30,000,000	–	–
Australia	300,000	20,000,000	–
Total	141,068,700	130,950,000	† 118,700

In Germany the production and consumption of hops is distributed as follows over the various countries forming the Empire:

Country.	Consumption in Pounds.	Production in Pounds.	Production more (†) or less (*) than consumption in Pounds.
Prussia	5,940,000	13,000,000	* 7,060,000
Bavaria	21,256,600	8,000,000	† 13,255,600
Wurtemburg	7,365,900	2,800,000	† 4,569,500
Baden	2,631,000	1,000,000	† 1,631,000
Elsass & Lothringen	9,000,000	1,500,000	† 7,500,000
Rest of Germany	1,515,000	5,850,000	* 4,335,000
Total	47,711,100	32,150,000	† 15,561,100

From this table it will be seen that the production of hops in Germany over the consumption averages about 15,561,100 pounds per season, which are principally exported to other countries. From other statistics we learn that the actual surplus of exports of hops over the imports, amounts to 15,230,000 pounds.

During the year 1876 there were shipped from the United States to Europe, 42,896 bales of hops. Of this number there were shipped from Boston about 1000 bales, from Philadelphia, San Francisco, Portland and other parts there were shipped from 10 to 1,500 bales, and the balance, or over

40,000 bales, were shipped from New York. The crop of hops last year was variously estimated at from one hundred and thirty to one hundred and fifty bales. Of these some 43,000 bales were exported, and about 10,000 bales were unsold when the new crop came off. This would leave from 77,000 to 97,000 bales as the amount taken by the brewers in the United States. The crop of 1876 was nearly or quite as large as that of 1875, but our brewers are not buying half as many as they did last year; so the surplus this year will be very much larger than it was a year ago.

I introduce here a useful table, showing the monthly receipts and exports of hops at New York for a series of years, also the exports from the United States and the comparative ranges of prices of domestic hops in New York a period of seven years, from 1868 to 1874 inclusive:

MONTHS.	New York.				United States.	
	Receipts, 1873.	Receipts, 1874.	Exports, 1873.	Exports, 1874.	Exports, 1873.	Exports, 1874.
	Bales.	Bales.	Bales.	Bales.	Bales.	Bales.
January	2,167	2,484	711	61	717	726
February	1,350	13,071	2,609	11	2,915	11
March	1,251	1,089	31	78	31	78
April	393	702	1,469	114	1,469	114
May	610	525	1,865	85	1,865	85
June	251	1,490	921	15	921	20
July	465	1,029	169	5	193	269
August	189	1,108	14	1,318	25	1,318
September	1,521	2,894	169	1,446	169	1,446
October	4,711	11,515	149	4,499	149	4,899
November	2,637	6,344	178	2,402	178	2,769
December	2,649	5,337	5	2,810	5	3,380
Total	18,400	47,788	8,290	12,844	8,637	15,115

1875.	New York.		United States Exports.	
MONTHS.	Receipts.	Exports.	1874.	1875.
	Bales.	Bales.	Bales.	Bales.
January	2,789	1,478	726	1,478
February	746	652	11	915
March	1,580	528	78	743
April	554	272	114	272
May	613	10	85	38
June	350	16	20	16
July	826	30	269	66
August	694	366	1,318	659
September	3,912	688	1,446	688
October	13,700	6,638	2,899	6,638*
Total, bales	25,764	10,678	6,966	11,513

*Includes exports from port of New York only.

COMPARATIVE RANGES OF THE PRICES OF DOMESTIC HOPS IN NEW YORK.

STATES.	1868.	1869.	1870.	1871.	1872.	1873.	1874.
	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.
New York.....	20 *a* 60	6 *a* 12	20 *a* 27	8 *a* 12	25 *a* 85	25 *a* 49	25 *a* 45
Wisconsin.....	52 *a* 65	5 *a* 9	16 *a* 23	5 *a* 9	25 *a* 60	25 *a* 48	25 *a* 45
Michigan.....	20 *a* 50	5 *a* 9	15 *a* 22	5 *a* 9	25 *a* 60	25 *a* 48	25 *a* 45
Ohio.....	20 *a* 45	5 *a* 9	15 *a* 22	5 *a* 9	25 *a* 60	25 *a* 48	25 *a* 45
Yearlings.....	15 *a* 40	2 *a* 5	6 *a* 10	2 *a* 4	25 *a* 60	.....	.....
Olds.....	10 *a* 25	1 *a* 4	2 *a* 4	1 *a* 3	10 *a* 30	.....	.....
Foreign.....	35 *a* 65	.....	.....	.....	60 *a* 80	.....	18 *a* 40

MONTHS.	1874.				1875.		
	Bavarian, per lb.	English, per lb.	Eastern & Western, per lb.	California, per lb.	State, per lb.	Eastern & Western, per lb.	California, per lb.
January.....	35 *a* 40	28 *a* 37	25 *a* 35	40 *a* 44	35 *a* 48	35 *a* 45	45
February....	35 *a* 40	28 *a* 37	25 *a* 35	40 *a* 45	33 *a* 45	32 *a* 42	42
March	35 *a* 40	28 *a* 37	25 *a* 35	40 *a* 45	31 *a* 40	28 *a* 38	38
April.....	27 *a* 33	23 *a* 27	26 *a* 30	31 *a* 39	30 *a* 39	28 *a* 36	38
May	25 *a* 30	20 *a* 25	25 *a* 30	26 *a* 36	30 *a* 40	28 *a* 36	34
June.....	25 *a* 30	20 *a* 25	25 *a* 30	25 *a* 35	30 *a* 37	28 *a* 33	30
July.....	24 *a* 29	19 *a* 24	24 *a* 29	24 *a* 33	.....	.....	.....
August.....	20 *a* 25	18 *a* 22	20 *a* 25	20 *a* 27	.....	.....	.....
September...	20 *a* 25	18 *a* 24	32 *a* 39	20 *a* 29	.....	.....	.....
October	.....	18 *a* 25	39 *a* 45	35 *a* 42	.....	.....	.....
November...	.....	18 *a* 25	38 *a* 45	40 *a* 47	.....	.....	.....
December....	.....	.....	41 *a* 47	44 *a* 49	.....	.....	.....

The cultivation of hops in Maine is principally confined to the western parts of the State. They are cultivated in several different counties, but the most extensively in Oxford county, almost every town in the county containing more or less fields.

The cultivation of hops in Oxford county was introduced some forty years ago into Canton on the Androscoggin river, and since then the cultivation has extended up and down the river quite rapidly, and the interest in hop growing has continually increased. The past year (1876) there were raised (as nearly as can be estimated) about 400,000 pounds of hops in the State, or about 2,200 bales; which at 25 cents per pound would amount to $100,000. There has been sold and sent into the market about 1850 bales. Those that have been sold netted the growers from 25 to 30 cents per pound; the remainder, or about 350 bales, yet remain in the growers' hands.

One of the most useful properties of the hop is its keeping quality. It is this, largely, which gives it its value in com-

merce, and in the practical uses to which it is put. From the best authority, I feel confident in making the statement that Maine hops possess this quality in an unusual degree, and will keep longer and retain their aroma fresh and unimpaired to a greater degree than the hops grown in any other section of our country. This being true, it gives greater importance to Maine as a hop producing region than it would otherwise possess.

Since writing the above, I have received the following from Prof. Levi Stockbridge of the Massachusetts Agricultural College, in answer to inquiries addressed to him:

"I have applied the facts stated by you (and I have also received the identical estimate from several gentlemen in Western New York) to my calculations on the chemical constituents of the hop plant, and feel confident the following formula will be an exact fertilizer for the production of hops: a compound composed of 25 lbs. of nitrogen, 39 lbs. of potash and 18 lbs. of phosphoric acid, and that amount of these elements should produce 1,000 lbs. of dried hops. I have had no opportunity to try or prove it. The first year's use must be considered experimental—but I have no fears of the results."

THE MARGIN OF PROFIT.

By Prof. M. C. Fernald, Maine State College, Orono.

The faithful laborer is everywhere worthy of his hire; whether the work be of the hand or of the brain. In proposing to enter upon any enterprise or pursuit, it is legitimate to consider what are the prospects of reward. By this standard nearly all our plans are arranged; in relation to it most of our acts are performed.

If the vocation of the farmer does not yield a fair return for the work of his hands, for the thought, the care, the economy, the skill which he exercises, it is a vocation not worth the following. I am not willing, however, to concede, for I do not believe that agriculture well conducted is not a fairly remunerative employment, not only for the man who labors for wages, but for him who owns a portion of the soil and directs the operations upon it. In our own State, and in sister States, there may be, doubtless are, idle, shiftless, worthless farmers, who do not deserve and do not achieve success; but to the honest, earnest, industrious cultivators of the soil, it will hardly be denied, that nature is fairly liberal with her bounties, and taking the years together, that the rewards of intelligent and well directed industry in this vocation are incomparably more reliable than in most other pursuits. Nevertheless, it cannot be expected that any thoughtful man will enter upon this calling, as he will not upon any other, without considering the chances of profit and of loss. No man engaged in it should be content not to know whether he is gaining or losing, and just where the margin of profit is to be sought, and the means by which it can be secured.

It is a question of weighty import to the farmer, "Wherein can I find the amplest returns for my diligence, my pains-

taking, my toil?" He says, "I now practice all homely economies; my expenditures I can hardly make less. How shall they be provided for?" If I read aright the lesson which science at the present day is endeavoring to teach to the agriculturist, it is, that his highest success lies in the line of a *more intensive culture*. If the expenditures cannot be made less, the returns must be made greater. Poor farming does not pay; it never has paid, it never will pay. By high cultivation only, by the liberal feeding of plants and of animals, can satisfactory results in farm economy be obtained.

Before entering upon any development of this idea, I desire to call attention to one error in farm practice which widely obtains—which underlies many other errors—and is the basis of much loss, but which the progressive farmer is not slow to correct. I refer to the entire omission of accounts with the farm, by which can be determined whether the business is a paying one or the reverse. Am I not safe in assuming that not one farmer in fifty knows by actual and trustworthy records, how much his business is paying him, or whether it pays anything or not? The manufacturer of cotton or woolen goods determines to the tenth of a cent the price per yard at which his goods must be sold to cover the cost, or yield any desired margin of profit. A reckless system of accounts, or no accounts at all, would be ruinous to him. The merchant, whose books should not indicate approximately, at least, the condition of his affairs, would be deemed unsafe in business transactions, and as guilty of inviting financial disaster. With him the character of the book-keeping may determine between success and failure.

In like manner, even if in a less degree, are careful records among the essentials to success in farm life. Not only should accounts be kept with the farm as a whole, but with every department of it; with the wheat field, the corn field, the potato field, the mowing field; with the swine, with the sheep, with the herd collectively, and with the individual members of it. Thus, only, can be determined what crops, if any, are cultivated at a loss, and what will give the largest

margin of profit. Thus, only, can be determined what animals it may be advantageous to retain, and what to pass over to the butcher. Thus, only, will the farmer conduct a business somewhat intricate in its details, on a safe and reliable basis. For illustration, I submit records made at the farm of the Maine State College, showing the milk producing and butter producing power of ten of the cows. Those marked "half Jersey" and the one marked "half Shorthorn" are also half native. The cow marked "native" is regarded as having in her veins a strain of Jersey blood, although in her appearance there is nothing to indicate it.

	Lbs. milk 10 m'ths.		Lbs. butter.	Per cent. of cream.	Period dry.
Cornelia, Shorthorn	7933	÷ 25	= 307	11	3 months.
Duchess of Lakeside, Shorthorn	4430	÷ 24	= 185	10.5	4¼ "
Hebe, Jersey	5011	÷ 25	= 200	12	½ month.
Pride of Lachine, Jersey	4186	÷ 20.6	= 203	21.2	1 "
Isabel, Ayrshire	3593	÷ 30.5	= 118	10	2¾ months.
Olee, Ayrshire	6838	÷ 28.2	= 243	11	1 5-6 "
Maggie, half Shorthorn	7220	÷ 28.2	= 256	12	2⅔ "
Dinah, half Jersey	5494	÷ 28	= 197	11.2	1½ "
Topsy, half Jersey	6650	÷ 17.1	= 389	14	2 "
Johnson, native	7393	÷ 19	= 389	15.5	1½ "

Although the relative feeding capacity of the different cows is not shown, yet a moment's examination of the table leaves one in no doubt as to what cows in the above list can be retained for milk or for butter, with advantage, and what cows not yielding a profit in their products, are valuable only for beef. It will be observed, moreover, that the percentage of cream is no sure index of the amount of butter which a given quantity of milk may furnish, so much more uniformly do the butter globules supplied from the milk of some cows break and yield their contents, than those furnished by the milk of other cows or other breeds of cows.

In seeking for the largest margin of profit in the pursuit of agriculture, it has been stated that the farmer's highest success lies in the line of a more intensive culture. This truth will become more evident from an examination of nature's agency and man's agency in the production of crops.

A chemical examination of plants reveals the fact that they are composed of two kinds of materials, an organic and an inorganic portion. The organic portion of plants, as is well understood, consists chiefly of carbon, oxygen, hydrogen and nitrogen. The first named of these elements, carbon, is abundantly supplied to plants from the carbonic acid of the atmosphere, through their leaves. Oxygen and hydrogen are furnished in the form of water, through the roots of plants. The remaining organic element, nitrogen, although constituting about four-fifths of the atmosphere, is never in appreciable quantity, if at all, supplied to plants directly from this source, but is furnished from the compounds of nitrogen with other elements, chiefly from ammonia composed of nitrogen and hydrogen, and from nitrates whose source of nitrogen in most cases is nitric acid composed of nitrogen and oxygen. The nitrates and ammonia are taken into plants from the soil by means of their roots.

"From the fact that nitrogen is available to plants only in certain combinations, that it is slow to form and easily leaves these compounds, that it readily escapes from manures and soils into the air and is leached away by water, it is one of the most commonly deficient and hence one of the most costly ingredients of the food of plants."

The ashy, inorganic or mineral portion of plants consists principally of potash, soda, lime, magnesia, iron, silica, phosphoric acid, sulphuric acid and chlorine. Does a fertile soil furnish all these constituents of plant food? The answer to this question is given by the analyses of such soils. I select one from Prof. Johnson's "How Crops Feed." Baumhauer's analysis of an alluvial deposit from the waters of the Rhine, near the Zuider Zee, in Holland. This soil, which produces large crops, contained:

	Surface.	15 in. deep.	30 in. deep.
Insoluble silica, quartz, -	57.646	51.706	55.372
Soluble silica, - -	2.340	2.496	2.286
Alumina, - - -	1.830	2.900	2.888
Peroxide of iron, -	9.039	10.305	11.864
Protoxide of iron, - -	0.350	0.563	0.200

	Surface.	15 in. deep.	30 in deep.
Oxide of manganese, -	0.288	0.354	0.284
Lime, - - - -	4.092	5.096	2.480
Magnesia, - -	0.130	0.140	0.128
Potash, - - -	1.026	1.430	1.521
Soda, - - -	1.972	2.069	1.937
Ammonia, - - -	0.060	0.078	0.075
Phosphoric acid, - -	0.466	0.324	0.478
Sulphuric acid, - -	0.896	1.104	0.576
Carbonic acid, - -	6.085	6.940	4.775
Chlorine, - - -	1.240	1.302	1.418
Humic acid, - -	2.798	3.991	3.428
Crenic acid, - - -	0.771	0.731	0.037
Apocrenic acid, - -	0.107	0.160	0.152
Other organic matter and combined waters, (nitrates ?)	8.324	7.700	9.348
Loss in analysis, - -	0.540	0.611	0.753
	100.000	100.000	100.000

An examination of the analysis, shows the soil to be rich in the alkalies and phosphoric acid, in fact in all the elements of plant food except the nitrates, which were not separately determined. The absolute quantities of the most important substances existing in an acre of this soil taken to the depth of one foot, and assuming this quantity to weigh 3,500,000 lbs., are given by Prof. Johnson, as follows:

Soluble silica, - - - - - -	81,900 lbs.
Lime, - - - - - - -	143,220 "
Potash, - - - - - -	35,910 "
Soda, - - - - - - -	68,920 "
Ammonia, - - - - - -	2,100 "
Phosphoric acid, - - - - -	16,310 "
Sulphuric acid, - - - -	31,360 "

This soil contains potash enough for 528 crops of potatoes at 200 bushels to the acre in each crop, or for 1,496 crops of wheat, at 25 bushels in each crop. It contains phosphoric acid enough for 741 such crops of potatoes, or for 815 such crops of wheat. This soil is exceptionally rich in the elements of plant nutrition, differing in a marked manner in composition from that of a barren soil, the analysis of which is here submitted as made by the illustrious author before quoted.

Prof. Johnson's analysis of a soil from the Upper Palatinate, "which was characterized by Dr. Sendtner, who collected it, as 'the most sterile soil in Bavaria':"

Water,	0.535
Organic matter,	1.850
Silica,	0.016
Oxide of iron and alumina,	1.640
Lime,	0.096
Magnesia,	trace.
Carbonic acid,	trace.
Phosphoric acid,	trace.
Chlorine,	trace.
Alkalies,	none.
Quartz and insoluble silicates,	95.863
	100.000

It will be observed that this soil contains but a trace of magnesia and phosphoric acid, and of the alkalies none at all. It is added, "This soil was mostly naked and destitute of vegetation, and its composition shows the absence of any crop-producing power."

From the study of analyses of different soils, and a comparison with the composition of plants, it has been ascertained that most soils contain certain constituents of plant food in such abundance as to require no attention on the part of the farmer. Thus in ordinary farm practice, it is rarely if ever needful to look after the supply of iron, of chlorine or of silica, and seldom of soda or magnesia. Of lime and sulphuric acid the soil is more often deficient, and hence the good results frequently observed from the application of lime and plaster. Nitrogen, phosphoric acid and potash are the ingredients of the soil of which it is most liable to become exhausted by plant nutrition. It is these constituents of plant food, the supply of which must engage the thought of the farmer who would maintain his fields in fertility.

So far as the plant is concerned, no one of the elements of plant nutrition can be regarded as more essential than another, since all are indispensable. No plant can grow and come to perfection unless it has a supply, in due proportion,

of every element which an analysis of the plant would disclose. A plant may have access to all the mineral elements required for its growth, but if it cannot obtain nitrogen these will be valueless to it; the plant will not grow. So, if potash or lime or magnesia be wanting in the soil, it will be of no avail that all other needful constituents be present, the plant will not grow minus potash or lime or magnesia, but will refuse to grow at all.

It seems an obvious consequence of the principle just enunciated, that the maximum crop which can be produced on a given area is determined by the minimum quantity of any element of nutrition which the soil can furnish. For example, if the soil contain but a small percentage of potash the quantity of crop which such land can produce will be measured by that small percentage. Plants will not continue to grow after the available potash is exhausted. The same is true of their deportment with respect to every other element of plant food. Another principle well settled in the theory of plant feeding, is that in relation to the condition in which the elements of nutrition must be presented to the rootlets of plants in order that they may be taken up and appropriated. It can hardly be said that plants live by eating but by drinking, and hence their food must be furnished by the soil in the liquid state. Only soluble substances in the soil, therefore, can contribute to plant growth. It is not sufficient that silica, phosphoric acid and lime exist in the soil, they must exist there in a soluble condition, to contribute anything to plant life. The potash of feldspar, the phosphoric acid of the mineral apatite and the nitrogen of peat, may be completely unavailable for plants, because locked up in insoluble combinations. A chemical analysis of soil is often deceptive, in that while it furnishes a knowledge of the elements actually existing in the soil, it does not indicate the condition under which they exist, or whether they are available for the sustenance of plants; and thus while a soil may be found to contain every element of plant food in abundance, it may, nevertheless, be perfectly sterile.

In briefly noticing nature's agency in the production of crops, an attempt has been made to show what the soil must supply, and some of the conditions most favorable for plant growth. Of equal importance with the subject of supply of plant food by the soil is the question of its permanency. Can our fields be cropped year after year, and by their natural strength support plant life in any considerable abundance without ultimately reaching a condition of complete exhaustion? The action of the atmosphere, of moisture, of frost and other natural agencies in the soil is such as to disengage annually a certain amount of plant food and hold it in reserve for growing plants. In this regard every soil has a certain inherent capacity. The rate of disintegration of the coarser materials and of the formation of the constituents of plant nutrition depends upon physical conditions, as temperature and moisture, as well as upon the chemical character of the soil.

Messrs. Lawes and Gilbert proved the natural wheat producing power of the soil at Rothamstead to be about 16 bushels to the acre annually. They obtained from the same soil, without the application of manures, 20 successive crops of wheat, the first of which was 15 bushels and the last 17½ bushels per acre, the average of all being 16¼ bushels. In this soil the processes of weathering and nitrification render available each year the amount of plant food abstracted by a crop of 16¼ bushels of wheat to the acre. In another soil the same processes may render available a smaller or a larger quantity of plant food, of which the amount of crop whatever it may be that can be taken from it for a series of years, without the application of fertilizers, is a nearly exact measure. In time, it is doubtless true that the compounds in the soil whose disintegration has furnished the alkalies, phosphates and other elements of plant food, may become so reduced in quantity as to supply little or no sustenance for crops, and thus the land be reduced to comparative sterility. In soils fairly rich in the materials for plant growth, and of ordinary depth, this period would be measured by centuries.

The expression "exhaustion of the soil," as commonly employed, indicates a relative rather than an absolute condition, and is designed to imply that cropping has been carried beyond the point of remuneration; or, in other words, the cost of raising a crop is more than the crop is worth. The speedy exhaustion of the soil, of which one frequently hears, has really no existence in nature. A soil may become impoverished of certain elements of plant food, and it is a part of man's agency in the production of crops to restore these wasted elements. A soil may become impoverished of certain elements required in large quantities for one crop, and yet yield generous returns of some other crop. These are not, in any true sense, cases of exhaustion or results of poverty of constitution, but conditions against which any intelligent farmer can readily provide.

In further consideration of the agencies which have to do with the production of harvests, it is worthy of notice that nature takes no direct cognizance of man's wants. She does not ask what plant he would have grow here or there. She furnishes the storehouse and conservatory of food for plants, but yields the food supplies to them only sparingly. She does not wholly determine whether 100 bushels or 200 bushels of potatoes shall be grown to the acre. She does not wholly determine whether the yield of wheat to the acre shall be 16 bushels or 32 bushels. As at Rothamstead, she may furnish annually food supplies for 16 bushels of wheat per acre, but it must be due to man's agency if a larger amount is secured. With nature it is not a matter of consequence whether a crop be remunerative or not. It is man who is seeking the margin of profit, which he can obtain only in obedience to her laws. In presenting the food of plants locked up in the coarser or finer fragments of rocks, and in partially decayed vegetable matter, she in effect says to the husbandman, "Put in the plow and pulverize the soil thoroughly, put on your stores of plant food from the farmyard, your ashes and the materials of the waste heap, your lime and plaster, your phosphates and nitrates, that by their direct

and indirect action richer and more abundant stores of food may be made available to your crops." The farmer who heeds the lesson will reap his reward in abundant and remunerative harvests. In the production of crops it is evident that man and nature work together, and that man's agency may be very helpful in bringing the nominally "worn out" soil into conditions of fertility.

The underlying idea of a *more intensive culture* in farming is the literalizing of all that is implied in making "two blades of grass grow where but one blade grew before," namely, the making of two bushels of corn or of barley or of wheat, grow where but one bushel grew before. It implies thorough underdrainage where underdrainage is needed. It implies complete pulverization of the soil where thorough pulverization is needed; in a word, whatever may be necessary to secure the mechanical condition of the soil best adapted to bountiful crops. It implies more; it implies a generous feeding of plants with the chemical elements of plant food, especially with those constituents of plants not abundantly restored by nature's processes, those which are most largely carried away in the crops and in the products of domestic animals, the nitrogen, phosphoric acid and potash. These must be supplied by the farmer, whatever else he may furnish or fail to furnish, if he would maintain his land in fertility and gather generous harvests. In the renovation of the soil and the production of crops, what *are* his sources of supply? From the farmyard he obtains a complete fertilizer, one containing all the ingredients of plant food; bulky, it is true, and slow in action, except when old or well composted, nevertheless fulfilling the requirements of a complete fertilizer most perfectly. From the ash heap he obtains also a valuable fertilizer, one supplying directly not only a large percentage of potash but all the other soil ingredients of plant food except nitrogen, and one whose indirect action is likewise important in rendering available to plants other materials in the soil. From the bones of animals ground, or treated with sulphuric acid, he obtains lime and phosphoric

acid for plant food. These are the most readily available sources of supply. Let the farmer furnish from these or other sources, whatever fertilizing materials he can command, and still the "crying want" of his land is for more. As before stated, nature supplies a part of the constituents of plant food in constant abundance, and a part in quantities not sufficient for large crops. Man must furnish the deficiency in order to reap bountifully.

More specifically, what besides his general fertilizers need the farmer furnish? Although it may be necessary in some soils, and may become necessary in any soil to supply lime, sulphuric acid and magnesia, yet almost universally the great demand is that which has been stated, for available potash, phosphoric acid and nitrogen. The amount of the last named substances present in the soil in soluble condition, very largely determines the abundance of the crop. In fact, there is in most cases nearly a direct ratio between the amount of available potash, phosphoric acid and nitrogen, and the products of the soil, up to a certain maximum limit. This limit is farther removed from the average crop than at first thought might be supposed. Experiments made in the growing of barley, show that for this cereal the limit is fully 4½ times the yield obtained under average agricultural conditions. This number compared with unity, is probably not too large to represent the relation between the maximum and the average yield in the case of the other cereals. Suppose the ratio between the maximum and average crop of wheat to be 2 to 1, (the ratio is really much larger) and the average yield to be 15 bushels to the acre, the maximum yield would then be 30 bushels to the acre. Every farmer understands that the profit in growing wheat would be on the last 15 bushels to the acre, rather than upon the first. The larger part of the first, would be required to cover cost of cultivation. The profit comes from the excess of the product above that required for the cost of production.

The science of chemistry is not a blind guide in agriculture. It has shown not only what the various crops remove

from the soil, but precisely the amount of each ingredient of plant nutrition. It has indicated definitely the amount of each of the most essential (i. e. most readily exhausted) constituents of plant food which must be supplied, that any desired result within the limit of possibility may be attained. "How then," comes the inquiry, "shall I make my wheat field which now yields fifteen bushels to the acre, furnish a crop of thirty bushels of wheat to the acre?" The answer is obvious: "feed for thirty bushels to the acre." If your land will naturally produce fifteen bushels of wheat to the acre, and from the home resources you can supply only enough of fertilizing material to bring the yield up to twenty bushels to the acre, evidently you will have to apply an amount of food (probably only potash, phosphoric acid and nitrogen) for wheat represented in the roots, straw and grain of ten bushels of this cereal; or, in other words, about ten pounds of potash, eight pounds of phosphoric acid, and 16½ pounds of nitrogen. It is not necessary that these be applied in a bulky form, but in the form of the chemical salts, which will furnish to the roots of the crop the several substances in soluble condition.

With proper mechanical cultivation of the soil, and with average meteorological conditions, disregarding the effects of insect ravages, the question of any desired amount of crop less than the maximum, is very largely, in fact almost wholly one of supply of plant food. The generous feeding of plants may not require any considerable outlay for fertilizers, the home resources of the farmer in this regard may be sufficient; generally, however, they are not. When they are inadequate, he can profitably supplement the home supply with more concentrated fertilizers. In fact, he cannot afford to cultivate a farm and not supply his growing crops most liberally with plant food. If one sort of crop requires potash in large quantity, for that crop it will pay to supply potash; if another requires liberal feeding with phosphoric acid, for that crop it will pay to supply phosphates; if another requires nitrogenous food, for that crop it will pay to supply nitrogen in form to be appropriated; and, generally

there are but few soils to which all three of these most essential constituents of plant food can be supplied without a decided gain in the abundance and quality of the crop, and hence in the margin of profit.

As regards the sources of supply of the concentrated forms of fertilizers, it may be remarked that the ammoniated or nitrogenous superphosphates furnish nitrogen, phosphoric acid, sulphuric acid and lime at moderate expense, and the German potash salts furnish potash and magnesia. These together constitute a complete fertilizer, inasmuch as they supply in soluble form all the constituents of plant food of which the soil is ever subject to be exhausted. In determining, however, with what to supplement the home supply of fertilizers, reference should be had to the crop to be grown and the amount desired above what the soil naturally produces, and the supply of the different elements of plant food be proportioned accordingly.

This subject of plant nutrition with reference to definite results, has been carefully elucidated by Prof. Levi Stockbridge of the State Agricultural College in Massachusetts. The almost marvellous precision with which results proposed have been obtained, is certainly a strong confirmation of the correctness of the theoretical principles on which this method of plant feeding is based, and an illustration of its practical value. Prof. Stockbridge has prepared tables based upon the chemical composition of the "tops and roots or tubers of our root crops, and the roots, straw and grain of our cereal crops," showing the amount of nitrogen, potash and phosphoric acid, and the sources from which they can be most economically obtained, to produce above the natural product of the soil any required amount within the limit of possibility of our various crops. A few of his formulas are here given:

Potatoes.

To produce 100 bushels of potatoes per acre and their natural proportion of tops more than the natural product of the land, and for other quantities in like proportion, use

Nitrogen,	21 lbs.	In the form of	Sulph. ammonia, 24 pr. ct. dry salt,	105 lbs.
Potash,	34 lbs.		Sulph. potash, 35 " "	225 lbs.
Phosphoric acid,	11 lbs.		Superphosphate, 13 " sol. acid,	85 lbs.

Indian Corn.

To produce 50 bushels of the grain and its natural proportion of stover to the acre more than the natural yield of the soil, and in like proportion for other quantities, use

Nitrogen,	64 lbs.	In the form of	Sulph. ammonia, 24 pr. ct. dry salt,	320 lbs.
Potash,	77 lbs.		Muriate potash, 80 " "	154 lbs.
Phosphoric acid,	31 lbs.		Superphosphate, 13 " sol. salt,	248 lbs.

Wheat.

To produce 25 bushels of wheat and the natural proportion of straw per acre more than the natural yield of the land, and in like proportion for other quantities, use

Nitrogen,	41 lbs.	In the form of	Sulph. ammonia, 24 pr. ct. dry salt,	205 lbs.
Potash,	24 lbs.		Muriate potash, 80 " "	48 lbs.
Phosphoric acid,	20 lbs.		Superphosphate, 13 " sol. acid,	160 lbs.

Beets.

To produce 100 bushels of beets and their tops on a given area of land more than its natural yield, use

Nitrogen,	11 lbs.	In the form of	Sulph. ammonia, 24 pr. ct. dry salt,	55 lbs.
Potash,	25 lbs.		Sulph. potash, 35 pr. ct. "	155 lbs.
Phosphoric acid,	6 lbs.		Superphosphate, 13 " sol. acid,	50 lbs.

At present rates, the cost of the materials for the amounts named of the several different crops, above the natural product of the land, is about as follows:

For 100 bushels of potatoes, $12,00, or 12 cts. per bushel.

For 50 bushels of Indian corn, $27,00, or 54 cts. pr. bush. In raising 50 bushels of shelled corn about 2¼ tons of stover would be obtained, which, at $6.00 per ton would be worth $13.50, or one-half the cost of the fertilizer.

For 25 bushels of wheat, $16.00, or 64 cents per bushel. The extra amount of straw would be worth at least $8.00.

For 100 bushels of beets, $6.00, or 6 cents per bushel.

The tests that have been made with these fertilizers in various parts of New England and the Atlantic States, show that they furnish in the main a reliable and profitable method

of largely increasing all the farm products, for with increased crops come enlarged flocks and herds, and an increase of the products which they furnish. It is gratifying, also, to note, that experiments thus far made, indicate no deterioration of the quality of the soil from their use, but rather increased fertility.

After repeated and carefully conducted experiments with these fertilizers for a series of years, on the College farm at Amherst, Mass., and after a wide observation of their use by practical farmers in that State, and beyond its limits, Prof. Stockbridge says of them: "If there is no great mistake in the principles and results, the conclusion must be drawn, that they solve one of the great agricultural problems of our time; a problem the solution of which has caused the greatest anxiety in all the densely populated countries of the globe, and one that has been a source of much apprehension here. In all the older States of the Union, our cities, both in number and population have increased with unparalleled rapidity. The civic population increases faster than the rural, the consumers of food faster than the producers. From all the rural districts enormous streams of soil products, in the form of vegetables, grains, meat, and raw material for manufacture, are pouring into these centres. These are the choice elements of the soil, the waste of which would maintain its producing power; but owing to our wasteful systems of sewerage it is all, or nearly all lost, and as a result these States have seen their agricultural lands producing less and less per acre of all of our important crops, until millions of acres, once productive, have become so sterile that their crops will not pay the cost of their cultivation. . . . All this because the food products of the people taken from the soil are not in any form returned to it. This cause has seemed a necessity, one whose results could not be avoided, if we must depend on the waste products of our crops to support the producing powers of the soil. But chemical manures may supply the deficiency. They will produce plants of choicest qualities, and in luxuriant abundance. With profit to the cultivator,

they may be the means of covering our hill-sides, valleys and plains with beautiful, bountiful crops of grass and grain, and at the same time restore their exhausted acres to permanent, pristine fertility."

In the high cultivation of his land, whatever fertilizers the farmer employs, he should observe the following precepts: 1st. Insist that the chemical composition of the fertilizers be distinctly stated and guaranteed by the seller. 2d. Select those " which furnish the fertilizing ingredients required by his land and crops, in the best form, and at the lowest price per pound." 3d. Purchase only of responsible parties.

The work of the agricultural experiment station in Connecticut, and the analysis of fertilizers at the Agricultural College in Massachusetts, within a brief period of time, have contributed largely to a revolution in the trade in fertilizers, so that no New England farmer need now invest in them without obtaining the value received.

It is not advocated in this paper that in order to high cultivation it is indispensably necessary to employ commercial fertilizers. It is claimed, however, that the only farming which pays, is that which liberally feeds the growing crops, and that to secure remunerative harvests, plant-food in abundance must be supplied, if not in one form then in another. The means of generously feeding his crops are fortunately at the command of the farmer; he who uses them wisely and well shall rejoice in full granaries and storehouses, in increasing flocks and herds as the substantial tokens of his thrift and prosperity. The principles of farm economy which have been considered are not limited to the cultivation of the soil, or to simply the raising of crops. The generous feeding of animals is not less essential to the farmer's success than the generous feeding of plants. The margin of profit is here secured, not by that method of feeding which simply maintains life, but by that system of feeding which enables the animals to furnish products; and not only this, but to furnish them in the largest abundance.

The methods of an intensive culture, applied to the farm, extends to all its departments and to all its operations, and the results that would follow, were they generally adopted, can hardly be estimated. The truth is not overstated by Mr. J. R. Dodge of the Statistical Bureau at Washington, when he affirms "the average yield per acre could be doubled, if the many could be brought up to the plane of the few, in the practice of intensive culture." Mr. Joseph Harris states a well-known but lamentable fact, when he says "we raise from 10 to 15 bushels of wheat per acre, where we ought to get 25 to 30 bushels; we raise 30 bushels of corn instead of 60, and 75 bushels of potatoes instead of 200."

The difference between what is raised and what *might be* is not an unimportant matter, for it implies a loss to the country of more than it now produces. To bring up the farm productions of the country to an adequate standard, one to which they can with profit be brought, may well be a part of the initial work of the new century.

If we limit the consideration to our own State, it is not too much to say that by intensive and judicious culture, by means ready of command, the farms of Maine can be brought to furnish, within a few years, double the present amount of products, to carry double the present amount of stock, and to leave annually in the pockets of farmers four-fold the present margin of profit. Increased prosperity with the farmers of Maine, implies renewed activity in all business enterprises, larger success in all other vocations, and a more complete development of the grand resources of our noble State.

From larger resources to the individual are derived comparative freedom from much that is now esteemed drudgery in farm life, pleasanter surroundings, and more abundant home comforts, papers and books, and a higher social life. Such a condition not only enlarges and brightens the horizon of the individual, but it reaches beyond to his neighbors, and forward to those who shall come after him. It implies encouraging advantages and high educational acquirements

for his children, but with no abatement of that love of farm life which is sure to be abiding when such life is seen and known under favorable conditions. It implies, finally, the presentation to the State of that worthiest product, to which all others are tributary, a generation of noble men and women, throughout all her borders, occupying and adorning the thrifty and happy homes, which are at once the charm and the reward of a cultured rural life.

WOOL PRODUCTION AND SHEEP HUSBANDRY.

By John L. Hayes, Secretary of the National Association of Wool Manufacturers, Boston.

[Note.—This lecture was extemporaneous, and is here produced from the reporter's notes. The lecturer has corrected only some statements of facts, without attempting to modify the familiarity of style due to purely oral delivery.—J. L. H.]

Ladies and Gentlemen: I can assure you it is with no little satisfaction that I come again to my native State. I have always felt a peculiar interest in her prosperity, and pride in my own origin. Two of the most active years of my life were spent not far from you, at the Katahdin Iron Works, and were devoted to the development of another branch of Maine industry than that which interests us to-day. There I had the pleasure of kindling, or rather of having my wife kindle, the first fire lighted in Maine for the successful smelting of iron ore on a large scale. One of the gentlemen here this morning spoke very fittingly of the propriety of one who addresses an audience, bringing his passports to show the authority with which he speaks. The passport which I offer is that I am one of the oldest sheep husbandmen in Maine. My father, Judge William A. Hayes, had a large farm in York county, and was one of the first to introduce Merino sheep. He and his brother-in-law, Mr. John P. Lord, still hale and hearty at the age of 93, were the first to introduce Saxon sheep into the State. When I was a boy, many and many a day and evening during the month of February, the time when rather unwisely the lambs were allowed to be brought forth, I have taken the delicate creatures from the barn and carried them into the cellar of the house, and there I used to have to sit hours and hours and nurse them. That created in me a taste for wool-husbandry, and that interest was fostered by a woolen factory

being built at Salmon Falls, just across the line in New Hampshire. There I first saw the process of making cloth, and when I was graduated at Dartmouth, I induced my class to send down and get the cloth for our commencement suits from this Salmon Falls factory. This was my first initiation into the wool business. I little thought then that I should spend so many years of my life in its development.

Of all the beneficial arrangements of Providence, there is hardly one more conspicuous than that which has placed at the disposal of man an animal capable at the same time of producing a most desirablefood, of benefitting agriculture, and of supplying one of the first necessities of man—that of clothing. These three qualities are eminently possessed by the sheep.

Before considering the qualities of the sheep, we will glance for a moment at its origin. The best naturalists are now agreed that its specific source cannot be found. The general belief is, that the sheep as now known, originated from a number of species, or that distinct races existed originally as now. But, whatever may have been its origin, the sheep is distinctly traced to Asia, the cradle of the human race. The name "buck" is often mentioned in the Persian Zendevesta, the Indian Vedas, the Chinese Chow King, and is sculptured on the most ancient monuments of the Egyptians. The names Bok and Bouk are found in primitive Asiatic languages. There are no traces of sheep found among the cave dwellers of Europe, but the bones are found among the lake habitations of Switzerland; so that they were introduced at a very early day. The most striking quality about the sheep, is what may be called its plasticity. It is easily modified by man. Next to the dog, the sheep is the most plastic of all animals. As Lord Somerville has said—"The breeder of sheep may chalk out upon a wall a form perfect in itself and then give it existence." This placticity is shown in various ways. One race produced in this country is called the Ancon or Otter sheep, having a long back and short legs like the otter, and having a quality especially valuable in the district in Rhode Island where they were developed—that they will not jump

fences. Darwin has referred to them as an example to sustain his evolution theory. Another is the Mauchamp race in France. A breeder in that country had a flock of Merinos—pure blooded and exceptionally fine, yet in the flock was dropped a ram lamb, very badly shaped, in fact almost a monster, but having a fleece very long and of wonderful silkiness. He went to work, and finally developed the wool known as silky wool. The dress stuff known as "chally" is composed of seven parts of this wool and only one part of silk, and the whole fabric appears to be silk. There was a very extraordinary development of an absolutely new quality —the obtaining of a new fibre. It is so valuable that it is better than cashmere for making shawls.

There are certain remarkable qualities about wool. Its specific gravity is one, and a very important one. Cotton has a specific gravity of 1.47, linen of 1.60, silk of 1.30; while wool has a specific gravity of but 1.26, so that it is the lightest of any fibre used for purposes of clothing. We all know the difference between a cotton comforter and a woolen blanket. This quality of wool enables us to wear our warm garments without suffering, and is indeed one of its most useful qualities. Another quality of wool is its polish; still another its capacity to receive dyes. Cotton does not hold dyes, like wool or silk. This quality of wool is a very interesting one. On that card are specimens of flannels of fifty different colors, and the manufacturer is making a hundred. This seems remarkable; but in the famous Gobelin tapestry there are as many as 2,500 distinct hues and shades. Some of you who were at the Centennial Exposition will remember the picture of Penelope, sorting and winding her wool and weaving it into embroidery. The hues are more brilliant and the tones more delicate than can be produced by any pigments.

But perhaps the most important quality of wool is the character of its fibre. The first question that occurs to us is: Why does wool spin? You see easily enough why silk and flax can be spun. They have long fibres, and all you have to

do is to twist them together. But how is the fibre of wool, which is sometimes only half an inch long, spun? It is due to the quality of the fibre. These two short fibres, cotton and wool, exhibit peculiar qualities. Cotton spins because its fibre was originally a hollow cylinder, not absolutely hollow, but a cylinder that when it dries, dries in the shape of a cork-screw. Manufacturers have been subjecting the fibre to heavy weights, and wondering why it would not spin. The greater the pressure the worse it spun, because it crushed the curl and prevented the fibre from hanging together. One of the latest improvements in the cotton manufacture consists in correcting this process. Wool is very differently constructed. In each fibre there is a series of thimbles with serrated edges dropping into each other. These little points project past each other and all curl round the cylinder of the wool. Each of these little points is of the same size; they are of the same size in coarse as in fine wool, but in fine wool they are closer together. It is these little points or barbs that give to wool its power of spinning. The points of the barbs of one fibre catch into those of another; and more than that, they give the felting power to wool. The wool of the closest fibre, or with most projecting barbs, has the highest felting power. The finer the wool is, the higher is its felting power; therefore, it may be made into broadcloths and fine felts.

At the bottom of the different fibres of wool are a series of bulbs, one set furnishing the yolk. The other bulbs contain a cellular substance which is developed into the filament of wool. The bulb gives to the filament of wool its size or diameter, and its manner of curling. You know that Merino wool has its curl and Cotswold *its* curl. The curl is governed by the shape given to it in the bulb. Another fact is that the shape of the bulb gives size to the fibre; so that if you increase the activity of the bulb, you add to the length of the wool but do not change its fineness. Instead of being short wool it becomes long; instead of being clothing wool it becomes combing wool. This is something that has been recently developed.

What is the difference between wool and hair? Hair originates in bulbs of the same character as those from which wool is produced. It principally differs from wool in its coarseness—its greater average diameter. Most of the fur bearing animals, as the otter and the beaver, have two coverings, an outer one called fur and an interior one called down. Now the theory is that wool is simply this down developed. The most accepted theory is that the sheep in its primitive state was provided with a covering of coarse hair, beneath which was a shorter covering of a wooly down. By culture the hair has been dropped, and the down developed into wool. I have here specimens of the pelt of an Arabian sheep furnished me by Mr. George William Bond, who is a believer in this development theory, and is making some important investigations upon the subject. This specimen you will see is apparently covered solely with coarse hair, and you might mistake it for the pelt of a calf or dog. But you will see entangled in the hair some fine down which the animal has shed. From other portions of the same skin, Mr. Bond has carefully separated the down, a specimen of which I show you. It has the fineness and silkiness of the silky Mauchamp wool, the diameter being so small that there are 2,000 to an inch. Some other facts support this theory. Coarse hair is often developed by careless breeding in our finest Merinos, and you are aware that the Merino lamb when first born is covered with coarse hair which soon drops out. This hair is supposed to be a relic of the primitive covering of the animal.

I have not yet noticed another characteristic of wool—the yolk found in the Merino sheep. This yolk is pure soap, that is, it is composed of grease and potash. It contains so much potash that by the chemists of France it is largely used in making Prussian blue. I have seen beautiful pictures made from these blues of the sheep's fleece. The amount of potash obtained from the fleeces of France, is more than enough to make all the gunpowder that is used in that nation. You see that there is, then, a great loss of an important element of fertility in the ordinary methods of washing sheep. Manu-

facturers are now turning this element into account by saving it. I know one manufacuturer who has made his farm rich by the application of the potash he has got from the yolks of his sheep.

My next point is the characteristics of the distribution of the races. A really scientific classification is of great importance, as all true science is but systematized knowledge. The old system of classification was based upon the character of the fleece. The writer who has thrown most light upon this subject, is M. Sanson of France. He has divided sheep into two classes, and regards all sheep as having sprung from perfectly distinct species. As the result of this theory species are fixed. He regards hair or wool and flesh as secondary qualities, which can be modified by culture. He makes his classification depend on the shape of the cranium. The cranial cavity has two diameters; *longitudinal* from the point of the auditive conduit to the bottom of the orbit of the eye; *transversal*, measured by the distance which separates the summits of the perforations of the ear. If the longitudinal diameter is greater than the transverse, the cranium is called *dolico-cephalous*, signifying an elongated cranium. If the transversal is as great or greater than the other, it is called *brachy-cephalous*, signifying a short cranium. This leads to the classifying of all races into two great groups.

Short Cranium.	Long Cranium.
Leicesters,	Cotswold,
Lincolns or Romney Marsh,	Merino,
South Downs.	Type of the Pyrenees.
Limousin,	
Barbarous.	

Now this is apparently a mere theory, but you see the practical consequence of it, for it makes the Merino and Leicester belong to two great distinct species originally. If this be so the crosses of these sheep will never produce a permanent new race. There will be danger of reverting.

Without pursuing this classification further, let us recur to a more popular classification. Dr. Fitzinger of Vienna makes ten distinct original races, viz:

Fat rumped, 7 varieties; Stump tailed, 5; Short tailed or Heath, 10; Tackel, 4; Fat tailed, 8; Rustic, 50; Pendent eared, 4; Long legged, 9; Long tailed, 5; Maned, 4.

Thus he makes 106 varieties. It would be impossible, while, if it could be done it would be confusing, to follow the description of each of these varieties. Therefore, without further attempt at classification, I will briefly describe the most important races, considered from a practical point of view.

One of the most important varieties is the Barbarous type, —adopting Sanson's classification. These are the sheep of Syria, the sheep of the Bible, and exist now as they have existed from time immemorial. These sheep have fat tails and fat rumps. Often a sheep weighing 150 pounds will have a tail weighing 50 pounds. Probably not many of us are accustomed to associate with our ideas of the paschal lamb an animal of this character. Heroditus, whom people used to suspect—as I see some of you suspect me now—of telling big stories, states that the people of eastern countries fastened trucks to their tails, so that they could be carried with ease. This practice is still followed at the east. The fat of their tails is used as a substitute for butter, and is sold in the markets of the east, being regarded as an indispensible article. The wool is coarse and long, and is admirably adapted for carpets.

Another is the Colchican or long-tailed sheep of Georgia in Asia. This was the country where the Argonauts went in search of the Golden Fleece. The wool was remarkable for its whiteness. The Heath or short-tailed sheep are those belonging to the Shetlands, Highlands and other heath countries of Europe. One variety of the rustic stock deserves mention, the Choanos of Spain. They are a small sheep and have a coarse wool. Some writers have stated that the sheep of Mexico and South America were degenerated Merinos. They are really descended from these Chourros, the native sheep of Spain. All these wools of the barbarous sheep and of the Choanos are carpet wools, constituting the wools known

in our tariff classification as wools of class third. They are produced by barbarous or semi-civilized people. They are not fit to be cultivated in this country with our high prices of labor, for the same reason that you would not grow rye where you could just as well grow wheat.

The next great class of wools is that known in our tariff classification as wools of the second class, and consists of what are known as combing wools. They are the product of the English races. It is remarkable that England should have developed such peculiar and marked races of sheep, but England has been from time immemorial devoted to wool culture and sheep growing. Wool was called in ancient times the "foundation of England's riches—the flower and strength and pride and treasure of England." The seat of the Lord Chancellor was the wool-sack, emblematical of the natural importance of wool. So abundant was this staple in England, that as early as 1390, 47,000,000 lbs. were exported. For centuries England exported nothing but tin and wool. You know that in former times the people of England were exceedingly isolated in their several counties. Their dialects were entirely distinct one from another. Under these conditions their breeds were kept distinct, until finally distinct varieties of sheep were formed, of which there are something like eighteen.

The most marked one of these is the Lincoln, found in the fens of Lincolnshire. These sheep produce an enormous bulk of wool, though not much grows on the bellies. The wool is of great lustre, and of great length. It will surprise you to know how valuable it is. It has a lustre almost like mohair. It is said that a Lincoln sheep on exhibition had a fleece of twenty pounds, the wool being 18 inches long. This was a hogget fleece—that is, from a lamb that has never been shorn. It would produce wool enough when diluted with cotton to make 672 yards of alpaca, or enough for 56 ladies' dresses. This was stated by a manufacturer in a public meeting in England.

The next important variety of which I shall speak is the Cotswold. These are long wooled sheep, and are grown on higher land than the Lincolns, in the counties of Gloucestershire, Herefordshire and Worcestershire. The name comes from two words, *cot*, signifying the shed in which they were kept, and *wold*, the open hilly grounds on which they were pastured; and they are now often kept in cots or sheds and tied up at night like cattle. The Cotswold is a hardy animal, with a heavy carcass and coarse wool, and is for certain purposes, of high value. They do not fatten so early as the Leicesters, but have a longer and a heavier fleece. They are suited for exposed situations and somewhat scanty pasture. The Cotswolds are very popular in this country. But there are not many pure-blooded Cotswolds, as they have been crossed with the Leicesters.

The Leicesters are found in the midland counties of England. They have a white face, no horns, and clip from 8 to 13 lbs. of wool, from 10 to 15 inches long. They are among the oldest races of English sheep, and the Leicester is unquestionably the origin of the native stock of the U. S. —that is, the old Leicesters, not the improved Leicesters. They were run down by low feed, but even in their degenerated state they retain many of the qualities of their ancestry.

Up to the middle of the last century, sheep were grown in England entirely for their wool. The first step toward improvement was the introdnction of the turnip culture, by William of Orange, at the end of the 17th century. They were fed to sheep, and it was found that by growing them the same land would support treble the number of sheep. Then sheep were grown for their mutton. Mutton became the first object and wool the secondary object. Soon after this a further improvement was made by an extraordinary man, Mr. Bakewell of Dudley. He conceived the idea that sheep could be modified. He went to work on the Leicesters —took the small Leicester and developed the improved race, which he called the New Leicesters. The results of his operations were such that they attracted the attention of all

England, and the prices received for the services of his rams amounted to 5,000 guineas per annum. The Leicester is famous for its power of preserving those qualities imparted to it by Bakewell. The wool is finer than the Cotswolds', and better adapted for the dress goods fabricated from combing wools. The Cotswolds and Lincolns have been modified by the Leicesters. The great change which seems to have been introduced was the shortening of the time in which the animal matures. It was made to fatten in one year, and to attain full maturity in two years. It took four years to mature a sheep in the old times. What then was the result of this improvement? You can see at once that a man could turn his capital twice over in the same time, and this improvement for mutton worked a marked improvement in the wool, as the wool was principally furnished by young and healthy animals.

The Downs are raised upon the chalky plains of England. The weight of the sheep is from 65 to 90 lbs., and they produce a fleece of about 4 lbs. They produce the best mutton and are the hardiest and healthiest of English sheep. Their wool is a middle wool, and well fitted for combing.

The only other race of importance which I shall refer to is the Chevoit. The sheep of Scotland are of two races. The sheep of the Highlands are small, but when fattened the mutton is esteemed as of great value. On the low hills of Scotland and the northern part of England the Cheviots have taken the place of these sheep. They are small sheep and bear combing wool. The carcass weighs about 60 lbs., the fleece about 3 lbs. They stand the snows and the cold well and earn their own living the year through. Crossed with the Leicester they make a beautiful combing wool. The cross is termed the Roxburx sheep. The Chevoit has been little introduced into the United States, but it seems to me to be peculiarly well adapted for experiment, at any rate, and particularly in this State.

Another sheep bearing combing wool is the Texel, which is a cross of the English and African races.

The Merino sheep is the greatest boon that manufacturers ever had. It is the foundation of the wool manufacture of the present day. You can see why. It is not only because of its fineness, but of its firmness, and because it has a higher fulling power than any other. The strongest clothing can be made from it. Take a rope with a hundred strands and it is much stronger than one of the same size with only fifty strands in it. The more strands in the same diameter the stronger it is. So with your cloth. The more fibres it has in it the more enduring it is, and consequently Merino wool makes the most enduring cloth.

The Merino is probably a relic of the Roman civilization. We find that the old Romans kept fine sheep at Tarentum. They were clothed in wool altogether, as silk and cotton were unknown. They understood teazeling, and knew how to full as well as we do now. There are a great many relics in the remains of Pompeii which show that they had reached a high stage of excellence in this direction. When the Goths and barbarians overwhelmed Rome, all that was swept away; but we know at the height of Roman civilization, that sheep culture had attained a high degree of perfection in Spain. Sheep of high qualities in the time of Tiberius, or about the time of our Savior, sold for a talent. Strabo refers to the sale of sheep at a price which would be equal to $1,000. We hear of high prices being paid by farmers, but we find that the same thing took place two thousand years ago. When all Italy was overrun by the barbarians the sheep remained in the mountains of Spain. When that country came under the dominion of the Moors, they bestowed high culture upon these sheep, and the sheep continued to remain there until the middle of the last century. So greatly did Spain esteem their value that she did not allow them to be exported, not even to her own colonies, to which she sent the Chourros, reserving the Merinos for herself. Charles V. established the Order of the Golden Fleece when Spain was a part of his dominions; and this, the highest of the orders of chivalry, is an indication of the value of the Merino. They were removed

from one section of the country to another for pasturage, the word Merino signifying wandering.

It is scarcely a century ago that Spain rescinded her rule and allowed them to be sent abroad. The king of Spain sent them only to his royal allies. They were sent to the Elector of Saxony, for one, in 1776. And the king esteemed them so much, that after their culture had become somewhat extended, it was the custom to have read from the pulpit on Sunday directions for growing them. I have spoken of the plasticity of the sheep. When the Merinos were carried to Germany, the first attempt was made to change them and to develop the fineness of their wool. Fineness was esteemed the most desirable quality in cloth and wool. They produced fineness to such an extent that the Saxon race, or the Escurial sheep, as it is better called, excelled all others in this regard. One of the animals weighs from 40 to 50 pounds, and produces not more than from 1 to 1½ pounds of wool to a fleece. In diameter there were 2,500 fibres to the inch, and in length it was but about half an inch long. That was the standard of excellence in wool, and remained so for fifty years. The single idea was to have fineness.

Another change took place in France, when the Merinos were carried to that country in 1786. Instead of breeding in that direction, the French began to develop size and length, and the result of their efforts is the Ramboullet sheep; and the sheep are large. They produce a fine fleece, of good weight, and with a fibre much longer than the other, or combing wools. The development of the long merino combing wool in France, led to the introduction of fine merino combing wool for ladies' dresses, and made the most important change in fabrics for female consumption of modern times.

This doctrine in regard to the value of wool is changed in Germany. There is very little of the short fine stock used, and the market stock is generally what is known in this country as Vermont wool. This is a type of Merino wool with a long fibre.

The introduction into the United States of the Merino, was made at the commencement of the century, about 1802, by Gen. Humphreys. Also a good many, several thousands, by Mr. Jarvis, who had been in Spain. These are the sources of the Merinos in this country. We have developed the Merino in this country principally for the fleece. Mr. Edwin Hammond of Vermont, has developed a Merino which is known as the American Merino. The wool growers of Australia say that the only sheep which have been carried to their country and been a benefit to their flocks, are those from the United States. The French and German sheep have been no benefit, but those from Vermont have been of priceless value.

Proceeding to a sketch of the production and commerce of wool throughout the world, the lecturer illustrated by a large diagram the production and number of sheep in the world, as estimated by H. Schwartz & Co., of London, a highly competent authority. Their table is as follows:

	Year of Return.	No. of Sheep.
United Kingdom,	1876	32,252,579
Russia,	1870	48,132,000
Sweden,	1873	1,695,434
Norway,	1865	1,705,394
Denmark,	1871	1,842,481
Iceland,	–	800,000
Germany,	1873	24,999,406
Austria,	1871	20,103,395
Switzerland,	1866	447,001
Holland,	1873	901,515
Belgium,	1866	586,097
France,	1872	24,589,647
Italy,	1874*	6,977,104
Spain,	1865	22,054,967
Portugal,	1870	2,706,777
Total Europe (exclud'g Turkey and Greece) about	–	190,000,000
Australasia,	1875	62,000,000
Cape,	Estimate	16,000,000
River Plate,	"	60,000,000
North America,	"	50,000,000
Remainder of America,	"	6,000,000
Total,	–	384,000,000
Turkey, North Africa, Persia, &c., say		65,000,000
India and China, say		35,000,000
Grand total,		484,000,000

*Recent statistics place them at 9,000,000. See Report of the Department of Agriculture for November and December, 1876.

The total consumption of raw wool in 1875, by Europe and North America, is estimated by the same authority at 1,449,000,000 pounds. The estimated population of Europe and North America is 347,000,000; making the consumption of raw wool per head of population, 4.18 lbs.

Proceeding to consider the commerce in wool, the lecturer continued:

The first consideration of importance bearing on the mind with regard to the commerce of the world in wool, is this: Of all the productions of agriculture, there is no one so capable of transportation without injury, as wool. It costs the smallest percentage on its value to transport it a given distance. While it costs 80 per cent. of the value of wheat to bring it from Chicago, 30 per cent. of the value of pork, and 20 per cent. of the value of beef, it costs but 4 per cent. of the value of wool. It can be carried from San Francisco to New York for 1½ cents per pound, and from Australia to New York for 2 cents per pound. These are important considerations, and they are considerations that tell both ways. In some respects they are of great value to our farmers. They give facilities to send their stock to market; but at the same time they give great facilities to foreign producers. You are protected on your animals by the distance of the foreign producer from your market; you are not protected on your wool. Wool is, therefore, an article on which some legislation is needed, to protect the farmer who grows it.

There is a curious fact which we cannot help contemplating, showing how the great powers of the world may do good without any thought of it. All this development of the Merino wool industry grew up from the possession by the kings of Europe of the Merino sheep. They treasured them as royal privileges. It was a kingly thing to have a royal sheep. There was another kingly thing to have—china. The kings of Europe a century ago developed china. Now look at it. Everybody has china, and every man and woman in this house has Merino wool on his or her back. The

blessings that have come to our people from these two things, can hardly be calculated; yet they were royal privileges originally. I would like to point out now the wool of which different fabrics are made. [At this point the lecture was made very interesting by reference to the samples of different kinds of wool and different fabrics, all of American manufacture, on exhibition.]

Of course you will say that the most prominent of all woolen fabrics is broadcloth. With the exception of one other, as I should say, it is the most beautiful and most precious, and it is the one of all that requires most skill in the making. I am happy to be able to show you the very finest article made in the shape of broadcloth. It is finer and nicer than any other thing shown at the Centennial Exposition, and the best thing about it is that it was made here in the State of Maine. It was made by Friend John D. Lang, at North Vassalboro'. I wish I could say it was made out of Maine grown wool, but it isn't. It is made of the finest Silesian wool. The next nicest fabric made from Merino wool is merino. Ladies know what I mean by that —the fine French merino. It is made from the finest combing wool. The broadcloth is made from the short fibre; this is made from the finest long combing wool. The next article of importance is our fine cassimere. I have beautiful specimens of it here, which are equal to any made in the world. They are made from fine to medium American wool, according to the quality of the cloth. Our American flannels are made from American wool, and we make better flannels than are made in Europe. You may think I am bragging a little, but as one of the judges on woolen goods at the Centennial Exposition I had a chance to see, and I know of what I speak when I say that our flannels are, as a whole, better than those of Europe. It is due to the quality of the American wool. Another fabric in which we excel in making is blankets, particularly those made from American wools. There was a handsome exhibit at the Centennial of blankets made at San Francisco. There were also some made in Min-

nesota, by a Maine man, Mr. Paris Gibson, which surpassed anything ever made in Europe, and he has actually sent them to Europe to be used in their sleeping cars. Another class of goods is knit goods, of which I have two specimens. They are made from American combing wools. Here is a very beautiful fabric, an American India shawl. It is made from American long wool. Here is a whole class of fabrics, worsted fabrics they are called. They are ordinarily spoken of as delaines, and are ladies' dress goods. They are made with cotton warp and are as good as though all wool. The warp actually adds to the strength of the fabric. They were formerly printed, now they are woven in most intricate patterns. Cashmeres are now made mainly from Merino wool, with cotton warp. There is another fabric, call alpaca, admirably made by the Arlington Mills of Lawrence, Mass. These are made of cotton warp, with a filling of English combing or Canada wool. They have brilliant lustre. They have only recently been made in this country. To show you the extent and excellence with which they are made, I only need to say that our own fabrics are now taking the place of the foreign entirely. They are in better taste, more desirable and cheaper. Probably there was never so great a boon to women in moderate circumstances as these goods are. Fine merinos are only worn now by people who buy costly goods because they are costly. The medium classes of goods of our own manufacture are recommended alike by economy and taste, and to show the abundance with which they are made, I may remark that one mill uses the fleeces of 10,000 sheep per week. There is another fabric that is made of long combing wools—that is, bunting. This is made of long English combing wools, Lincoln or Cotswold—Cotswold is the better. I have here a shawl which I have worn for 20 years, and you see it is a pretty good shawl yet. I exhibit it to show how durable these coarse goods may be.

I have here specimens of Ingrain and Three-ply carpets. The warp of these is made of the carpet wool of which I have spoken, while the filling is of long wool. The ingrain has

two colors in a line, the three-ply three. Here is a specimen of Tapestry carpet. The warp of this is printed and the filling so woven in as to make the pattern. Here is a specimen of Brussels carpeting, which at first glance resembles the tapestry, but is much more enduring. Here is a piece of Wilton carpet. These delicate colors are made from English or Canada wool. I think you will conclude, if you examine it, that it is as perfect a piece of carpeting as can be made. Here is a piece of Tapestry Velvet, and still another of Axminster. Our carpet manufacture surpasses any in the world. We make more because the masses of our people have better furnished houses than any other. The Austrian Commissioner, who was my guest, said to me: "Why, you have your chambers carpeted; we never have anything of that kind in Austria."

I will refer to one other class of goods—worsted coatings. They are made from fine to medium wool, and are very popular goods. Men do not wear broadcloth now for business suits, they wear worsted coatings and cassimeres; consequently the demand, instead of being for fine wools altogether, is largely for medium, and this opens a wider range both for the manufacturer and the farmer.

I propose now, to discuss wool growing in its relation to agriculture. I am now, I know, stepping out of my own field and trenching on yours. I have spoken of things that I know about. Nevertheless, the relations between woolen manufactures and agriculture are so intimate, that they are constantly forced upon the mind of one who has been situated as I have been. That relation I think I may safely say is one which is beneficial to agriculture, and to make the proposition a general one, agriculture may increase its profits by making itself tributary to manufactures. Therefore, let us look at and analyze the relation between sheep husbandry and general agriculture.

You all know that lands require constant renewing; they must be fed. The best lands in Genesee County, N. Y., and in Ohio, have run out. I know of a place where a railroad

was built to bring flour from a famous flour producing district, and in a few years the land became so badly run out that they had to take the rails up. Now, I lay down the proposition,—and it is one which the greatest country in the world has established by its practice—that the most economical method of manuring land is by grazing it with sheep. There are 32,000,000 sheep in England; and Scotland, which is not so large as the State of Maine, has 5,000,000 of them, and the land there is worth three times as much as it is here. Why do the agriculturists of these countries keep them? Because they have found that they do not exhaust the land like other stock. Their manure is better, because their food being thoroughly digested. The manure is dropped more evenly. And again, the sheep bite so lightly that they do not pull up any of the roots of the grasses where they feed. It is laid down as a scientific proposition, that where sheep are fed on land it does not run down. The idea has been advanced, that if a piece of land will furnish pasture for 1,000 sheep one day, it will furnish pasture for 1,001 the next day; and so at the end of the year for 1,365. Of course this is merely an illustration, but it shows the theory as believed. Another one has said that 1,500 sheep fed on an acre of land 24 hours, or 100 sheep for 15 days, would carry an acre of land through a four years' rotation.

I have read all the volumes that I could find in the Royal Agricultural Society of England bearing on this subject, and the conclusion arrived at by their writers is, that sheep do not pay of themselves, but that keeping them is the only way they can carry on their farming operations and preserve the fertility of the land. The wool pays them something, and the mutton pays something more, but the great object is keeping them to sustain the fertility of the soil. You probably know the history of English husbandry, therefore I will barely refer to the general practice. Say 1000 sheep are put on 1000 acres. They are fed every day with turnips on the land. It is supposed, theoretically, that they are all in one pasture, though of course that is not the fact. The next year

grasses of various sorts are grown on the land, and on the third and fourth wheat and barley (I do not recollect in which order), and the manure left by the thousand sheep carries the land through this four years' rotation. I have heard of a case in Vermont, where a sheep farmer was compelled to abandon one farm after another, as they became too fertile for profitable sheep growing. I know the fertilizing influence of sheep culture, by my father's experience. He had 300 sheep, and his land was naturally poor—a light, dry, sandy soil; but by using muck and composting his sheep manure, and letting his compost remain for over a year, he grew such corn as I never saw anywhere else. A man in Wisconsin who kept sheep, at the end of twenty years raised his 24 bushels of wheat to the acre, while the average yield of wheat in Wisconsin is but 10 bushels per acre. Probably you know about this thing better than I do, but I will adduce one other instance of success in renewing the fertility of a farm in this way, that of Mr. Chamberlain of Red Hook, N. Y., which I give on the authority of Hon. George Geddes, who is a very sensible and able man, and whom Horace Greeley regarded as the authority on agricultural matters in New York.

"In 1840 he purchased a farm at Red Hook that had 380 acres that had been used to raise hay to sell so long that it was worn out. The hay crop of 1841 was 17 loads; 40 acres of rye gave 10 bushels to the acre; 25 acres of corn averaged 20 bushels to the acre; the remainder of the farm was called pasture, and proved equal to the grazing of one span of horses, two pairs of oxen, and one cow. The land was so exhausted that it would not grow red clover. The so called commercial manures were tried, such as guano and superphosphates, with but little advantage; wood ashes were better, but none of these substances could be used with economy, and Mr. Chamberlain was forced to act on the assumption that the Spanish proverb is true—'The hoof of the sheep is gold.'

"The detail of his process of improvement was given by me in the Tribune in 1869, and would take too much room

for repeating here. But by using sheep as manufacturers of grain, hay, straw, corn-stalks, swamp muck, (of which the farm had an abundant supply) leaves and weeds into manure, he not only restored this worn out farm to its original fertility, which could never have been very great as the soil is quite deficient in lime and consists largely of sand and ground up granitic rocks; but he made it so productive that its crops would attract attention, and be highly satisfactory in even the far-famed Genesee country or Ohio. I have an account of the crops of 1866: 800 loads of hay, estimated to weigh in the winter fully 600 ton; 40 acres of Indian corn, estimated to yield 50 bushels to the acre; wheat, for which the land is not well adapted, but which is the best crop with which to sow timothy and clover seeds, 30 acres, averaging 15 bushels; 30 acres of oats; 8 acres of roots, and the pasturage of 300 sheep and the teams, cows, &c., necessary to carry on the farm, and to supply the families on it with milk and butter. The winter before he fed 300 sheep for market, making a direct profit of $1 each, and he fed 37 steers and oxen, and wintered 300 store sheep and some cows and young cattle; all these animals made an immense pile of the most valuable manure."

Mr. Chamberlain's plan, when he first commenced making manure by using sheep, was to spread it thinly so as to make it go over all the surface he could and have enough to make clover grow, and he said that when he brought his land to where it would produce red clover, that thenceforth improvement was easy and rapid. The sheep not only gave the first impulse but were all the time depended on as the great manure producing power; and the resulting change in so short a time is most wonderful, and teaches a lesson that is of incalculable value to the whole people, and Mr. Chamberlain should be classed among the greatest benefactors our country has produced.

Mr. Dodge, the eminent statistician of the Agricultural Department at Washington, gives the following statement of the way in which sheep raising is carried on in New Jersey.

"New Jersey, lying between the two largest markets in the country, which feed a population of 2,000,000, is famed

for the high prices of all feeding material, and yet this branch of sheep husbandry flourishes, there, as in no other State in the country. Her flocks, consisting mainly of ewes, are yearly changing. Selected in August for their thriftiness and adaptation to breeding, from flocks driven from Pennsylvania or Ohio, and costing from $3 to $6 per head, they are pastured in early autumn, usually served by Southdown rams, fed well during winter, their clips sold early in spring, their lambs turned off in May and June at $4 to $8 each, and the mothers in the meantime fattened to follow their offspring early in summer. Thus within twelve months, fleece, lamb and mutton are converted into cash, and from $6 to $10 per head received for feed and care besides a supply of valuable manure. Here are quick returns and good profits. The breed is the common grade Merino stock of the country, selected with reference to size, thrift and constitution; the lambs are cross-bred, partaking largely of the Southdown superiority in quality and of the aptitude of cross-breeds for fattening readily, both sheep and lambs are disposed of promptly, no feed is wasted in keeping the vital machinery in working order, and losses from old age and epizootics are avoided. This is the prominent feature in New Jersey sheep farming; it yields a present profit, and insures future fertility. Some countries in southern New York and eastern Pennsylvania pursue a similar course to some extent, with similar results, some flocks yielding a gross increase of 200 per cent. upon original cost within twelve months. A flock of 68 ewes in the summer of 1868, was turned upon Virginia wheat stubble seeded with clover, and without other feed or care over 100 lambs were sold in May of 1869, at $5 per head, realizing nearly $300 above the cost of the ewes in addition to the original stock and wool on hand. A gentlemen in York County, Virginia, writes me that he keeps 100 common ewes, breeds to Southdowns, sells an average of 80 lambs annually at $4 each, and obtains enough for wool to pay all expenses of keeping, while the benefit received by his land is equal to the interest on its value, leaving the receipts for

lambs as interest and profits on investment. Another in Clark County, Virginia, tried Merinos and Cotswolds. Both breeds did well, but while the Merino lambs brought $2 each, the Cotswolds were worth $4, and the prolificacy of the Cotswolds was far greater."

Now comes up the question, What shall Maine do in the way of sheep husbandry? There is the rock. I know well that I am not capable of giving you practical details; I can only deal with general principles. What shall Maine do? What kind of sheep shall she raise? I think it is pretty clear what is the judgment of practical men on this point. I have talked with a great many farmers here, in New York and the West about it, and they all recommend just that which a member of your Board, Mr. Wasson, recommends in the admirable paper which he has written on the subject—a mutton sheep.

I think in growing sheep in this country you must throw aside all consideration of the wool. It is strange how false notions will get into mens' heads. A wool manufacturer or his agent will tell you you must grow this or that kind of wool. I tell you you can't grow any kind of wool that won't sell. Go on and manage your sheep in the way that you can get the most money from them, whether raising mutton or lambs, and let your wool take care of itself, and it will take care of itself. You must regard your sheep as machines for converting your grass and grain into wool and mutton, and to do that in the shortest possible time, you will take an English mutton sheep which fattens easily, and go for mutton. Do that and what is the result? You have a sheep that yields you a healthy wool and wool that will not break. You know a good deal of wool is spoiled by having tender places in it; so help your sheep through the tender places by using good feed all the time, and then there will be no tender places in the wool. But somebody says who will grow the Merino? Why, all the world grows Merinos. Australia and the Argentine Republic grow them by the million. England grows English combing wools, and that is what you should grow. You are close by Boston, and you are sure of a

market for all the Cotswold and Leicester wool you can raise, and at high prices. Go in coolly, and as has been said here to-day, exercise your common sense. Every farmer must do that. Find out for yourselves the way to do it, and feed to make mutton, and you will get a profit in doing it, while your land is being improved. In that way you will have in sheep-husbandry an important auxiliary to fill up a place on your farm. With 54,000,000,000 lbs. of wool consumed annually, we should produce more of it ourselves, and I believe as I have stated that it is for the interest of our people to make the growth of it an incident to the growth of mutton. There is a new field and you have a chance in it. You know that a change has taken place in regard to the growing of beef, caused by an invention by which beef and mutton are put up and cooled, so that they can be taken by the car load fresh in the carcass, put in boxes and carried to England. This is making a perfect revolution in the production of these articles, and there is a demand for all we can ship. You are just in the place for availing yourselves of these changes, and you are going to make a fortune if you do it. If I knew how, I should come down here into Maine and make a fortune myself, but I don't know precisely how, and therefore I can't tell you; but the tendency of intelligent men in Maine is toward growing a mutton sheep, because that is the sheep adapted to a mixed husbandry. The Merino is adapted to a pastoral husbandry, like that of California and Australia, but the mutton sheep must continue to be the sheep for us, and it seems to me there is a demand for a movement in the direction of mutton growing.

There is one reflection that comes right home to us to-day. We cannot any of us forget that this is the 22d of February, the anniversary of the birth of George Washington. What is there that we can refer to that connects him with our subject. I have already shown what Merino sheep husbandry has done for our country. Now, George Washington was indirectly the source of it. He was fond of sheep husbandry, and he imported Leicesters, and it is said that the Leicester

blood remains in that section of Virginia to this day, and that this accounts for the long wool that is to be found there. Washington had on his staff and in his family, a gentleman by the name of Humphreys, who was afterwards General Humphreys. As a member of Washington's household, he became inspired with his ideas, and among the rest with his love of agriculture. When Minister of the United States in Spain, he remembered the lessons which Washington taught him, and he sent from there the first flocks of Merinos which came to this country. In this way our flocks date back to Washington, and Washington may be said to be indirectly the source of the greatest boon which our sheep husbandry has ever received. I am glad that I brought this flag here to-day. It should be raised on every public occasion where reference is made to the Father of his Country.

That flag was called by the soldiers during the war, as you will remember, "*Old Glory*." I am reminded of a little incident in connection with that name, which I cannot help relating. While I was a resident of Washington, a little while before the battle of Antietam, the rumor came that the troops were moving up into Maryland. I took a walk one evening in the vicinity of Gen. McClellan's house. The streets were quiet, and the moon shone so that it was almost as light as day. By and by I heard the tread of marching feet, and soon the advanced column of ten thousand men in arms came in view in the silent and almost deserted streets, showing as in the light of day under the full moon then in the ascendant. As the veterans passed me, my enthusiasm grew stronger and stronger, and it reached its height when a regiment from my native State of Maine came up with their tattered flag; and as they passed I could not forbear from calling, "Hurrah for the State of Maine! Hurrah for Old Glory!" I was a younger man than I am now, and hardly conscious that the white had begun to appear in my hair, and so I was taken a little aback at the response of the Maine boys—"Bully for you, old man!" Although a little abashed by the response, which reminded me of my declining years, I

was so affected by it that I cannot recall it without a transport of patriotic feeling; and when I see a Maine man now nearly 80 years of age, who has made in his State the finest cloth shown in the International Exhibition, I say, "Bully for you, old man!" When I see his son introducting the best breed of horses, and in that way adding to the wealth of the State, I say to him, "Bully for you, young man!" When I see my friend Paris Gibson, going from Maine to Minnesota and making blankets which surpass those of English manufacture, I say, "Bully for you, young man!" When Mr. Wasson writes the best paper on sheep husbandry, I say to him, "Bully for you, young man!" When your Secretary, Mr. Boardman, shows us his admirable and exhaustive paper upon utilizing in the interest of agriculture the refuse of your herring fisheries, I say, "Bully for you, young man!" And when I see a young woman who performs her own household duties, and then goes out into the fields and pastures, takes the wild flowers, cultivates them, and acclimates them to the flower garden, and introduces to the world her treasures for floral horticulture as new treasures, I say, "Bully for you, fair daughter!"

That flag, gentlemen, symbolizes our political independence. It does more than that; it signifies the industrial independence of our country. Ten or twelve years ago our flag was made abroad. I once gave an address, right in sight of Independence Hall, and I said, "Shame on us! The very flag that floats over our forts and our ships, and over Independence Hall itself—that flag is made in England." But during the war, America said she would make her own flag, and she did it, and improved upon the making; for the stars were formerly made separately and sewed on, but now each star symbolizing a State, all the stars are woven imperishably in the web of the Union, and along with them is woven the idea of our industrial independence! Industrial independence is the key to the efforts of the Association which I represent; and I think it should be the key to the efforts of the farmers of Maine.

WHAT PRODUCTS SHALL MAINE EXPORT?

By Ira E. Getchell, President of the Board.

It is not desirable for any nation or State to be a large exporter of crude agricultural products. History does not furnish an example of a nation or people being permanently prosperous, the surplus of whose agricultural productions is exported in exchange for manufactured goods of other countries.

While the system of raising crops to be consumed on the farm, may make the business of farming self-sustaining, and may keep up the fertility of the soil, the universal raising of crude products for export is sure to impoverish our lands and lead to ruin. No system of farm management is to be thought of—much less recommended—that shall not leave our farms in as good condition, at least, as when we commenced to till them. As our State has a great diversity of industries—we being exporters to a considerable extent of the products of mines and forests and manufactured goods, the creation of which gives rise to local markets for the fruits of the soil—it may have the same significance and be as practical, perhaps, to consider the question: In what direction shall we, as farmers of Maine, increase our agricultural products?

None is so good as a home market; and if we can raise more of such products as we now import in part, to supply the home demand, it will be equivalent to the exportation of an equal amount and value of some other commodity to pay for these, besides saving cost of transportation both ways. The observance of any general maxims as to what may or should be grown for export, cannot be urged; because no rule can apply to all sections and circumstances. But we

may consider some changes in our present system of farming, that shall relieve us of the necessity of exporting some of our produce, and at the same time point the way of profitably supplying many of our wants, thereby saving money to the individual and State.

In considering the subject of exportation, the question of first importance is, which of our productions can best be spared without committing robbery upon the great stores of nature, the fertility of our soils? In agriculture as in piety, faith and works must go together. What I mean is, faith in farming as a profitable occupation, such faith as wins. Much of the farmer's work is done in a faithless spirit. We fail to reap the advantages within our reach—we do not realize the agricultural capacity and possibilities of our State. About forty per cent of the workers of our State are tillers of the soil. Yet it is doubtful if much more is produced than will feed our own population. True, many who are reckoned farmers are engaged in other occupations, and farm only at odd jobs. This will reduce the percentage somewhat and make the showing not quite so bad. In Great Britain only six and one-half per cent. of the population—or one in sixteen—is engaged in agriculture; yet this small proportion of producers furnishes one-half of all the breadstuffs consumed in the kingdom.

Theorizing is a favorite but unprofitable occupation. We reason that if the farmers of Minnesota and California can raise their thousand acre fields of wheat without manure, and at a very small cost, it is useless for us to try to compete with them. If corn can be grown in Illinois for ten cents per bushel, what folly to think of growing it in our cold State! If Texas steers can be bought for $4 per head, fatted on Illinois corn at ten cents per bushel, and sent from Chicago to Boston for forty cents per hundred, we cannot raise stock in competition. So with pork, wool and other products. Now at the risk of being charged with egotism, I will make the assertion that we can raise all these western products in our own State, in as great perfection as can the West—and that

too profitably. And this we should do at least to the amount sufficient for our own consumption; and though I may be called old-fogyish, I would recommend that we live more within our own resources—that we consume less St. Louis flour, less Illinois corn and pork, and less Texas beef.

We should realize the fact that Maine is rapidly advancing in prosperity. Consider her manufactures of woolen and cotton goods, of boots and shoes, her lumber, ice, granite, lime, slate and feldspar. The continuous and steady growth of these interests, and the fact that they have withstood business depression and hard times, prove that they are as permanent industries of our State as agriculture itself. And the growth and development of these and other industries is a guarantee in the future that Maine will not be obliged to export the products of her soil, but will find better markets at her own door.

There is invested in the State, in farms, tools, machinery and live stock, $131,000,000—more than three times the capital invested in manufactures; and our annual farm products are worth $33,500,000. There are employed in manufactures 62,000 persons, in agriculture 82,000. This fact shows the latter to be the leading industrial pursuit of our people.

Now if Maine can raise her own breadstuffs profitably, why ought she not to do it? Her population is about 627,000, and assuming that each inhabitant consumes annually five bushels of wheat, or its equivalent in flour, she would require more than 3,000,000 bushels of wheat per year to supply the demand for bread. We raise less than 300,000 bushels, one-tenth of the amount consumed, leaving 2,700,000 bushels to be brought from beyond the State. Reckoning the price at $1.60 per bushel, we send out of the State annually for flour more than four million dollars. And one of the worst features of this exhibit is the fact that quite a proportion of this enormous sum—hardly less than one-fourth of the whole, or one million dollars—is paid by the farmers themselves.

The soil and climate of Maine are adapted to the growing of wheat. There are but five States outside of New England that average so many bushels per acre as our own, and no State where wheat bears so high a price. Great Britain with an area only three times as large as Maine, where the annual rental of much of her land would buy an equal amount here, with soil naturally no better than ours, with only six and one-half per cent. of her population engaged in agriculture, raises one hundred million bushels of wheat annually. This they grow from three and one-half million acres of land, the average being nearly thirty bushels per acre. Now they obtain this surprising result not through any advantages they possess that we do not have in Maine, but from necessity. They believe it can be done; and they go to work and do it. The business is conducted with the greatest skill. Chemical manures are used to the amount of half a million tons. Fleets of vessels are employed carrying guano to their shores. Their sheep number thirty-three millions—as many as we have in our whole country.

These facts are mentioned to show the possibilities in agriculture and the ease with which we can raise our bread, and even become exporters.

Now let us review our present mode of raising wheat and see if it is not profitable. In 1870 Maine's wheat crop averaged fourteen eight-tenth bushels per acre, and the price was $1.78 per bushel, making our wheat fields worth $26.34 per acre. The same year Minnesota wheat fields were worth $12.60 per acre; and California, whose annual wheat product is worth more than her gold, and whose prices are higher than in any other wheat exporting State, held her wheat at $5.50 per acre less than ours. In the nine wheat exporting States which raise more than ten million bushels annually, the average yield per acre is one and one-tenth bushels less than in Maine; the average price per bushel one dollar, while in this State $1.78 is obtained.

These statistics prove that we have to pay the highest prices for the two and three-quarter millions bushels we

import; that our soil and climate are favorable for raising an amount per acre above the average; and that the only reason why we do not raise bread enough for our own consumption is because we do not sow the required number of acres. The same arguments will apply with equal or greater force to the corn crop; for though there have been years when it was not profitable, or even advisable, to grow wheat, on account of the ravages of insects, there has seldom been a year when a paying crop of corn has not been raised in all except the most northern sections of our State.

There is no more beautiful sight than a large crib of yellow corn, and certainly there is nothing of so much value to the farm. It makes the machinery run easily during the whole year. It means the fattening of pork and beef; it means heavy sheep and lambs and sleek horses; an increase in the production of butter, cheese and eggs; and, best of all, it means a large and valuable amount of fertilizer which insures a bountiful crop for the future.

While admitting that concentrated fertilizers may be profitably applied to special and even general field crops, if they are used intelligently, yet, if all farmers who raise corn, hay, potatoes and other bulky crops—cultivating large areas of land—would invest their surplus money in corn to be fed to stock on the farm, instead of buying guano, superphosphate and the like, I have no doubt a few years would show a decided advantage in favor of corn.

Maine plants about 35,000 acres of corn, and harvests rather more than a million bushels. We buy a million (I do not dare to call it three millions, though I think the facts will warrant) bushels more, for which we pay $750,000. This we should raise in our own State, and feed on our farms. During the last twenty years Maine has more than doubled her yield of potatoes; in the next I predict she will double her corn crop.

In riding from New York to Philadelphia by rail, we pass through the entire width of the State of New Jersey, which

is indeed the garden of America. The general surface of the State is level, the soil is light, warm and easily cultivated. We behold the large herds of cows, the fine stables of milkmen, and the broad acres of the market gardener. These we expect to see, but are surprised at the immense amount of corn that is cultivated. We may almost imagine ourselves on the western prairies. True, New Jersey farms are not large like those of the prairie, but there is corn here and corn over the fences as far as we can see. And we ask ourselves the question: Is not this land too valuable to grow corn upon? The State has about a million inhabitants; the city of New York, across the Hudson, on the east, has a million; the city of Philadelphia, across the Delaware, on the west, has nearly a million more. The State is about one-fourth as large as Maine, and while we raise one million bushels of corn, New Jersey raises ten million annually—and that, too, though situated in the immediate vicinity of the two largest cities and markets on the continent, with land worth $500 per acre and upwards, and stable manure $10 to $12 per cord. In 1870 the price of corn averaged in Maine $1.14, in New Jersey 81 cents; in 1873 ours was worth 91 cents, theirs 62 cents. A stranger would say at once that either we could not raise corn in Maine, or were engaged in some more profitable business. The statement of our inability to raise corn is confronted by the facts that we know that our home grown corn is several pounds heavier per bushel, and of better quality than the western, and that our average per acre is the same as theirs—33 bushels. Let every Maine farmer ask himself the question: Can I engage in a more profitable business than growing corn?

Sheep husbandry, one of, if not the most important of all branches of stock raising, does not receive the attention which its merits demand. Mutton and wool are food and clothing. There is a constantly increasing demand for these, and the supply is of world-wide importance. Russia, the land of the North, during her long cold winters feeds 45,000,000 of sheep; Great Britain, with an area but little more than three

times as large as the State of Maine, has 30,000,000; and her colonies increase the number to 100,000,000, from which she supplies her looms. Great Britain also furnishes our own manufacturers with one-third of their wool. France, with a population of 40,000,000, on an area less than the State of Texas, whose ten million farms average less than eighteen acres each, finds it profitable to keep 25,000,000 sheep. If Maine owned as many sheep per acre as densely populated France, instead of 400,000, we should have 4,000,000. If we kept as many as Great Britain we should have nearly 10,000,000 sheep.

The statistics of crops, stock raising, &c., of England are referred to, because they are carefully gathered; because her experiments are skillfully made, and her whole system of agriculture carried to a high degree of perfection. It may not be advisable for us to adopt all these practices where conditions are different; yet there are many facts we are liable to overlook in our practices, and a glance at our neighbor's ways of doing things may not be unprofitable.

The chief animal production of Great Britain is sheep. The number of this kind of stock reaches 33,000,000, while only 5,000,000 neat cattle are kept. Her most fertile and highest priced lands are stocked with sheep. It is the basis of English agriculture; sheep are kept to enrich their land. The profit from such a course we almost entirely overlook, and nearly lose in our present practice. If we pasture hillsides and broken land that cannot be plowed, we lose what in England is reckoned one-third of the profit. Let me suggest a course which I have practiced to advantage. Increase your number of sheep so that your pastures will hardly carry your flock; fence off the number of acres you intend to plow two years hence; turn your whole flock into this inclosure one day each week during the summer. The change will be grateful to the sheep; they can do without water one day, if necessary, and you will be doubly repaid in your first crop. For our old fields that have been cropped continuously year after year, there is nothing, in my

experience, which will produce a renewal like a few years rest and enriching by pasturing with sheep.

England raises no Merinos. Such wool as is needed to supply a rapidly growing demand both in that country and this—combing wool—is grown. In 1857 England manufactured $90,000,000 worth of worsted goods; in 1864 she exported very nearly that amount. This country has been, and still is, a large customer for these goods. While we import $9,500,000 worth of other woolen cloths, there are $16,500,000 worth of their worsted goods annually brought to this country. This, however, is not going to continue. There is, perhaps, no one of our manufacturing interests growing more rapidly than the manufacture of wool. In 1860 we had 3,209 setts of woolen cards in operation; in 1870, 8,386—an increase in ten years of 250 per cent. In this prosperity Maine has her full share. In 1860 she had 80 setts woolen machinery; in 1870, 321 setts, thus in ten years the number being quadrupled.

Though Maine produces one and three-fourths million pounds of wool annually, her woolen mills consume seven and one-quarter million pounds. During the last decade the number of sheep in the State diminished eighteen thousand, while the manufacture of wool increased four-fold. This is not as it should be; for not until Maine can supply her own mills with wool, as well as her operatives with bread, can she reap the full benefit of these industries. To do this we shall be compelled to increase our number of sheep to 1,800,000—about one-third as many as the State of Ohio now owns, and about one-fifth as many per acre as Great Britain has.

There is one other subject I wish to refer to. It is the manufacture, care and application of manure and fertilizers. It may not belong to the question, yet it is a matter inseparably connected with all our farm operations; one upon which depends the results, the success or failure of our farm management; on which depends the answer to the question as to whether we raise a surplus of products for export or

even sufficient for our own consumption; a matter, withal, that receives very little of our attention, in which there is more neglect and waste than in all others. Indeed, the first and important question we should ask ourselves after removing a crop from our land, is how to restore and keep up its fertility. If we can profitably sell hay, potatoes, grain and other gross feeding crops from our farms, and keep up their fertility from outside sources, all may be well. If we depend upon home resources for our fertilizers, we must sell beef, pork, mutton, butter, cheese, eggs and wool—such as seems best suited to our different individual conditions and circumstances.

There has lately been a series of valuable and interesting experiments with fertilizers conducted at the Massachusetts Agricultural College. Crops and soils have been analyzed and formulas prepared, showing what elements are usually wanting in soils to grow the different crops in perfection. Experiments have been made on a great variety of crops on many thousand acres, with uniform and remarkable success. Now, without buying a ton of the Stockbridge fertilizers, we may learn valuable lessons from these trials. We learn that plant food comes very largely from the atmosphere—from 90 to 95 per cent.—that only the mineral or ash constituents and nitrogen come from the soil; and chemistry teaches us that these are contained in their most available form in barnyard manure. But the most important lesson to be learned is the great value of these elements and their liability to waste. If we buy a fertilizer containing one pound of nitrogen, it costs thirty cents or more; and however chemists may differ in some matters, they all tell us that nitrogen is constantly escaping from manure heaps and all decaying organic substances. Now, every one in the State who cultivates well a farm of 100 acres and consumes most of the crops on the farm, manufactures during the year (or should with care and economy) from two to three hundred dollars' worth of manure. The farmer harvests his corn and grain, carefully measures the number of bushels, secures them in boxes and bins and

estimates their value. But his manure, in too many instances, is carelessly thrown out doors, to be dried by sun and wind and leached of nearly all its valuable elements by the rains. I believe that if the farmers of Maine would use proper absorbents and save all the manure now made in the State, without adding thereto from outside sources, and apply the same properly, our wheat and corn crops would be increased a million bushels annually.

The venerable Josiah Quincy once being asked what he considered his most profitable farm crop, replied, "My manure heap." A successful Connecticut Valley farmer (Col. Colt) told me not long since, that he had used chemical manures profitably; but he considered stable manure much cheaper. His method of manufacture was this: in early winter he buys twenty or more head of cattle, feeds them on Maine hay and Illinois corn about four months, and sells them for beef. "Then," he says, "if I don't lose more than ten dollars per head on my cattle, I consider the investment a good one."

Some of the exports from our State are suicidal in their tendencies. Boston dealers in fertilizers are constantly advertizing for sale, car-loads and cargoes of wood ashes to arrive from Maine. Our corn, potatoes and other crops require considerable quantities of potash in their growth, and there is no source of supply so available as ashes. Our new lands owe their fertility largely to the supply of ashes they received from the burning of forests. Our crop of potatoes which is worth more than $1,500,000 annually to our State, and which is more than twice as valuable per acre as any other crop we raise, removes much potash from the soil. Hence arises the great objection to our raising and exporting potatoes in unlimited quanties. Truly, to send our ashes out of the State is killing the goose that lays the golden egg.

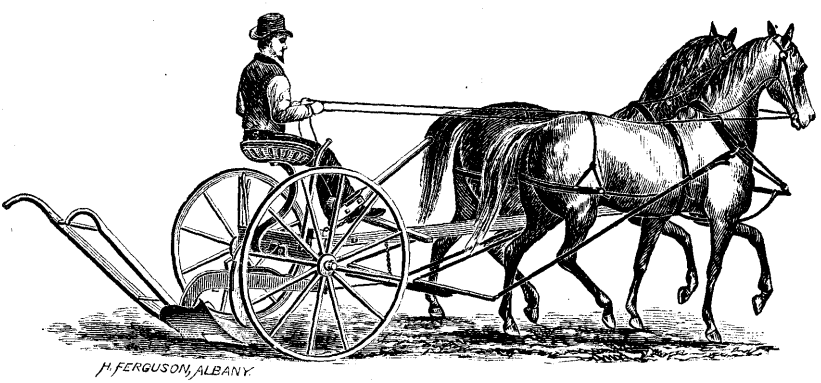
There is another interest in the State that has grown in the few past years, from small beginnings, to be a large source of revenue, and an industry from which the farmers of Maine should reap great benefit. I refer to the menhaden fisheries.

I get the following statistics from reliable sources: Number of sailing vessels engaged in the fisheries, 800; steamers, 200. Number of hands employed, 4,600. I cannot get correct information in regard to the value of products, but probably it is near a million dollars annually. After the extraction of the oil there is left as refuse a valuable and powerful fertilizer, very rich in nitrogen, which of late is dried by heat and barreled. At least nineteen-twentieths of this is sent out of the State. It is sold at present at $10 to $12 per ton, and shipped to Georgia and the Carolinas. There it is mixed with South Carolina phosphate and applied to their cotton fields. All who have any knowledge of this matertal, pronounce it very valuable; and I think it a legitimate matter for this Board to make experiments with this fertilizer, to obtain its value as compared with other manures, and report whether it is not the part of wisdom for us to consume a part of this manure at home, and to export the agricultural products grown from it.

It may perhaps be expected that, in presenting a paper like this for your consideration, some specific course will be submitted for adoption; and to cover the points suggested in this paper, I recommend that for the promotion of the best interests of the agriculture of our State, it is desirable to increase largely the number of our dairy cows and sheep. This will directly make up all deficiencies in the production of butter and cheese, if any, and leave a surplus for export; will increase the amount of meat and wool; and what is of no less importance, supply our soil with food which shall place the bread raising capacity of our State on a permanent basis. Gentlemen, I submit these suggestions for your consideration.

In conclusion, let us accept with thankful hearts, the gifts which the God of Nature has lavished upon us and our State. Let us fully appreciate the value of our noble forests, the wealth of our mines, the inexhaustible power of our grand rivers in their course to the sea, the permanent advantages to be derived from the sea-coast, commerce and fisheries. And

when we look to sections of our country that may seem to have superior advantages of soil and climate, but are, and always must be, deprived of these other advantages, let us, as we have a right, be proud of our native State, believing that the steady growth and prosperity of her manfacturing, commercial, mining and other diversified interests, will secure for her agriculture an honorable and profitable position in the future; and that ours, indeed, is a goodly heritage.



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PAPERS AND DISCUSSIONS

PRESENTED AT THE

SEMI-ANNUAL MEETING AT ALFRED, Oct. 16th-18th, 1877.

MANURES.

In arranging a programme for the autumn session, the committee on topics, at the last annual meeting, believed that some time could be profitably spent in considering a few of the points relating to manures, which have not been so generally discussed as have some of the more leading features of this most important subject. They accordingly decided upon four subdivisions of the same, embracing the topics presented in the succeeding pages, which are given from the manuscripts of those to whom they were severally assigned, together with the discussions called out by the reading of the papers. The essays do not claim to be exhaustive of the various heads, but are rather suggestive, as indicating the importance of the points brought up, and the great need of their receiving more attention from farmers, and more thought from our agricultural writers. They were presented on different days of the Convention, but for the sake of unity are given in this connection in the order in which they were presented:

I. Imports and Exports.

By D. M. Dunham, Bangor.

When our farmers were clearing the forests and raising heavy crops upon virgin soil, little or no manure was needed; consequently the natural sources of supply were either largely overlooked and suffered to go un-utilized, or the supply was gathered and shipped to older States. Not many years ago, nearly every town had a place at which to make potash, and the ashes were carefully saved and sold at from ten to twenty cents per bushel, the potash sent away, and the leached ashes, very generally, were not considered of sufficient value to the land to pay for carting them away from the potash factory. This business now is nearly abandoned, and the ashes either used upon the farm or sold to the soap maker. From Bangor there is now shipped to other States 45,000 bushels of leached ashes, at one shilling per bushel. One of our soap makers claims that the leached ashes are worth more for the land, bulk for bulk, than unleached. Whether this be so, or whether it is a product that he has to sell and wants to make appear a little better than it is, is a point I will not attempt to decide. It takes about two bushels of unleached ashes to make one of leached, and the total amount exported from this State is believed to be about one hundred thousand bushels, annually, from which is received $16,000.

As near as I can learn from those engaged in the business, about one hundred tons of bones are shipped out of the State, at about $20 per ton, making a total of $2,000. These bones are largely brought back again mixed with a little ammonia, and a good deal of very cheap material, and sold at about $40 per ton. Thus we see, that we pay a very fair profit to somebody for "rattling our bones." The bones that are shipped are very generally gathered by street children in our cities,

and as they would but for this go to waste, they may indeed be looked upon as acting a quite important part in our public economy. The annual production of bones from our tables is nearly seven thousand tons, and my belief is that by far the larger part of them go into the rubbish heap, notwithstanding the quantities gathered by poor children. If these could be mixed with ashes and kept moist for a season, they would make a very respectable quantity of fertilizer.

By far the largest export of fertilizers shipped from our State is by the Cumberland Bone Company and the Menhaden Oil and Guano Association. The former company shipped to the South last year about 2,800 tons of phosphate, at $38 per ton, or a total of $106,400. The same company shipped nearly 25,000 tons of porgy chum, at $12 per ton, making $300,000. The Menhaden Oil and Guano Association, embracing most of the factories in the United States (which are however, nearly all located upon the coast of our own State) reports about 50,000 tons exported, making at the above price $600,000. These, with the amount exported by the smaller factories upon our coast, would not vary greatly from $1,000,000, annually. It is claimed by our fishermen upon the coast, however, that this business is carried on in such a way that the lion's share, at least, goes into the coffers of parties who are not our own citizens.

To recapitulate, we have as our total exports of fertilizing materials, the following:

Ashes,	$16,000
Bones,	2,000
Phosphate,	106,400
Porgy chum,	1,000,000

Making a total valuation of manures exported from our State in a single year, of one million one hundred and twenty-four thousand four hundred dollars' worth.

It is much more difficult to ascertain facts in regard to the importations of fertilizers into Maine. In fact, after the most diligent inquiry and correspondence, I have been unable to reach anything that is at all satisfactory. The channels are

so many and varied, and the supply received from so many sources, and so much depends upon the persistency of the agents who go through the country to sell it, that I shall only attempt to make a few figures and let you take them for "over" or "under."

Estimating phosphates of the various kinds at five thousand tons, at $40 per ton, and we have $200,000, paid out for this one fertilizer. C. L. Bartlett & Co., agents for the Peruvian Government for the sale of guano, write me that they sell about one thousand tons to come to this State, at $60 per ton, making a total of $60,000. They write, also, that the sale here is increasing. The amount they claim as sold here is more than I had supposed was the case. The Pacific Guano Company say they sell nearly thirty thousand tons in the United States, about fifty tons of which comes to this State, at $50 per ton, or $2,500. The agents say they expect to sell much more here the coming season. About fifty tons of the Stockbridge fertilizers were sent into Maine last season, at $40 per ton, or a total of $2,000. Some twenty thousand tons of plaster rock is imported, at $3.00 per ton, or $60,000. This is doubled in price before it goes into the hands of consumers; the additional price, however, assumes the nature of a home industry, and should not be added to the cost of imported fertilizers. Thus we have as a summary of imports, the following:

Phosphates,	$200,000
Peruvian guano,	60,000
Pacific guano,	2,500
Stockbridge fertilizers,	2,000
Plaster,	60,000
Total,	$324,500

Or, in other words, we export $1,124,400 worth of fertilizers annually, and import $324,500 worth, making a balance in our favor of $799,900. But, taking the advice of the old farmer to his son, never to run in debt, but if he had such a desire to be in debt he could not possibly get along without it and run in debt for manure—then the above balance is against us.

Discussion.

Mr. Gilbert. The paper has brought out some points which are worthy of our serious consideration. Generally it is a matter for congratulation if our exports exceed our imports, but it is not so in this matter, for the excess represents a drain upon our resources which ought to be utilized for the benefit of our hungry soils. But assuming, what I do not doubt, that in the preparation of the paper the gentleman has kept on the safe side, the figures which he has given do not represent our entire loss, because so much of the material as is returned to us we purchase at a price very much enhanced above the price of the crude material which we sell. What is sold, is sold for $10 or $15 per ton, incorporated with material which is perhaps of less manurial value than itself, and sold at from $40 to $50 per ton. The question is ever recurring to us, if we ought not to stop the exportation of so much of this crude material? and in my opinion we might reap large advantages from such a course.

Mr. Flint. It is impossible for us to get anything like approximate statistics on this subject, for a number of reasons. The porgy chum, for example, is made from fish that come to our shores, and may be said to belong to all the world; and it is manufactured largely by parties out of the State, so that the amount received for its sale goes largely to citizens of Massachusetts and New York. To offset the ashes and bones which are carried out of the State, we have the manures made from the consumption of corn, shorts and flour brought from the West. But while we can come at our importations and exportations only to a limited degree, I think it is apparent that much money goes out of the State which should be retained here. The object of the maintenance of this Board is to make our agriculture self-sustaining, and that can only be when we have learned to utilize to their fullest extent our agricultural resources.

Mr. Leland. I will speak on only two points: the exportation of ashes and bones. In exporting ashes, we are

sending away material which it is very important that we should keep at home. Potash is one of the most essential elements of plant food, and one which has been largely withdrawn from our old soils, and our crops are much diminished for the want of it. Then in regard to the exportation of bones: you have all noticed how our animals, and especially our milch cows, seem to be suffering from the want of bone material. This is sometimes remedied by feeding bone meal. It indicates the exhaustion from the soil of another important element, phosphate of lime; and it should be remedied by using the bones we are sending away. These two elements of which I have spoken, are probably those most quickly exhausted from the soil, and the money returned is nothing like an equivalent for their value which is thus lost.

Mr. REYNOLDS. There are a good many of our pastures that have been fed for a hundred years. I have one that has been fed for seventy-five years, and I have a pair of steers three years old that have been always pastured in it. I have seen them pick up and chew bones, which they seem to crave. Why is it? Because there is a lack of bone material or phosphate in the soil. I notice the same thing with my cows, and I think the bones should be all saved and used in Maine.

Mr. AYER. The point made by the gentleman from Somerset is one which I think worthy of further attention. The importation of grains from the West is something about which much complaint has been justly made. Nevertheless, there is a redeeming feature in the enhanced value of the manure. I know that many of the best farmers of New England are feeding grain, and especially shorts, on account of the increased value of the manure heap. When we consider the constituents of shorts we see that it has a large value in that respect. I read recently in an agricultural paper, the result of an experiment in the use of shorts as a manure for corn. It was used side by side with superphosphate and barnyard manure. The result was, that the shorts were the most valuable manure. The price there would of course be much less than here; perhaps half the cost here represents the price of

transportation. This becomes a very important matter to consider, when we complain of these importations from the West. I think there is no reason why we should not import grains when we have not enough, and when we can feed them to our animals at a profit.

Mr. WILLIAM EMERY of Alfred. In our section we know but little about the exportation of manures, because we have none to export. Our ashes are mostly used here at home. We know the worth of them, and instead of exporting them our farmers buy them. A good many ashes come into this town every year from the manufacturing establishments of Massachusetts. I have at times examined these ashes that are brought here and found them of very little worth. They are made from loose material, like sawdust, and I have thought at times that coal ashes were largely mixed with them. I don't think it is profitable for our farmers here to buy a great deal of them for manure. I am inclined to think that about as many bushels of ashes are brought into the State as are sent out of it, but I think that those we buy are not worth a quarter as much as those we sell.

In regard to the fish chum, I have but little confidence in it as a manure. I think it would be best for us to manufacture it right here at home, so as to get as much money out of it as we can. I think it is best to stop the importation of manure by making and saving what we need at home. Most of our farms are pretty hilly, and it is evident that a good deal of the elements of fertility has washed down from these hillsides into the hollows. Almost every farm has more or less of such accumulation, in one form or another, and it seems to me that the greater number of farmers do not appreciate them. Then I think that farmers are neglecting the first principle of making manure. Farmers used to keep large stocks of oxen, cows and young cattle. Now, in many districts, you can't find oxen enough to break out the roads in the winter. I think with proper management there would be no necessity of bringing a single article of manure into Maine.

Vice President HARRIS inquired if Mr. Emery had ever used any porgy chum.

Mr. EMERY answered that he had not.

Mr. HARRIS. I have had some experience in using it, and have procured it for others, who have transported it for greater or less distances, and have done a good business with it on their lands. One gentleman in particular, whose farm is fifty miles back, would not do without it if it cost $50 per ton. He has tested it, and knows what he is talking about. I have used ten tons of it per year, myself, and I think I know that it is good. Properly composted it gives you a first-rate manure. It is rich in nitrogen, the most costly fertilizing element. I think any man who uses it intelligently and wisely will find its use profitable. If our farmers understood its value, Bradley would have to pay more for it than he does. It is carried out of the State simply because there is not a home demand, and there is a demand abroad.

Mr. KYES. I think there are some other exports of our farm commodities which are injuring our farms very much. One is, in shipping potatoes. It is my experience, that farmers cannot live by raising potatoes at the prices they have sold them for the last five years, and buy even porgy chum or ashes at the prices obtained for them, to raise them on. Then on many farms they sell hay; and what farm is there that will bear to have the hay sold off of it? Potatoes carry off more fertilizing material than anything else. I know we must export something, but would'nt it be better not to export so many potatoes, and save our dressing for something else? As has been said, we ought to manufacture to the highest point whatever we sell, and not sell in the crude state, as we do many of our articles, such as porgy chum, and some other things.

II. Liquid Manures.

By George Flint, North Anson.

The subject of liquid manure is not a new one. It is as old as the manure question itself; and has received attention from many thoughtful men, but by the great majority of farmers it has been sadly neglected.

Very few know the value of the urine of our domestic animals; and it would doubtless surprise the most shiftless farmer to learn that the greater part of the fertilizing elements from his farm stock has been allowed to waste, through ignorance of their value, or carelessness in handling them. The present average fertility of the farms of our State, when compared with that of former years, proves conclusively that there is somewhere a very great loss of fertilizing material. Thousands of acres on our hill-sides, and in our once fertile valleys, attest this fact. So great has become the impoverishment, that it has attracted the attention of scientists, who have come to our relief, and by close study, analyses, and patient investigation, have discovered the principles of plant life, and the requisites of plant nutrition.

Every plant has to draw for its support from both the soil and the air; but as the air always furnishes its part without our aid, it is not within our province to take it into account. The only properties for us to consider, are those derived from the soil. By examination they are found to be principally potash, nitrogen, and phosphoric acid. These the plant must have, and the soil must supply them. This is no new theory. The German chemists have given the subject much attention, and from their tables, and from the estimates of others, Prof. Stockbridge has prepared formulas for our principal crops. For instance: corn requires, to produce fifty bushels and the

necessary stalks, of potash 77 pounds, nitrogen 64 pounds, and of phosphoric acid 31 pounds; and these elements are appropriated in about this proportion.

Generally speaking, the farmers of the past have used manures only in a solid or bulky form, neglecting in a great degree the liquid portion of animal excretions, an analysis of which will show at a glance their value.

By the authority above quoted, the urine of a horse contains, in a thousand pounds, of potash 15 pounds, and of nitrogen 15.5 pounds. The urine of a cow, the same quantity, contains of potash 14.4 pounds, and of nitrogen 5.8 pounds. The solid portion of the horse contains, of potash 3.5 pounds, of nitrogen 4.4 pounds, and of phosphoric acid 3.5 pounds. The solid portion of the cow contains, of potash 0.1 pounds, of nitrogen 2.9 pounds, and of phosphoric acid 1.7 pounds. The age of the animal and the kind of feed varies the result; but the average is not materially changed. A growing animal appropriates the materials required to form the bones, muscles, skin, &c., which a mature animal must throw off in the excretions, thus leaving the excrements of a mature animal richer in certain elements than a young and growing one.

The value of these ingredients at the market price, as rated in the commercial fertilizers, shows the urine to be of the greater value. The amount of urine, or of the solid portions, varies greatly in amount. At a safe estimate, the cow voids of urine 13,000 pounds, and of solid 20,000 pounds in a year, giving in the urine one year, of potash 182 pounds, of nitrogen 75 pounds; in the solid one year, of potash 70 pounds, of nitrogen 58 pounds, and of phosphoric acid 34 pounds. These amounts, at the market price, gives as value of the

Liquid portion - - - - -	$33.31
Solid portion - - - - -	20.10
A total of - -	$53.41

as the commercial value of the entire excrement of the cow for one year, at the same price we pay for concentrated

manures, viz: potash 8 cents per pound, and nitrogen 25 cents per pound, without giving credit to phosphoric acid. The liquid portion is easily and readily decomposed in the soil, and is in proper form for plant food; while, in the solid much of the elements of fertility is in an insoluble condition, requiring time and the chemical action of other materials to disintegrate them and prepare them for use.

The leechings of manure heaps is another form of liquid manure. It is used to a great extent in China, and many of the older countries where they want the quickest results. Soap-suds, and all wastes from the kitchen sink, contain potash and many of the elements required, in smaller quantities, as lime, soda, salt, &c.

When we consider that in the main all this supply of manure has been allowed to waste for generations, is it any wonder our fields should want the elements of life; or that the owner should be called to send abroad for materials to supply the deficiency? Taking the entire waste of the shiftless farmer, it will amount to this, that three-fourths of his entire manure runs through the stable floors, or off in drains. It is soaked out of his heaps by the rains, and after it has washed and leached, dried, and leached again, it is carted off and called manure.

The methods of saving it are various; but the most practical, and consequently the best one, is to use absorbents, and move it in that form. As this properly comes under the head of composting, I will leave it to be considered under that subject, charging you to keep in mind that any method, at almost any cost, is preferable to sending out of the State for commercial fertilizers.

Discussion.

Vice President Harris. This is a question that interests the farmers as much as any that can be considered. The statement has been made, backed by good authority, that the liquids voided by domestic animals are worth more than the solids. I think I have reason to believe that this statement

is correct in my own practice. The question is now before the Convention for discussion.

Mr. AYER. I will relate the result of an experiment made by a friend of mine; to do which I shall have to tell you the way he preserves his liquid manure. Few farmers are able to build an expensive cellar; but this one of his was such a one as most any farmer can put under his barn. He raised his barn up about three feet, and fastened it securely with stone, then excavated under his cattle about three feet more, and built a drive-way, so that he could drive through. You will see that he didn't make his cellar hardly deep enough, but that was the way he did it. In the fall of 1875 he put into that excavation about ten cords of swamp muck, or swamp mud, of not very good quality; and the next June, after taking out his first year's manure, he put in about as much more of the muck, and with a view of ascertaining the relative value of the solid and liquid portions of the manure, he threw the solid manure under a shed which he had, and allowed only the liquid portion to go down on the muck. His cattle were housed at night during the summer, and the material was forked over from time to time until winter, when much could not be done with it because it froze. In the spring of 1877 he hauled it out and put it on an acre of land prepared the fall before by plowing in the usual manner. One-half of it was sown to wheat, the other planted to corn, the dressing for the wheat applied broadcast, that for corn in the hill. An adjoining acre, dressed with an equal quantity of well-rotted barnyard manure, was planted one-half to corn manured in the hill, the other half to wheat, manure applied broadcast and harrowed in. The result was, the half acre of wheat dressed with the muck and urine yielded 18 bushels, the half acre dressed with an equal amount of solid manure, 12 bushels. The half acre of corn dressed with muck and urine produced 80 baskets sound corn, that with yard manure 50 baskets. Now, gentlemen, you can try it for yourselves, and see whether this experiment proves the truth of the statements which have been made as to the value of liquid manure.

Now, when we consider that not one farmer in ten has made preparations to save the liquid manure or the washings of the manure heap, and that a majority of the farmers in Maine are buying large quantities of commercial fertilizers, it seems to me we have something to think of and something to do. Is the conclusion of the paper, that we have been losing three-fourths of the value of our manure, correct? I think it is. I believe that the authorities say that the liquid portion of the manure is three-fifths of the whole in value, and I think the loss sustained by the washing of the solid portions bring the entire loss up to three-fourths of the whole. Now, if we have done this it is no wonder we have been compelled to pay out enormous sums for fertilizers to make our lands produce. I do not doubt that Mr. Dunham was correct so far as he went, but I do not believe he got one-half of the amount paid out for commercial fertilizers in the State of Maine. I was talking with a dealer the other day; the conversation was not commenced by me, nor was it with reference to this subject, but he was pleading poverty. He said he had sold $2,300 worth of Bradley's and the N. E. Co.'s superphosphates, and had collected only $200, one-half having been due this month and one-half in June. Our farmers have not as many potatoes to spare as they had last year, and they have no promise of getting half as much per bushel. These facts ought to teach us a lesson. As was said this morning by Mr. Emery, we ought to learn to depend on our home resources; and I believe if we would save and use our liquid manure we should not need to buy these commercial fertilizers, nor to look after this porgy chum. The best farmers in our vicinity have been saving, and their farms look better for it; but few of them have been led to do it because they were aware of the great loss they were sustaining, for few farmers know what chemical analysis has proven and scientific knowledge has demonstrated in regard to this subject.

Mr. VARNEY. I have had very little experience in general farming, my use of manure having been in my business as a nurseryman and florist. Years ago, however, I became fully

persuaded that not one farmer in five hundred in the State of Maine was making a proper use of his manures. Some years ago I found that I was making more dressing, and adopted the system of using some kind of absorbent for the liquid portion of my manure, and I found that I was gaining year after year; and the statements which have been made in the paper are in complete accordance with the conclusions which I arrived at years ago. I do not know that it makes any difference what we use as an absorbent, if we succeed in saving the liquid manure and put it in such a condition that it may be taken up by plant growth. It seems to me that quick returns are needed in farming as well as in the commercial world, and I have no doubt that it would be well for us to adopt such methods for converting our manures into liquids as would enable us to make a direct application of them to the soil in liquid form. I like the remarks which have been made in regard to the importance of utilizing our own resources. I believe if proper use was made of the material within reach, every farm would be growing better instead of growing worse. The first thing needed is such an improvement in our stables and their location as will enable us to save the entire bulk of the solid excrement as well as the liquid voidings of the cattle. If it were anything else in the world but manure, farmers would be sure to save it. They are not careless about many things, but as has been said, not one farmer in ten seems to act as if he had the least knowledge that there is any value in liquid manure. If I have a plant that is sickly, I do not give it manure in a solid form, but make a liquid preparation, and in a week's time I find it lifting up its head and rejoicing. As has been said, we don't use half the manure we have, and before we import we ought to see to it that we make a judicious use of what we have. I remember that in talking with my sister, Mrs. T. S. Lang, who resided in Paris a year, that she said that when riding about the city parks, or out of town, when the horses voided their excrement in the street it was no uncommon thing to see the women run out and gather it up, to be used in grow-

ing flowers. What wonder is it that they beat us in that department? If we had some of the same spirit here our farms would not be running out as they are to-day.

Vice President HARRIS. This illustrates a leading propensity of the French people, to save; and when we find that the greater part of the elements of fertility are going to waste we ought to be willing to take a lesson from them. We want to impress upon our people the importance of saving and applying our liquid manures.

Mr. C. B. LORD of Alfred. With any intelligent man who has given the subject any thought, or had any experience, there is no question about the great value of liquid manure. As to the best methods of securing it there may be differences of opinion. My own experience has been somewhat limited, but I have had experience enough to lead me to believe that the means for saving the liquid manure, both from house and stable, are within the means of every one who cares to do it. My own plan is this: I have a conductor behind each horse and cow stall, which (the floor beneath the slat-work in each stall being a little inclined) receives the urine, and conducts it into the middle of my manure shed, which is outside of, but attached to my stable; and if any person has any severe doubts in regard to the advantages of this method, I think if he had been present when the shed was cleaned out a few days ago he would have been convinced of the strength of the manure. As has been said, we do not realize the importance of this matter, and I hope that ideas may be gained here which will lead our farmers to take the subject into immediate consideration.

Mr. JOHN F. HOBBS of Alfred. I have always considered liquid manure very essential to the farm, and have tried to save it. A few years ago I was convinced of its value a little more fully than I had been. Near my barn there was a hole which had been dug out by digging out manure for years, and in it were several hogsheads of water which had washed from the yard and under the barn. It was in the fall of the year, and the water was not so strong as it would have been in the

spring. I got a hogshead and hauled it out into the field, on a very poor piece of grass land, and emptied it, about a half hogshead full in a place. It was on a side hill, and run down. The next year, where I turned the water there was a good swarth of grass. In some places it grew so stout it lodged. I suppose it was at the rate of one and a half or two tons to the acre, and between the places it was not more than at the rate of 500 pounds to the acre. In some places it run down the side hill in little brooks, and the next year you could see exactly where the track was. I have been trying to save this liquid manure. I use about 25 cords of sawdust per year. I have my tie-up so that there is a gutter behind the cattle. I put the sawdust in this, and under the cattle. I don't think I use more than half as much sawdust as I ought to; I think it soaks up and saves a good deal of the urine, and I see no ill effects from it in the manure.

Mr. GILBERT. One fact has been established here, and if we succeed in bringing out no other, the expense of these meetings will be fully repaid in the establishment of this one. The paper has shown us that the nitrogen and potash in the excrement of a cow for one year, *computed at the price which the farmers of Maine are paying to the dealers in commercial fertilizers*, is worth over $53.00. Three-fourths of this, or $39.75, is absolutely wasted. Now, supposing the farmers of this State keep on the average the equivalent of ten cows, and you have an absolute waste of $397.50, and in this is not included the value of the phosphoric acid in that manure. Is it any wonder that you have felt compelled to go to the manufacturers of commercial fertilizers to supply the place of this waste? Carry these figures home, put them on paper where you can look at them, and let them be a spur to increase your exertions to stop this enormous waste.

Mr. LELAND. I would like to call the attention of the Convention to one point: that is, that the liquid portion of manure is immediately available as plant food, whereas the solid portion has to be subjected to chemical action before it is available. Then if means can be devised by which it can be saved

and applied directly to the soil, there is no further danger of loss, for the soil will retain all the elements of manure until the plant is ready to appropriate them. It seems to me that the method spoken of by the gentleman, of taking it directly to the fields in a hogshead is a very simple one, and it might be cheaper than it would be to haul large quantities of material to absorb it. If the liquid manure which we get from the wash tub and sink spout can be taken to the garden and applied directly to the soil, where it can be taken up by the growing plants, it is probably better saved than it could be in any other way. But to save it in liquid form requires constant care, and farmers are apt to be negligent. I think that calling attention to the magnitude of this loss must do good. One thing we must admit: that large areas are now barren, so exhausted of the elements of fertility that they barely pay the expense of cultivation. The question comes home to us, How shall we restore these elements of fertility? Can we do it as we are attempting to, by buying manures at great expense and letting our home resources go to waste? I believe that this loss of liquid manure exceeds all the other losses in our farm management. We must take means to save it. Some will do it in one way, and some in another. The question to take home to ourselves is, How can we do it best? I think there can be no doubt that the best place to save it is in the barn cellar, directly under where it is voided. Now, when we speak of barn cellars, farmers at once think of the cost. It is true that a cellar may be made that is so expensive as to be beyond the reach of many farmers of moderate means. But there are many barns which can be raised up, have stone put under the corners, cedar posts put under the body of the building, and thus a manure cellar can be made at a cheap cost, where the liquid manure can be saved by absorbents or by any other system the farmers may see fit to adopt. We must first feel the need of this saving, then we shall find means to provide for it.

Mr. Brooks of Alfred. I heard once of, I think it was a community of Shakers, who built a barn with a cemented

cellar, so arranged that they could save the urine, and also with a chance to let in water upon the solid part of the manure and convert it into liquid; and it was all put on the land with a sprinkler, and the result was amazing, greater than any one would have suspected. I have always remembered this, and have endeavored to save all the solid and all the liquid manure about my premises. I have a cellar, and use a good deal of absorbents. I save the droppings of the cattle about my buildings; save it as I would so much money. You have all noticed, that cattle when turned out will drop manure as soon as they begin to move, and unless these droppings are taken where sun and rain will not affect them they won't amount to anything, the sun will dry them up and the rain will wash them away. I think the manure that is saved will more than pay for the labor of saving it.

Mr. VARNEY. I have a neighbor who has been for several years past making use of the scouring water or waste water from the woolen factories at our place. There is a good deal of dirt and sheep manure in it. He made an arrangement to have it run into a vault in which there was a pump. He has a very simple arrangement by which he takes it on to his farm summer and winter. He has a tank, which when full is a fair load for two horses, and simply puts on the spout, pumps it full and hauls it off. There is a series of holes at the bottom of the tank, and these are covered with a sliding piece which is also perforated with holes. A movement of this piece brings the holes in it over those in the bottom and allows the water to run out. I have asked him whether he thinks it pays, and the only answer I get is "I think I sha'nt abandon it at present." He told me that he drove across a strip in the winter when the snow was a foot deep, and the next summer he could see that strip just as plainly on the grass as he could in the winter on the snow.

I have a tank about four feet deep and ten feet across, set in the ground, where the water from my sink house is deposited from day to day. When it is full my man removes it. For my foreign grapes I have used nothing for years but the

water from that tank, and I should not know how to get along without it.

Mr. STARRETT of Warren. The remarks of Mr. Varney suggest another source where there may be a considerable loss of a fertilizing element, viz. in allowing the water which has been used to wash wool to go to waste. There is quite a large woolen factory in my town, and I have never heard of this waste water from it being saved and applied. It is a well known fact, that in what is termed the yolk in wool, there is quite a large amount of potash, and also that this yolk is separated from the wool in process of washing, and is left in the water, which accounts in part for its effects as a fertilizer.

JAMES H. PENDER, of the United Society, Alfred. We have cellars under most of our barns, and always have absorbents put in to keep the urine. It is only of late that we have had barn cellars, and we find that we receive some three times the benefit that we did when the manure was thrown out. We used sawdust for an absorbent for a number of years, and came to the conclusion that it was a damage to our farms, hence we have not used it for some time.

WILLIAM EMERY, ESQ., of Alfred. It is very well known that there is a class of individuals living near villages and larger cities, who, keeping no stock are obliged to resort to fertilizers for their plants and gardens; but I believe that if they should take care of all the liquids about the house, and make a wise use of them, they would find them worth more than all the fertilizers they buy.

I have had some little experience within the last three years in saving the liquids from my house. I have a large cistern that holds from 12 to 20 hogsheads, which is connected by pipes with the set washtubs in my house, with the sinks, and with the bath tubs; and in it we save all the waste water from the house. I have a force pump in the cistern, so that I can take the water whenever I wish to, and force it to the different parts of my garden. The soil of this village is sandy and porus, and needs a good deal of water, and at times we suffer considerably from drought. For three years past I

have used that water solely for garden purposes, about my house, where I have my grape vines, pear trees, flower and vegetable garden, and have used nothing else of any account. I am satisfied that I get more benefit from that water every year than I could from the fertilizers I could purchase for twenty dollars. I hazard the assertion, that there is no flower garden, vegetable garden, pear trees, or grape vines, that surpass mine, here or anywhere. Grape vines, according to my experience, require a great deal of liquid, and this which we save is just what they want to make them grow and bear an abundance of fruit. Up to within three years, my vines never bore much of any fruit, but since I have used this liquid they have flourished and produced a large amount. I believe if every person would save these liquids, they would have enough to enrich a small garden, such a one as persons about our villages usually have.

In relation to the urine from stock, I have not had much experience, although I have always since I have kept a horse used some absorbent, either sawdust, sand or turf. There are always places about the premises, such as the corners of gardens, where turf is growing, which can be taken off and thrown behind your horses. This matter of saving the urine of horses and stock must, I think, commend itself to the good judgment of all persons. If care was used by all farmers to save it, we should not hear much about buying commercial fertilizers. How very often in looking at the yards where cattle are kept in the summer, you see a large pool of water. What do you see in that water? Isn't there enough to satisfy you that there is a good deal of richness that is passing off in it? These things should receive the attention of all farmers, and we all should be farmers; if we cannot be large farmers we should be small farmers. There is no man living in the country as we do here, but wants a house and garden, and when you find an individual that don't have them, you don't have much of a man.

Vice President HARRIS. There was an old barn on my farm when I came into possession of it, a half dozen years ago. I

keep some thirty head of cattle. I did not wish to go to the expense of raising the barn up, so I excavated some four or five feet deep under the tie-up, and having muck at hand I carted that in and filled it up to the floor, put some posts under the sill and boarded it up all along. Instead of going to the expense of making gutters, I bored holes behind where my cattle stand, so that all the liquid voidings go through on to that muck. I should like to have every farmer see the effect of that muck, to which no manure had been added except the liquid voidings of this stock. It convinced me of the great value of liquid manures.

Mr. LELAND. That muck is all that saved our president from being classed with a very careless class of farmers, who bore holes behind their cattle. We frequently see manure thrown out in heaps and left without any protection whatever; and all the elements combine to wash and waste it. I verily believe one-half of it is wasted and gone; the farmer's own land may get part of it, or a neighbor's land, or some brook may get it. My own practice is to tie up my cows every night, and use my manure as fast as I can make it. I don't know whether others may approve of it or not.

Hon. JAMES O. ADAMS, Secretary of the Board of Agriculture of New Hampshire, in response to the call of the President, said: I have been greatly interested in this discussion, and the more so because it is a vital one to men who get their living from the soil. I am glad to see that the attention of the farmers of this State is called to it, and from the spirit shown I am sure some of them have been practising in the good way; and I am sure, too, that some of them will no longer be classed with the negligent farmers, but will take advantage of the lessons learned.

Quite a number of things have been spoken of that should not be allowed to be forgotten, and attention has been called to some of them several times. One very important matter thus alluded to is the value of the droppings of the domestic animals. It has been thought that the cows of your State and mine are a poor set of animals, that don't quite pay their

board; but I think if we reckon in this extra yield of manure, which it is no fault of theirs that we do not take care of, we must give them a little more credit than we have been in the habit of doing. The cows of my State do not yield more than $40 worth of milk annually, and that don't pay their board. I doubt if yours do any better. But if we add to that the $50 worth of manure we might as well save, we find it makes quite a difference in the account.

I will only make allusion to some of the practices of more economical nations in regard to the saving of fertilizers, and especially liquid fertilizers. It is the habit of the French people to save all the urine from their boarding houses and hotels. It is said that in China one of the perquisites of the chamber-maid is that she shall have what she empties from the chamber vessels. It is said that the servants receive quite a little revenue from chamber, privy and sink.

It has already been said that seedsmen and florists keep their plants thrifty by feeding them with liquid manure in some shape. The question arises, whether we ought not to make an effort to save our liquids in a liquid state, and not have anything to do with absorbents at all. Probably this is the most economical way. There is a good deal of time and labor required to gather these absorbents and handle them over from time to time, and unless your farmers like to shovel manure better than I do, I think they would be glad to save some of that work. In my own city of Manchester, there are a good many gardeners who have made arrangements to get the liquid manure from the stables. Many of these stables are cemented. These gardeners make a point to get that manure as much for the sake of the liquids as anything else, and draw it out in tight carts and save it in the soil. There are many of them who take night soil and reduce it as near as possible to a liquid state, and draw it on their land. The result is, that they get bountiful harvests every time.

Another point which has been alluded to, is the saving of the washings of wool. Mr. Smith, the Superintendent of the

Manchester Print Works, who was also a good farmer, was in the habit of saving this to put on his crops, and established a reputation for it, so that another firm in Manchester commenced to use it, and it always succeeded in bringing crops. Its effects are not evanescent; when once applied to land it will bear well for years and years.

Here is a point in regard to the application of liquid manures. We apply them almost always to the top of the ground. Now, I believe in a top application. I don't mean that I believe altogether in top-dressing, but I believe that we can apply very near to the surface better than away down. We used to think we must put our manure down deep. I think if it is to be put down deep, or on top, it is better to put it on top; but perhaps it is best a little way down. Now, we apply liquid manure on the top and let it go down according to its nature. Some of it won't go down; you know some chemicals will not percolate through the soil. I do not think a very large portion of what farmers call strength passes off in the atmosphere. Generally, that which we smell is not worth much as a fertilizer; I think chemists will tell you that it is sulphuret of hydrogen to a large extent, and that it is not of much value; that a gas is formed which retains the ammonia which it was formerly thought passed off.

Alderman Mechi, of London, who has a farm a little way out of the city, has adopted the liquid system altogether. He not only saves his liquid manure, but reduces his solid manure to liquid by pressure, using a steam engine which also forces it upon the land. He prefers to apply all his manure in a liquid state, and does it with great success. His operations have attracted a good deal of attention. My friend, Colonel Walker, whom I expected to come here with me, spent some time with Alderman Mechi, and if he had come could have told you something about his system that would do some good.

A matter to which attention has not been called, is the use of the sewage of the large towns. You know what immense amounts of fertilizing material has gone to waste in the streams upon which the towns are located. In some foreign

countries, the sewage of the cities has so defiled the streams that it has become a nuisance which people have been obliged to devise means to get rid of, and premiums have been offered for the best method of getting rid of it; and some splendid machines have been devised, until they came to work, when they did'nt do anything. Recently, they have adopted in the city of Edinburgh, the principle of collecting the sewage in a large receiver, and drawing it on the soil. Several firms have secured the control of this, and the statement has been made that one of them cut, what would when dry be twenty tons of hay to the acre. The statement seems incredible, and I confess I have not much faith in it.

One other thing, which perhaps you would hardly class under the head of liquid manure, is that of irrigation. If any of you had a little stream by which you could water the land when you saw fit, you would see a result, not only in consequence of the moisture, but in consequence of the nutriment furnished to the plants in the water. There is a farm in my own State which the owner some thirty years ago undertook to irrigate. He expended quite a sum of money in bringing water from a pond to a side hill in an exhausted field, and now, after it has borne hay for thirty years with no manure, it produces more than a ton to the acre, of excellent grass, so that the investment was a good one. There are a good many little streams trickling down from our mountains and hills that might be turned on the plains, and would serve a noble purpose in time of drought, and would bring with them a great amount of fertilizing material that now runs to waste. It is pretty evident that the Maker of the Universe made these streams for some purpose more than to gratify the eye and turn here and there a mill.

I may remark, that perhaps the reason why the manure of fowls is regarded as better than that of other animals, is because it contains the urine in a solid form.

Mr. BROOKS. I thought I had been pretty careful of my manure, but I can see and feel that there has been a larger waste about my house than I thought of. I think I have

received instruction, and feel fully determined to attend to this matter more closely than I have done.

Mr. BRACKETT. I have always been somewhat radical in regard to this matter of purchasing fertilizers. I have always been opposed to making these men who deal in fertilizers rich, as we have been doing. I believe it is unnecessary to go off our farms to obtain manures necessary to carry them on. Until you have used all your available means, until you have saved all the liquid waste that has been referred to, and all the other waste about the premises, (as for instance, in how many places the droppings of the hen roost lay over year after year)—I say until you have used all your available means, you cannot afford to buy special manures; and after you have raked and scraped all you can, even then you had better make your own fertilizers.

III. The Compost Heap.

BY Z. A. GILBERT, EAST TURNER.

The value of liquid manures was shown yesterday, in a very good light, and one which must have opened the eyes of such as had not previously given special attention to the matter. Since we understand its great value, the necessity of saving it presents itself forcibly to our minds. I say necessity, and I think all good farmers admit that it is a necessity. Only a few days ago I was talking with a practical farmer, one who is dependent entirely upon his farm for an income, and he made the remark, that it is absolutely necessary to save the liquid manure from stock and buildings in order to keep up the fertility of the farm. To use his own expression: "It will go back on you if you don't." He said the solid manure produced on a farm was not sufficient to

keep it up to its present degree of productiveness. If this be so, then comes in the question, What method shall we adopt to save this liquid manure?

There are two methods which present themselves to the practical farmer. The first is, that of saving it in a liquid form and applying it in that state. This is the most natural method, and so far as it can be carried out it is perhaps a desirable one; but I think that the attempt to carry it out has not been completely successful. Some individuals have gone to considerable expense to provide fixtures for that purpose, and have met with only partial success. The main difficulties in the way of the adoption of this method are, first, the cost of the necessary fixtures; and second, the fact that there are serious difficulties in the way of applying it at all seasons of the year, as for instance, when the ground is occupied by the growing crops. It cannot, either, be conveniently preserved for any length of time in large quantities in its liquid form. It would be very desirable indeed if a method could be devised whereby all these difficulties could be obviated. I should be very glad if some of you can show me how I can do it on my own premises. I have thought of this matter much, for I realize that it is necessary and proper for us to economize in the expenditure of labor in this direction all that we can.

We come now to the other method; that of saving it by absorbents—the method generally adopted by farmers who try to save it at all, and the one which promises the best practical results. It is true, that in using absorbents we have a good deal of bulk to handle, and if we increase the bulk we have, we increase proportionally the labor of handling. But it is better to handle this bulk than to lose the liquid, far better. If we could avoid the handling of a large bulk, to save the small amount of fertilizing material contained in it, we should be happy to do so; but, unfortunately, we have this material in bulky forms. All understand that the plant food contained in liquid manure is but a small portion of the whole amount; and the same is true of solid manure. If we

could devise some method of separating this small amount from the whole bulk, and of using it after it was separated, without risk of wasting, it would be desirable, but we are not able to do so. The ground, then, that I take at this time is, that the only method of saving manure which is practicable to the ordinary farmer, is by the use absorbents, or in other words, by composting.

Following this comes the question, Shall we decompose the solid manure before it is applied to the land? This is a matter on which there has been a great deal of discussion, and in regard to which people still differ in their views. We all know that in the decomposition of the solid manure there will be a great waste of plant food, unless some absorbent is combined with it to hold that which would otherwise escape. This process of combining absorbing material with the solid manure of course increases the bulk of the mass, and the expense of handling, as is the case with the liquids. Here, then, comes in a question of economy: Does the manure become enough more valuable to pay for this operation of composting? I am aware that it is the opinion of farmers, that no plant food is added to manure by this operation. We frequently hear it said: If you apply manure in a green state and cover it slightly with the soil, you have got all there is in that manure. This being conceded, since of course the time and labor involved in the operation of composting are saved by the adoption of this method, we should have to admit that it is the best practice; and I am certain that in my vicinity most farmers hold to that opinion.

I have to dissent emphatically from that opinion. I have been forced to the conclusion that the value of manure is greatly increased by the operation of decomposition, where it is conducted intelligently and wisely. I say I have been forced to that conclusion. When I was a boy, my father composted for the purpose of decomposition a considerable portion of his manure, by mixing it with absorbent material. Very naturally, I questioned the economy of the practice, for like most boys I did'nt wish to increase the amount of labor

about the farm. But I found as I grew older, that the most satisfactory results always attended the application of this decomposed manure. The practice extended somewhat to other farmers, for you know these things are apt to be contagious. Though farmers are charged with being careless, many of them are pretty close observers, and especially are they observant of results. It was invariably the case, that the best results followed. I recollect one little circumstance connected with my own practice in this respect. I built a barn cellar some years ago, and composted my manure in it. A neighbor of mine, it seems, watched the operation, and thought I was a very foolish fellow to go to all that labor. He built a barn cellar, and did'nt compost, but applied his manure to the land in a raw condition. I watched the operation closely, to see whether his method or mine was the best. I did not see that very valuable results followed the application of the raw manure. At last he came to me one day and said: "Before I built a barn cellar I thought you were foolish to expend so much labor, and I would show you that I had a better way. I was'nt going to haul my farm into my cellar to manure it, and then haul it back again; I was going to apply the manure to the soil and compost it there. I tried it and made a good liberal application." According to the prevailing notion, he had got all that manure in the soil, but he did'nt get the crops; it remained in the soil. He studied on that. The next year he thought he would fix me—thought he had'nt mixed it sufficiently with the soil; so he took a strip of ground and applied a very liberal quantity of manure, thoroughly mixing it with the soil. He put an immense amount of labor on it, for the purpose of convincing me that my method was wrong, and he failed. He said, "I give it up, I can't do it on crude manure; your compost will beat me every time." That was convincing testimony, and I felt encouraged to go on in composting; and I am still in favor of it, notwithstanding the work it involves.

Now, I like to know the reason for things. If we put crude manure in the soil, with all its ingredients, why don't we get

the full benefit of it? Some will say, "decomposed manure acts readily"—that in my case I could see the effects immediately, and was therefore "deceived." I was not deceived. I was convinced that I got not only present results, but results that followed a rotation through several years. I looked out for that point, and fully believe I was not deceived in that direction.

The question recurs, then, why do we not get the full benefit of that raw manure; and an answer to it encroaches somewhat on the domain of science. I am aware that a practical man like myself must tread lightly here. However, in handling manures I have to deal with the constituents of manures. You all know that nitrogen is an important element of plant food. But nitrogen cannot be used by plants at all until it is changed to ammonia or nitric acid. Fresh manure contains a considerable quantity of nitrogen, but very little ammonia. If, then, manure in this condition be applied to the soil, a small portion of the nitrogen only will be decomposed and assume the form of ammonia; the remainder will unite with the elements in the soil, in insoluble forms, where it may remain in the soil for years, perhaps forever, of no use to the farmer. For example, fresh horse manure contains not more than one pound of ammonia in fifteen tons of manure, yet in those fifteen tons there is nitrogen enough to furnish one hundred and forty pounds of ammonia. If, then, this manure be applied to the soil in a fresh state, there is a serious loss of its leading element of plant food. Nearly every soil contains large quantities of nitrogen in insoluble forms far in excess of the ammonia needed for crops. But so long as it remains inert, it is no better to the farmer than so much granite. To render this plant food soluble, and therefore available, the manure must be decomposed before application. And to prevent all waste while decomposition is going on, it must be composted. This is my position; I know I lay myself open to criticism, but I am after information. If I am wrong I want to know it. But there is one thing about it, it tallies with my experience, and with the experience of my neighbors.

If the system of saving the liquid manures by absorption is resorted to, it is easy to combine with it the operation of composting the solid. In fact, it is not practicable to save all the liquids from farm stock without handling in some way a portion of the solids; the two are so mixed that I know no practicable way of saving them entirely separated. The absorbing material does a triple work; as an absorbent of the liquid, a divisor of the solid, and thus allowing the admission of the air to perform the work of decomposition, and as a saving medium for the escaping gases.

The next question is, What material shall we use as an absorbent? I believe I am safe in saying, that the best material at hand in considerable quantities is muck. I am quite enthusiastic on the subject of muck. I have used large quantities of it, and always with satisfactory results. It is used extensively in my vicinity, and is carted considerable distances by those who believe in its use. When well dried, it will absorb a very large quantity of liquid, and it does not become heavy to handle. It is almost entirely vegetable substance. When taken from the bed a large amount of water is suspended in it, so that it is necessary to have it dried before it is used as an absorbent.

Another absorbent, always on hand, and enough of it, is soil. When dry it will absorb liquid very well. It is not so valuable an absorbent as muck, on account of its being heavy, neither does it absorb so much in a given bulk; nor does it contain in itself so valuable properties. This last, it is not necessary perhaps to speak of here, because I am speaking of it not as a manure but as an absorbent.

Sawdust is used much in various localities, but I question whether it is well to use it, when everybody has plenty of soil within reach. Sawdust makes a good bedding, is clean for stock to lie upon, and is easy to handle, but as a component part of the compost heap it is not desirable, to say the least; no one claims that there is any great value in it. I do not say it is injurious to the manure, I only say it is not desirable.

I have never gained much satisfaction in the attempt to use leaves as an absorbent. If you are short of straw for bedding, leaves can be used for that purpose. I heard an agricultural address the other day, in which the speaker expanded somewhat upon the value of leaves, and said that a man could go into the woods and scrape up fifty loads in a day. I never was able to do so much as that when I had the best chance; and when we consider that one load of muck contains as much absorbing material as fifty loads of leaves, (for you have a very small quantity of material when your leaves are decomposed and compacted as thoroughly as muck is), I think we cannot depend upon using them as our principal supply of absorbent material. They are useful in their place, but we should not give them more importance than their value will warrant.

Straw is a good absorbent so far as it goes, and a good manure after having been decomposed. It makes a good litter for stock, and should all be appropriated. So we might go on through the whole list of absorbents, but it is not necessary, you all know what they are, and they need not be enumerated.

Before I speak of my own practice, let me say that I do not like to recommend my own methods very highly. I have not so much confidence in them that I am certain they are the best. For this reason I am reluctant to speak of my course in this regard, and if anybody has a better one I want to known it. But whether my method be faulty or not, if there is anything about my farm that I feel I have a right to be proud of, it is the care which I exercise in saving the liquid manures in and around my buildings. I think I am safe in saying, that since the cold of last winter ceased, there has been no waste of liquid manure about my house or barn. It is very difficult to carry out any system which you may adopt in winter as well as you can in summer, as any one will say who has tried it.

My practice is different from that of most farmers, who make a business of composting manure, in one regard; most

of them yard their hogs on the manure heap. They put in the absorbent material, or what is far more common, omit it altogether, and let the hogs run over it, and the consequence is it is trodden down so that no decomposition takes place. In order to decompose a heap of manure, it is necessary to leave it in such a condition that the air will permeate through the whole mass. The Professors can give you the scientific reasons for this; I won't try to.

If you throw out horse manure into your yard or under your shed, and let the cattle run over it and tread it down solid, it will remain in precisely that condition for all time for aught I know. Consequently, I allow nothing heavier than a hen to run over it. I know almost everybody says—put hogs on horse manure. I cannot agree with them, and I have tried both ways. Horse manure is the very richest barn manure we have, with the possible exception of sheep manure. I regard it as much richer than cattle voidings, and I obtain better results from its use. I drop several cart loads of muck into my cellar—my cellar does not freeze—and every two or three days I throw over my manure and mix muck with it, and let it lay till spring. In the spring I put men in and fork it over again. No manure I use gives me so much satisfaction under every condition, and wherever I apply it, as that horse manure.

I keep my hogs in the barn cellar, but not on the manure of the cattle. Give hogs plenty of absorbents which are not already a manure, and they will make manure of them. Don't give them something that is already manure, and especially do not give them anything that is already so valuable as your horse manure.

My cattle are stabled nights during the whole year. I use muck as an absorbent, and as I said, make it do the work of absorbing the liquids and decomposing the solids at one operation. The muck is also a powerful deodorizer, and keeps my premises sweet and clean, just as they ought to be kept. There is nothing of that strong odor that you will detect in a barn where nothing is used. Soil is good in that

regard, but not as good as muck. This, or similar practice, goes through the whole round of the premises. The slops of the house are absorbed by material provided for that purpose. I have never thought it desirable to run the slops under the barn for the pigs to wallow in. I don't want my pigs to wallow in filth. I don't know a neater animal about the barn than the pig, nor one that enjoys a clean bed better. Consequently, I provide absorbing material to take up these slops, where it is exposed to the sun and air, and the water is evaporated from the surface or leached through the mass, leaving the plant food retained in the absorbents. It is not necessary to excavate; it can as well be done on the surface.

Prof. FERNALD. While it may be well to have it exposed to sun and air, to evaporate the water, would'nt it be well to have an arrangement to cover it when it rained, so that it should not take on more water?

Mr. GILBERT. The suggestion is a good one, and I think such an arrangement could be easily made. Now, you see I have no costly fixtures. Any farmer can practice these methods, only he must keep his eyes open, and ever be on the alert. It is so easy to neglect, so easy to let these little things go by, when those that seem to be larger demand our attention. But we must remember that the sum of the little things make up the larger ones, and when we give to these little things the attention that their importance demands, our farms will increase in fertility. Every farm in the State of Maine has within its limits material enough if properly appropriated, to increase its fertility. There is not the slightest question about it. All that is required is to save what would otherwise go to waste.

In closing, let me say again, that it would be very desirable to apply plant food in a concentrated form if we could do it. It would be very convenient if we could carry manure enough in the vest pocket to plant an acre of corn. But concentrated commercial fertilizers are very costly. These which I have talked about saving are right at hand, and cost nothing but the saving. You can save far more plant food for the same

money, than you can buy. It is a matter of the greatest importance, and I wish it could be impressed on the minds of farmers, that attention must be given to these little items of the waste that is daily going on about our premises.

Discussion.

Mr. Leland. It is the farmer's work to produce crops. He produces them from the elements of plant growth that are stored in or that are supplied to the soil. The matter of first importance to the farmer then, is the supply of plant food; and especially so when he is called upon to raise his crops from a soil which has been drained of it. We as farmers want to address ourselves to the saving of this waste of plant food, that we may use it in restoring the lost fertility of the soil. Not only do we want to save what we have, but we want it in the best form. By combining different fertilizing substances we may get the most complete and potent manure, and thus may find it a matter of economy to combine them, rather than to use them separately. I think, too, that Mr. Gilbert has shown us that there are practical difficulties in the way of the use of liquid manure separately, on the farm. Again, manures differ in their chemical condition; some act too rapidly, others too slowly, and by judicious combination these faults may be corrected.

Muck has been spoken of, and where it is easily obtained is generally used in the compost heap. Leaf mould is used by some, and is considered most valuable. Bones should be collected, and ashes saved, and used. Waste from every source should be absorbed and used. Some will contribute to the heap one element of fertility, and some another. For example, if you put in bones they will contribute phosphoric acid; if ashes, potash; and the urine will contribute nitrogen, and your compost will be a very complete manure.

A few words about muck. It is considered to be a very valuable substance. One deposit may be valuable in itself as a fertilizer, another is simply valuable as an absorbent. But

all muck is valuable for its absorbent properties. There is another point in regard to muck which is generally overlooked, and that is its value as an amendment to certain soils, and especially to those soils which are denominated leechy, in enabling them to retain moisture. For such soil it is exceedingly valuable. Another valuable property of muck is this: that it will absorb ammonia from the atmosphere, or will hold it when it is washed from the atmosphere by rain. We have heard that it will absorb ammonia when it is formed by the decomposition of manure. It seems to absorb it as readily as it does moisture. Let me say here, that while I am a great reader of scientific matters, I do not profess to know very much about them—and sometimes I think the scientific men don't know the whole themselves. Farmers are apt to be frightened when they hear that a scientific man is going to lecture. They are like the boy who, frightened by the solemn manner in which the minister asked him, "Who was it that made the world in six days and rested on the seventh?" answered, "I did, but I won't do it again." We ought to learn all we can from science, and if its conclusions are confirmed by practice and convince us that we have been doing wrong, we ought to resolve like the boy that we "won't do it again."

In regard to the results that may be obtained by composting, I give the experience of a dairy farmer. He prefers a retentive subsoil as an absorbent to muck, and provides it for this purpose. His stock are kept in the barn at all times when they are not in the pasture. They are in nights during the summer, and the voidings are thrown into the cellar and mixed with the subsoil. Early in the fall he hauls out the manure and applies it to his mowing fields, and has been able in a few years to bring up the yield of hay from one to two and a half tons to the acre. As I said, he prefers subsoil to muck; farmers can experiment and see which is best. Another farmer of my acquaintance, who always keeps a quantity of this absorbent material on hand, and whose fields are in marked contrast with those of his neighbors, puts it

behind his cattle, whence it is passed with the manure to the hog pen, and the hogs are enticed to work it over thoroughly by throwing corn among it. After as much is put in as they will work over, it is removed and other material put in. He has made a quantity of manure this season, which, liberally applied in the field, has enabled him to raise over 300 bushels of Early Rose potatoes to the acre, while the average yield in that section was less than 100 bushels, showing what he saves as compared with the farmers who bore holes in the barn floor behind their cattle.

There is a great loss from the poultry yard. Fowls kept on the farm are allowed to roost in the fields, by the road side—and the shed where the farming tools are kept is a very general roosting place for them. I have a neighbor who had nearly given up raising corn; he thought he could get his corn easier by raising and selling potatoes. He attended the meeting at Newport, and was convinced of his error. He saves his manure much as Mr. Gilbert does. He spread this on the surface, worked it well in, and applied a pound of composted hen manure to the hill. I have here a statement which was printed in the local paper, and which brought out a good many others, but nobody had a piece that equalled this for rapidity of growth. The statement closes by saying: "I would rather have a barrel of hen manure than a barrel of the best commercial fertilizer that was ever brought into the county."

Mr. Reynolds. I have composted considerable manure for the last three years. I tie my cows up at night, and have a trench back of the cattle, which I fill with loam. In the morning I clean it out and it all goes down together. I have generally made from forty to fifty loads; this summer I have made much more. The use of absorbents does not fine it up thoroughly, and this year I let the hogs do it. I have eight shoats; the pen is 14 feet wide and 38 feet long. I have it filled up to the depth of four feet, making 2,128 solid feet of manure. I have a stable where I usually keep two horses; the urine runs down into the cellar, where I keep an old hog

in one part and two early shoats in the other; and there I have made about thirty loads, or about one hundred loads in all during the summer. I have kept ten cows, and a part of the time a pair of steers, which I tied up until the very warm weather.

Considerable composting is done in my neighborhood. A short distance from me is a farm of about 1,200 acres, owned by Mr. Warren Ward of New York, which he has named the "Herdsdale Farm." He has a barn 170 feet long, with a cellar under the most of it. He keeps twenty-seven cows, and under the tie-up he has a pen 10 feet wide and 75 feet long, where he keeps seven hogs. He has about 3,000 solid feet of manure in that pen. He has also a stable 30 by 40, where he keeps a lot of horses, generally from four to six, all summer, with hogs underneath. He has carted in a large lot of muck and stuff from the road side, and has about as much manure there as under his barn. He has also a building that is used for a hog-pen, that runs 80 feet from the stable, with basement underneath all parted off for hogs. He keeps about fifty hogs, and intends another year to keep one hundred. Another year he is going to build a barn with a cellar under the whole of it, so as to keep more hogs, and when he has that done I think he will be able to "go the whole hog."

Mr. NEALLEY of South Berwick. Muck beds are not so accessible with us as they are in some other portions of the State. We use clay quite largely in the compost heap, and with very good success. I know it would not seem at first sight that clay is an absorbent, but it will absorb very much when dry. My own farm is not large, but it is very productive. I use clay with the soil that is on top of it, in composting. I have used muck, but I find it is a long time in getting dry, and does not absorb the liquid as well as clay. I know clay is a hard substance, and it is not easy to handle it over, but hogs will do it. I use my material in precisely the same way as was stated by Mr. Reynolds. I keep three cows, two horses, and sometimes as many as a half dozen hogs. I always

put my stock in the barn at night. I keep a good many hens and save all the manure.

Elder Otis Sawyer of the Alfred Shakers. I wish to say a few words corroborating what has been said in regard to the value of muck. In the winter of 1852, when in charge of the Shaker farm in New Gloucester, I hauled out 100 loads of muck from what I considered a valuable bed, which I had discovered the season before, and put it near our buildings. The brethren had experimented with muck some years before with unfavorable results, and objected very strongly to my hauling this out; one aged brother who had helped haul the other lot, being very certain that there was no value in it. The next spring, in planting our corn we failed to have enough manure to put in the hill, and for experiment I hauled into the field three or four loads of that muck, which had then lain three or four months and received the action of the frost. I put a shovelful in a hill, and then went over the piece with ashes, and put a handful of ashes in each hill on the muck, covered it with a little dirt, and planted the corn. The old gentleman still had no faith in it, but he helped cover it, and marked it to see where it was. In August I invited him to go out and see it. "Why," said he, "it is charming good corn; I don't see but 'tis just as good as that which was planted on the best manure." It was extraordinarily good muck—vegetable material decomposed. The muck that was left we shovelled over, mixing with it four or five casks of lime, slaked with water; and I think I put some refuse from the barn or cellar with it, and shovelled it over, mixing it well through, and put it on the garden; and wherever we put it we considered it as good as an equal quantity of manure from the barn. So I have great faith in the use of muck, and we use it in composting, every year. We put it under the stables and privies, and find great advantages from the use of it. We keep our hogs under the stable where we keep our horses, and on the manure. We have muck there and sawdust, and think the latter a good absorbent when we cannot get muck. The hogs work the horse manure and muck

together, and when we haul it out we find it very strong in ammonia, and consider it the best manure we have on the farm.

Vice President HARRIS. The remark that this muck was of excellent quality, suggests to me a warning against calling every deposit of black swamp mud, muck.

Prof. CARMICHAEL, in answer to an inquiry in regard to the composition of muck, said:

I must return the thrust of my friend here, Mr. Leland, by calling attention to an infirmity which has a great deal to do with these questions. I recollect of a learned professor who asked a student, who he was desirous should pass an examination, the color of the mineral beryl. "Red," answered the student. "Red—yes, brownish red, greenish red, yes, green—correct answer." This illustrates a characteristic of the race. If we want a thing to take place, we can prove that it will take place; if we want a thing to be so, any assertion that it is not so will not change our opinion.

Muck is decayed vegetable fibre, and as has been said, it is marvelously retentive. It may take up potash or some other substance, and the manurial properties it furnishes must be largely in the substances thus taken up; though to certain soils it may be beneficial in improving the texture.

I wish to call the attention of the Board to some remarkable experiments made by Prof. Voelcker, which have demonstrated that earth will burn up the ammonia in human fœces just as charcoal would; and that earth which has been used in earth closets is almost worthless for agricultural purposes. Ammonia is the most valuable constituent of manure, worth twenty-one cents per pound, while phosphoric acid is worth but six cents. I think the suggestion of using clay rather than earth, is a valuable one.

Mr. FARRINGTON. I wish to put a question to Mr. Gilbert. He says that if horse manure be applied in a green state, the nitrogen which is in it does not change into ammonia, and that 139 parts in 140 of this element will be lost; whereas, if it be composted the nitrogen becomes soluble, and is appro-

priated by the plants. Now, my question is this:—What difference does it make whether the manure containing this element in an insoluble state, be composted with a cart load of muck, earth, or sawdust, in the barn cellar, or in the vicinity of the barn, or be hauled into the field and mixed with the earth—composted with a larger amount of earth?

Mr. GILBERT. I don't pretend that I can answer all questions that may be asked, but fortunately for me, I believe my answer has been anticipated by Prof. Carmichael. He has just told us, and it hits my case precisely, that when human voidings are combined with soil, the nitrogen is lost to use, or, as he expresses it, burned up by the soil. Now, the ground I took was precisely that—that in mixing the green manure with the soil, the nitrogen which should have been changed into ammonia combines with other elements, becomes insoluble, and is lost to the farmer.

President ALLEN. I only wish to say, what I think Prof. Carmichael would say, had he not been called away, that there is a distinction to be made between the humus, or soil, and dried muck, or the subsoil clay which he thought would make a good absorbent. All these elements seem to be adapted by Providence to the office of getting rid of the noxious constituents of offensive matter, and the muck or clay not only performs the office of a deodorizer, but the special office of an absorbent in retaining the ammonia.

Mr. FARRINGTON. My question has not been answered. Mr. Gilbert recommended both muck and soil as absorbents, giving the preference to muck, as being more easily obtainable, a better absorbent, and possessing greater manurial value in itself. My question related to the comparative effect of the same substance, soil, used in different proportions in the field and in the compost heap.

Gen. BROWN. I think that Prof. Carmichael's mention of the Voelcker experiments, in relation to the value of earth which had been used in earth closets, grew out of a conversation which I had with him in regard to the subject. As you are aware, there are difficulties in the way of the use of

water closets in the country, where sanitary arrangements are not easily effected; and it is pretty well known that quite an excitement has been made about the deodorizing properties of earth. It was regarded as a great discovery, that in a very short time the excrement would become entirely inoffensive, so that it could be readily handled; and as there was no chance for the constituents to escape, it was believed that its manurial properties were entirely retained by the earth. Living in the country myself, I have used one of these closets, making use of finely sifted coal ashes as a deodorizer. I am satisfied from my experience with the use of this material from the closet on the land, that a chemical process goes on which destroys the nitrogen; and the result of these experiments, as stated here by the Professor, shows that the same is true where earth is used. Therefore, I think it is a mistake to use earth in composting. Clay would undoubtedly be much more satisfactory. I believe the best place for the earth is in the field. If we want to get manure and earth together we will find it best to haul the manure into the field and mix them there.

Vice President HARRIS. I would like to know where Mr. Gilbert gets his authority for calling horse manure better than that made from neat stock. My own impression about it is, that the value of manure depends very much upon what it is made of. I don't care very much what is the machine that makes it, provided you have used the right material.

I wish to say one word in regard to the application of manure. We are trying to get at the most feasible way of saving manure, so as to give the land the benefit of it. Of course we want to curtail expenses as much as possible, and the labor account of the farmer is a very serious matter of expense. I take it for granted, that few farmers get along without hired labor. My own practice, and I believe I shall follow it till I am convinced that there is a better, is to haul my manure whenever I have it, and have a place to put it. I don't care what month in the year it is, nor what day in the

month, if it isn't Sunday. If I have land plowed that I want to put manure on, my manure is going there as fast as I can make it.

Prof. FERNALD. If manure is drawn directly to the field, I think it should be hauled there somewhat earlier than it would need to be if taken from the compost heap, so that there may be some time for decomposition to take place.

In regard to the earth closet, I think the best material that can be used there is clay in a fine state. In most places it can be obtained finely pulverized in the scrapings of the road, and it will retain the fertilizing properties of the excrement. I have used it for several years, and used the material as a fertilizer in my garden, and found it very effective. This year, for the purposes of experiment I made an exchange, and used it on grass land, and applied barn manure to my garden; but for several years this is the only manure I have used on it. The clay should be very finely divided.

Mr. GILBERT. In answer to the question of the President, I would say that the analysis given by Mr. Flint in his paper, makes horse manure richer than cattle manure. Another authority which has weight with me, is the testimony of my fields.

Vice President HARRIS. Mr. Ayer says it is safe to buy shorts to feed to stock, and figures out the value of the manure in consequence. What is the sense of doing that if you have a fixed value for each kind of manure?

Mr. GILBERT. Of course manures vary with the feed, but the results given is the average of a number of analyses.

Mr. HARRIS. Can you raise better corn on your horse manure than on hog manure?

Mr. GILBERT. I do every time. We should not lose sight, as some remarks which have been made might have a tendency to lead us to do, that it is value and not bulk which we are after in composting. We want to get the most plant food in the smallest possible bulk. So, when a man says he has so many loads of compost, it does not prove that he has more value than another man who has a less number of loads. It

should ever be our study in making compost to concentrate it. You will find that you can sometimes make this material do a good deal of duty, and its value will be increased in proportion.

IV. Muscle Beds.

By Samuel Wasson, East Surry.

Those marine deposits, known as "muscle beds," occur at numerous intervals in the coves and inlets along the sinuous coast line of Maine. Wherever the waters of fresh streams are discharged into these coves, bays or inlets, and at the point of equal resistance between salt water and fresh water currents, are the locales favoring their formation. Here the sediment, mud, slime and ooze, brought into the salt water by the influx of fresh streams, are met by marine mud and mosses, seaweed and sea-grasses, jelly-like radiata, by non-decillions, and blue-shelled muscles, clams, cockles, and snails innumerable for multitude, accumulate in the inflowing tide, making a final deposition, which becomes the residences of generations of muscles.

These deposits are charged with organic forms, and impregnated with various chemical salts, such as carbonate of lime, sulphate of soda, sulphate of magnesia, chloride of sodium, (common salt), which enter the structure, and are essential to the life of innumerable animal and vegetable forms, dwelling in the sea, and dwellers in muscle beds. These repositories furnish suitable habitats for all the molluscous animals, especially for the bivalvular shell-fish (of the genus *mytilus*), known as "muscle." Here they congregate and multiply in great abundance, finding homes, food, and graves.

The muscle, unlike any other species of shell-fish, is provided with a byssus; a long, delicate and silky fasciculus of

filaments or hairs, by means of which it fastens itself to some substance, or to its neighbor, giving a colony of them the appearance of a web of shell fish. These deposits, or muscle bed plateaus, usually are in some sea basin, so that only after the accumulations of bygone ages, are they elevated above the surrounding surface. The best muscle mud lays at extreme low water mark, and cannot be got only at the high run of tides, at the new and full moon. Muscle beds vary in size, from half an acre to ten acres, and in depth, from one to ten feet. There are two ways of getting it—by gondolas or scows in the summer, and on the ice in winter. Common sized gondolas will carry from four to six cords. Three men will load and unload them at a tide. The mud should be delivered at landings or wharves, at a dollar and a half per cord, and drawn to the field at the rate of two dollars per cord, per mile. A much cheaper way of procuring it, is to haul it in the winter. Unless the ice is very thick, a man will cut the holes and shovel out two cords at a tide, at a cost of fifty cents a cord. Unless the bank is steep, a single horse will draw on the ice to the shore, and directly to the field, a cord at five turns, or at a saving of 50 per cent. over summer getting. Its weight, six tons to the cord, and bulk, are such as to forbid its profitable transportation to a long distance into the interior; but within a moderate distance of the deposits, its value as plant food warrants an extended use.

It pays best, to use it as a top-dressing for grass and grain, and to this end, when drawn to a field it should be dropped, a shovel full in a place, three feet apart each way, or equal to ten cords per acre. Thus dropped, it is exposed to the air and frost, for it must be frozen, before it can be spread, and unless it is well frozen it is of no value. Unlike similar marine deposits on the coast of France, known as "tangues," it requires a freezing air to break up its cohesive character. By freezing, muscle mud undergoes a process of disintegration, or rather of slacking, like lime or marl. When freezing it swells, and when thawing it slacks and falls into a fine powder, and can be spread like ashes. The greatest benefit is derived from it

on moist, clayey loams, and next on sandy loams which do not parch with drought. If applied to grain or hoed crops, it should not be worked deeper than with the harrow. If plowed in, there should be two plowings, for the nearer it is kept to the surface the better.

Practice has shown that more than ten cords per acre, per year, is injurious rather than beneficial. An application of ten cords per acre will produce from one and a half to two and a half tons of hay per acre, for several years, provided the seasons are favorable. Fields that are dressed heavily with muscle bed, suffer great diminution of crops in dry seasons; but there is this offset, the muscle mud does not go to waste like manure, but remains inert until wet weather, when it becomes active. When too large quantities are applied the land is apt to fall heavy, bake and crack, and to be restored to good condition, must be dressed with seaweed, muck, or manure.

Of the durability of muscle bed, especially on heavy clay lands, the instances are many, of fields which after one good coating have continued to produce a good crop of hay for more than twenty years. For a garden, especially for turnips, beets and carrots, it seems to supply the elements necessary to produce a good crop. It is said to be an excellent fertilizer for onions.

Muscle bed, is well said to be a very complex body. It varies in quality. The best is that which contains the most muscle shells, and the least coarse sand. As it has but rarely come under the inspection of an agricultural chemist, but little is known of its composition. A single analysis which has come under our eye, gives its average composition to be:

Organic matter,	2 per cent.
Soluble salts,	1 "
Carbonate of lime,	33 "
Clay, sand and silicates,	63 "

Its value as a fertilizer is determined chiefly by two causes: as a supplier of plant food, and as a mechanical agent. The elements of plant nutrition which it affords, and which have

a definite value, are ammonia, potash, soda, lime, magnesia, and phosphoric acid, each an essential constituent of plants.

As muscle bed supplies all the essential constituents, it should be classified as a complete, rather than as a partial fertilizer. It is also a lasting one, and one of the few lasting manures obtainable in a cheap form.

Carbonate of lime, which represents 33 per cent. of the plant-feeding composition of muscle bed, is the prevailing component in the shells of the invertebrate animals, such as muscles, clams, lobsters, oysters, &c. It is known that lime, in all cases, forms a considerable proportion of the weight of the ash of plants. According to Professor Johnston, the crops of one acre during a four years' rotation, contain on an average 430 pounds of carbonate of lime, in a state of marl, shell, sand, or limestone gravel. Without doubt it is the shell-lime which makes muscle bed show its effect so signally when applied to clay or loam, for it decomposes the clay and frees its alkali, thus enhancing the effect of tillage.

In estimating the value of manuring agents, most non-professional, or purely practical farmers, fail to consider their mechanical agency and influence. True, science has no standard for measuring the mechanical value of a fertilizer; neither has it for the mechanical operations of tillage, or why a field well tilled yields a richer crop than one badly tilled; yet, it is well known to both science and practice, that the operations of tillage and of manure are supplementary to one another, and also that a manure which acts partly as a mechanical agent exerts as favorable an influence as one which supplies only the direct elements of plant food.

The efficacy of dock or flats mud, which, when applied to certain fields will so largely increase the amount of their future hay crop, is due mainly to its action as a mechanical agent; for, flats mud is little else than silicates and comminuted shells, or carbonate of lime, which science asserts "has no commercial value as a fertilizing substance," while the experience of those who have used it give it a high value, perplexing or paradoxical as the statement may appear.

Says Prof. Dana, "he who sows muscle bed, sows carbonate of soda, which has the same effect as ashes, only in a more decided manner. The real fertilizing value of muscle bed, when it is rightly applied, is much greater than its analysis would seem to warrant."

We cannot account, in the present state of chemical science, for all the effects which we see, and which we know are produced upon grass fields by the action of muscle bed; nor will we attempt to propound any theory, while our chemical facts are as imperfectly ascertained as is now the case. In practical agriculture, we know that it is a first-class fertilizer for grass lands, although the agencies in operation are as entirely beyond our control as they are beyond our ken. Nor do we offer any theory to explain why it will produce such a remarkable growth of herds-grass (*phleum pratense*), red-top (*A. vulgaris*), June-grass (*Poa pratensis*), and Meadow-fox-tail (*A. pratensis*). Often a single application will double or treble a growth of these grasses, and such of their allies as seem to require an extra feed of lime.

It may be said that this talk of doubling the grass crop, is a "castle in Spain," or well enough to "point a moral," but we can name many a farm in Trenton, Lamoine, Franklin, Cranberry Isles, Surry and Brooksville, where it has practically been accomplished. That far too many of our coast-wise farmers have no practical knowledge of the value of this marine manure, our hungry, half-ton-per-acre, impoverished and barren sea-shore fields attest. In the simple sentence, "the grass faileth," is expressed the very extremity of farm desolation, a "desolation" for which there is no excuse for one living within a six mile range of a muscle bed deposit.

In the long list of manures, natural and artificial, we can name no one which at the same cost, will produce such a quantity of hay upon a given surface, as muscle bed; and he who applies it to his grass fields in liberal measure, need not, in calculating the crop, leave a wide margin for hard seasons and bad luck.

In some parts of the world the muscle is prized as an article of food; with us they are considered of no value; indeed, most of our along-shore people suppose it to be poisonous. To some stomachs the muscle is injurious, and the same is true of two other species of bivalves, found and in much esteem on our coast, the clam (*Mya arenaria*), and the quahaug (*Venus mercenaria*). On the coasts of Scotland and France, muscles are gathered by cargoes, by dredging, to supply bait for the cod fishermen. In some of the bays in France, muscle culture is a profitable business. The mode of culture is similar to oyster culture. A year is required for them to grow to a marketable size. The muscle, like the clam, is self-generative. In bays devoted to the breeding of muscles, no copper bottomed vessels are allowed to enter, as the copper impregnates the breeding hurdles with poisonous properties.

I am requested to answer, "Whether the right to take muscle bed, or seaweed, is a public and common right, or whether a riparian owner can maintain an exclusive privilege to any part of it, or to the whole?" It is very remarkable that the statutes of Maine, with its thousand pages of nicely prepared enactments, is silent in regard to the ownership of the tens of thousands of acres within the flux and reflux of the tide. Hence the ownership of land between the lines of high water and low water, over which the tide ebbs and flows, must be determined at common law, or the law of usage.

The Colonial Ordinance of 1641 provided that the proprietor of land adjoining on the sea or salt water should hold to low water, *where the tide does not ebb more than* 100 *rods.* That ordinance, however, did not present a rule for apportioning flats to the owners of adjoining uplands; nor have the decided cases entirely agreed in furnishing a rule for that purpose. The principle of law is, that a deed of land adjoining the sea carries with it adjoining flats, with muscle bed or seaweed as appurtenants thereto.

Discussion.

Gen. J. Marshall Brown. All persons who reside within ten or twelve miles from Portland, on the bay, are familiar with the term muscle mud. I presume there is not a farmer residing within a reasonable distance from the shore who has not either used it on his own farm or witnessed its effects. We have barnyard manure spoken of as a perfect manure. In our section we consider muscle mud a perfect manure for grass—that is, a field will never require anything but muscle mud to keep the grass good; and I am informed by my friend, Prof. Carmichael, that it contains all the constituents of a perfect manure.

I presume no one has ever been on the bay at low water without seeing innumerable small shells. These are the signs of a muscle bed, which consists of decayed and decaying muscles, and the ooze and slime accumulated in the formation of the bed. Muscles can only live, I am told, in mud which is covered part of the time with water. Muscle beds are formed as oyster beds are, and the superincumbent mass gradually destroys by pressure those underneath, until there is a mass ten or fifteen feet deep, composed of decayed animal matter, and shell-fish, together with the deposit which the tide leaves at low water, which gradually becomes a portion of the mass.

The use of shell fish for manure is probably as old as their use for anything. The early discoverers found the Indians using shell fish as well as ordinary fish for that purpose. It has been used in my neighborhood for a long time. My own farm is one of the oldest in the State, having been cultivated since 1632, and there has been no time when the use of muscle mud was not known. I have been informed, that thirty years ago its use was more general than now; that no man ever attempted to carry on a sea-side farm without muscle mud. Shells are found throughout the mass in a more or less disintegrated state, but are not probably of great value, as I am informed that our land does not particularly need lime; the great value is in the decayed animal substance.

In my neighborhood the farmers improve the interval between harvesting and winter, to get out large quantities of it. It is secured in scows, so constructed with bulkheads that they will float when very heavily loaded; for the mud as it comes from the bed is very heavy. The scow is floated to the bed at high water; at low water the mud is shovelled aboard, and at the next tide the scow is floated ashore and unloaded. Twenty-five years ago there were half a dozen wharves on Presumpscot river given up to the landing of this mud, and from them it was sold to the farmers. The largest quantity which has been got out for many years, was got out last winter on the ice. The facilities for getting it out are better in winter than in summer. When the ice will bear the teams, holes are cut in it over the bed, the mud is then thrown out on it and hauled off. Sometimes the farmers will have two or three sleds, and relays of horses, so that the teams are continually passing to and from the shore, where it is loaded, and whence it is hauled at the pleasure of the owner. It is quite an extraordinary sight for one not accustomed to it, to see twenty-five, thirty, or perhaps forty teams together. The mud cannot be spread until it has been disintegrated by the action of the frost. After this disintegration takes place, it has much the appearance of ashes. It is fine, with half crumbled muscle shells scattered all through it. The accumulation is all the time going on. It is probable that there is more of it now on Casco Bay than there was twenty-five years ago; so that it is a bank on which one can draw without the possibility of having his drafts dishonored.

I have made some inquiries of my neighbors as to its value as a dressing. My first informant told me that a neighbor of his, living seven miles from the seashore, preferred to pay two dollars per cord for muscle mud delivered at the freight station of the Maine Central Road, where it was put on the cars, transported seven miles, and then carted to the field—he preferred to do that rather than to pay the same price for stable manure in town. That shows the estimate which a careful, successful farmer places upon it.

A reliable gentleman informed me, that twenty-five years ago he deposited a large quantity of muscle mud on a grass field. It was deposited in heaps in the fall of the year, or probably after the first snow came, when he could go over the field without injuring it, and spread in the spring. This gentleman states that now, at the expiration of twenty-five years, one can see in the field the spots where the muscle mud was thrown.

I will give my own experience in using it. Four years ago I had a worthless bit of land from which all the grass had long since departed, and which was covered with all sorts of weeds not worth cutting. I dressed quite a large strip of it pretty freely with muscle mud, hauling it on in the winter, and spreading it in the spring. That very year there was a marked improvement in this patch of land. Any one could compare it with the other portion, which for experiment I left without dressing. It continues to produce a good crop of grass, and there has never been anything put on it but muscle mud, no seed.

On the farm adjoining mine, which two years ago I had under my charge, I made a contract for the delivery of 100 cords of muscle mud upon a field of ten acres, for which I think I paid $2.25 per cord. It was delivered in the fall of the year, hauled from a gondola, the field immediately adjoining the landing. It would of course cost considerable more delivered in the country, according to the distance it must be transported. In the spring it was spread over the field as well as it could be without brush harrowing it, which I should have done had I had the facilities. The field produced such a crop of clover without any seeding, that the next year it was difficult to walk through it. These are the only experiments made by myself. I cannot tell where the clover comes from, but it is the testimony of every person who uses it, that it brings in at once a growth of clover without the sowing of any seed.

Of course, the evaporation of the water will reduce the weight of muscle mud. If a person living in the country had

a place near the landing where he could haul it, and let it be disintegrated, the weight to be transported would be much less. Farmers in my vicinity, however, take it just as it comes from the bed.

Messrs. MALLETT and WINSLOW made statements as to the use of muscle manure in their respective counties, giving such information as they had gained from those using it. The former spoke of a statement made with some excellent wheat exhibited at the Sagadahoc Fair, in which a yield of forty-seven bushels was obtained from one acre and forty-seven rods of land, dressed with muscle mud alone, the acre being greensward, the remainder old ground. Mr. Winslow spoke of its effect upon grass fields, in bringing in grass without seeding; the farmers say they don't know where it comes from, but it comes.

THE EDUCATION OF FARMERS AND MECHANICS.

By Charles F. Allen, D.D., President of State College.

The education of farmers and mechanics is a subject of great importance to every nation. While so many in every community are engaged in these industrial pursuits, the well being of this large proportion of the inhabitants demands the attention of the statesman and the philanthropist. To secure the greatest good of the greatest number is no unworthy aim of the most pure and exalted. Expansion of intellect gives a double power of enjoyment. In proportion as a human being is raised above the brutes in his reason, so are his enjoyments of superior value, more lasting, and of higher worth. Nor can the intellect receive full development without systematic instruction. To increase the sum of human happiness the intellect of the working man should be trained, and every facility of the most approved methods of education should be furnished.

Moral education is closely connected with intellectual advancement. Not that intelligence and morality are of necessity equally developed in all individuals, or in all communities, for some prostitute the noblest faculties to the service of vice. But the tendency of intellectual culture is to promote virtue; while vice and ignorance are natural allies. We cannot expect that free institutions in a Republic, which have taken root in intelligence and are nourished by a pure morality, will flourish when education is neglected by the great mass of the people. The laborer, without mental power that comes alone through a thorough education, is not prepared to meet the responsibilities of a citizen, nor to enjoy the prerogatives of a freeman. Education does not interfere with successful labor. So far from hindering the creation of value through

industry, education renders the toil of the workman more productive. Nor is it enough to have workmen who are skilled in their several departments of labor. There is a difference between skilled labor and educated labor. Skill gives facility of performance—education, power of thought. Every one knows that by frequent repetition any act is more readily performed. Feats, which to the unaccustomed are impossible, or which would require much time and care, are easily performed by the expert. What appears to be a special endowment is only the natural result of the great law of habit, and requires no especial exercise of thought, invention, reflection or judgment, but merely practice. The trained eye to perceive and the trained hand to execute make skilled labor. The narrower the field of operation, the more intense the activity, and consequently the more successful the immediate result. Mechanical skill is largely induced by the division of labor. The most wonderful accuracy and celerity are attained by laborers in those manufactories where uninterrupted employment is given to each one in some minute part of the general work. To concentrate the whole of one's soul, intellect and body in one narrow round of activity, however intricate, will not make an educated laborer, though it will produce a skilled workman.

For the supply of skilled labor we are still largely indebted to the old world; where an over-crowded population, and the strong pressure of eager competition of ignorant, starving laborers, under a system of minute division of labor, compel those who would live to secure the highest attainments of skill. The emulation of the child to imitate his father's dexterity, the training of youthful muscles, the almost instinctive aptitude early manifested, and the life-long practice uninterruptedly pursued, make the skilled artizans imported at great cost to fill the places where most of manual dexterity is required in our large manufacturing establishments. The ignorant peasant of France may be the most skillful lace weaver; the Italian hand can best chisel out the elaborate designs of the sculptor; the Hindoo alone has the skill to

weave cashmere shawls; and the Chinese to work trinkets in ivory. These are not educated laborers. The Yankee boy who has graduated from the old brown school-house does not fancy such a restricted use of his energies. Instead of a weary apprenticeship and a life-long bondage in monotonous toil, he prefers some employment that will task his intellect as well as his muscles. He chooses not to be only part of a machine that does fine work, so he prefers to make a machine that will do the work while he watches its operation. Instead of making himself merely mechanical, the educated laborer frees his soul from the conscious degradation which must always exist where there is a sense of mental inferiority to his employer. Cheerful service can be rendered where respect is shown, and respect can only be commanded by intelligence. A vigorous mind left uneducated rebels against the condition of inferiority and servitude; and if it cannot break the barriers of caste and rise in educated power, it too often drowns itself in dissipation and vicious indulgence;—or brooding over its condition, gives way to envious discontent;—and sometimes with passions inflamed by intemperance the debased laboror turns against his employer with brutal and vindictive violence. It only needs some slight provocation or some artful demagogue to induce strikes and mobs. Ignorant and degraded laborers are easily roused to make insane demands for wages higher than earnings; and to enforce their claims by methods still more insane. As if the destruction of capital would improve wages, or forcing the rich to withdraw their capital would benefit the laboring class.

From this dangerous class, tramps come forth to prey upon society; to beg or steal, to rob or murder, as fitting opportunity may serve,—skirmishers of the fearful army of disorganizers that war upon government and property. To protect the national life, to secure the peaceful possession of property, to prevent anarchy and ruin, we must have educated laborers or a despotic government; we must build and maintain schools and colleges, or jails and prisons.

The best remedy against the wide-spread and growing disaffection, jealousy and antagonism between labor and capital, is the system of co-operative labor, by which the laboror becomes himself a capitalist, and shares in the profits of the enterprise. But the ignorant laborer has no desire for such a position, as he never thinks it within the compass of his attainment. He is too narrow and unreasoning to start out of the beaten track of slavish toil. Without education the laboror, even if he desired it, could not profitably to others, or safely to himself, enter into a co-operation for which he is unfitted. The laborer must be intelligent, to desire some share of the capital which his industry requires; and he must have some training besides mere mechanical skill to organize a company of fellow laborers whose united earnings may furnish the money necessary for the prosecution of the business.

Nor will the capitalist be likely to receive an ignorant laboror as a co-partner, by which alliance the workman is to receive wages and also be a sharer of the profits. If there is suitable education, proprietors may possibly convert their manufacturing establishments into such joint stock companies, with shares so sub-divided, that each intelligent and enterprising workman might own one share and thus virtually become a partner in the concern, while the controlling power is still held by those who furnish the largest proportion of the capital; and thus the interests of the employer and the laborer become identical.

Or if boards of arbitration are to settle the question that may arise between employers and workmen, education is necessary to protect the interests of the laborer in these adjudications. None but the educated will submit their interests to the decision of others, and none but educated laborers can wisely determine what awards to give. The board might as well be entirely composed of capitalists, as to be a mixed commission, made up of educated capitalists and ignorant workmen—for the unenlightened would only be ciphers to give weight and force to a one-sided decision of their associates. In the fierce competition of manufacturers,

smaller establishments are forced out of the field. The superior advantages of larger factories by the division of labor and by the saving in the expense of machinery, thus reducing the cost of production, are forcing mechanics more and more into these larger companies; and all the evils of combinations and agreements, by which contending parties are selfishly struggling for their respective interests, are more and more to be apprehended.

Nor is the danger of strikes and combinations confined to mechanics. Farmers are called upon to enter into combinations to protect their interests against powerful monopolies or combinations of those who stand between the producer and the consumer. And uneducated farmers may be instigated te acts as unreasonable as those which ignorant mechanics have blindly done when roused to frenzy by the supposed injustice of their employers. Selfish demagogues are ready to stir up the passions of Grangers, and induce them to commit acts of injustice or folly, if the agitators are to benefitted. Sovereigns of Industry may be patronized by greedy cormorants, who would ride into power and office on the tide of excitement; what care they for the destruction of the whirlwind, if they are lifted into notoriety? Without some knowledge of the principles of political economy, the measures proposed by those associations that honestly desire the highest welfare of the producing class, will often prove unavailing or deleterious. Desirable results cannot be secured by a violation of natural law, or of the laws of political economy.

A few years since certain carriage makers that needed some special aid in their business, petitioned the Legislature to protect honest labor against the competition of the convict labor in the State Prison; provision was accordingly made that the carriages manufactured at the prison should not be sold in this State. The product of convict labor was, therefore, disposed of in the wholesale market at Boston. The result of this restriction on trade was beneficial neither to the manufacturers nor to the consumers; the same steamboat

that transported the carriages to be sold at wholesale in Boston, brought them back on its return trip, to be retailed in Bangor, the home of the petitioners. To the purchaser of cheap carriages, the extra cost of a two-fold sale and a double transportation, was not penalty enough to force him to encourage honest industry, by paying more for carriages than they could be bought for in the market.

Rather than to rail at middle men, because some sharper with oily tongue has induced the farmer to sell his hard-earned products for less than their market value, it would be better for the producer to read enough of current literature to know what is the state of the markets and the probabilities of a decline or advance in prices.

The restrictions of legislation on the production or exchange of commodities are of doubtful utility. It requires something more than an act of Congress to induce a better style of life, and to insure the prosperity of farmers and mechanics. No external circumstances or artificial appliances can supersede the necessity of intelligence, industry and economy, for true success.

The mere association of laborers, however pleasant, is not sufficient to improve their condition, if it does not promote intelligence. It may well be asserted that trades-unions and other organizations of workingmen have done more harm than good to the members, when these associations have undertaken to regulate the hours of labor, the rate of wages, and the privileges to be accorded to workmen. The attempt of a combination of interested parties to dictate terms to employers, or to prescribe to them rules of conduct, will be met by combined power of capitalists to resist the arrogant demands.

Intelligence is necessary to raise the industrial class—not merely to make them more skilled artizans, but to develop a nobler manhood,—and this itself will make labor more productive. But vigor of intellect depends largely on the method by which the mind is trained. It becomes therefore of great importance to know what kind of an education is best adapted to the wants of farmers and mechanics.

The importance of our common school education cannot be over-estimated. It is easy to criticise the defects of teachers, and any one can imagine that some needed improvements will soon add much or greater efficiency in the work of primary instruction. Each one that discusses this subject has some pet hobby; one would have music taught to every child—another thinks drawing the basis of all study—another would introduce some patent method of reading—and another would change all the text-books or discard them entirely. Although these projected improvements have not yet been fully adopted, we think highly of our common schools; we look back on the minds trained up here for usefulness and power, and rejoice to know that Maine scholars are prominent leaders in education in all the States of the Union. To advance the interests of our public schools, special institutions have been called into existence, whose object is to increase the efficiency of teachers. Normal schools give free instruction to those who are to make teaching their business. By directing public attention to the importance of securing competent teachers, by elevating the standard of required qualifications in candidates for this important profession, by presenting superior methods of teaching and furnishing suitable appliances and by systematic training, much has been accomplished in the improvement of our primary schools. Our State has taken another step in advance by adopting the system of "Free High Schools." Here a more generous provision is freely made to supply to all who wish a more advanced course of study than was formerly afforded by public expenditure.

The seminaries and colleges where the highest forms of education can be obtained, have been under the control of private corporations or religious denominations, and many plausible reasons have been assigned for this illogical division of educational work between the church and the State. The liberal education of the classical college is not adapted to the wants of the producers, and therefore unless some other liberal education is provided, the occupation of the farmer, which should be a liberal profession, will remain a most

illiberal labor. All the declamation of orators about the dignity of labor will not change the fact that Agriculture is honorable just in proportion to the amount of mind and heart one uses in the employment. The man who aims only at the cultivation of the soil, while the soul is left barren, may succeed in raising large crops, but he is not worthy of honor. He may be looked up to as a farmer, but he is conscious that he lacks the elements which demand the respect of intelligent men. But why should not this grand primeval profession, honored by patriarchs and sages, and destined to be the occupation of the great mass of men, afford full scope to the highest capacities of our nature? Because we have allowed ourselves to believe that productive labor was not consonant with the highest development of thought.

The grandest triumphs of human intellect have been in struggling with fire, air and water. These have been made to reveal their secrets and to bow submissively to man's control. They do his bidding—they are inspired with his soul, replete with his intelligence—their service ministers to his delight and to his honor. But while these elements thus ennoble those most intimate with their properties, the earth seems to degrade her associates. Jupiter, Pluto and Neptune, are liberal with their honors; but Terra, like a harsh step-mother, enslaves her children. They ask, "how can he get wisdom that holdeth the plow, and that glorieth in the goad, that driveth oxen and is occupied in their labors, and whose talk is of bullocks?"

But is this state of degradation and servile toil a necessary condition of the tillers of the soil? Long ago the Roman historian said it was a question whether military success was due more to the vigor of mind or strength of body. Who asks that question now? The Grecian king well said he would rather have an army of stags with a lion for commander, than an army of lions with a stag for commander. In farming, the vigorous brain is worth more than the brawny muscles. The poetess says, "earth waits her queen." Rather say, the rich dowered earth waits for her coming lord, who

with a lover's tenderness may woo her to disclose her charms; with a devotee's ardor may be absorbed in her delights; and with a master intellect may control her spirit. The accepted husbandman will be neither a cringing slave, nor a capricious tyrant, but a prince adorned with the benefactions of science. To him, earth will look up with a smile, and own his rightful sway. He may exult in the favors she bestows, and rejoice in a beauty he ever seeks to adorn, and in the wealth with which she is endowed. How inviting this adventure! But no faint heart will here succeed. The patient preparation, the unswerving fidelity, the life-long devotion are all demanded.

The farmer's occupation has especial advantage for a life of thought. Other occupations confine the laborers, for the most part, shut up in dingy shops, to one dull monotonous routine, where few mental faculties are cultivated. But the many-sided life in the open air and glad sunshine demands of the farmer a wide exercise of intelligence, as he "holds communion with nature in her visible forms," and watches the mysterious changes whose operations he directs; while every muscle is brought into healthy and varied exercise, every faculty of his soul is brought into full use.

But to become a master in his profession, he must have an education, which is at the same time liberal, and rightly adapted to his calling. No narrow technical drill, no mere professional training will suffice, nor will theoretical and scientific education alone accomplish the desired result. It must be a *practical* education—not in that narrow mercenary difinition of practical, which weighs all things by their exchange value, but in that true sense, the practical development of faculties by use for higher capability. It is mingling the highest thought with the labor of the hands to make the product more profitable to soul and body.

The farmer may get a living without a liberal culture, if he is content to spend all his days in getting a bodily existence. His grounds may bring forth abundantly; he may pull down his barns and build greater and think to feed his soul with

their contents—that is not life, such an existence is of the earth, earthy.

As we look back on the past history of agriculture and the condition of farmers, and compare the former days with these, the most interesting point of contrast is not so much between ancient and modern means and appliances, comforts and conveniences, breeds of cattle and farm utensils, fertilizers and drainage, buildings and wealth, but between the intelligence of farmers in this and in a former age,—the education of the farmers a hundred years ago and at the present time. There were no agricultural books or papers then; see the quantity of such reading now in the market! No agricultural science then,—now the best thought of the age is turned to investigate the nature of soils, the principles of plant-growth, and the methods by which an increased production may be secured with the least expenditure. Half a century ago, professional men of other callings, lawyers, ministers and doctors, were the best agricultural writers, having little practical knowledge or skill in farming by which they could correct their fanciful theories. Now we have not only amateur farmers to write for us dainty disquisitions, but agriculturists, thoroughly educated in the college and on the farm, who find the benefit of applied science in their own practice, and are ready to communicate the rich treasures of their information to their brother farmers.

To increase the number of liberally educated farmers, to promote agricultural science, and to improve the condition of those who cultivate the soil, agricultural colleges have been established. There is a demand for such institutions. Many of our young men of excellent natural endowments, instead of rushing into the over-crowded professions, are resolved to fit themselves for a successful life of productive industry; as success depends on intelligence, they wish for the best training, that education which will alone ensure an honorable and a profitable career. They require the best instruction in the science of agriculture, and in the art of farming, therefore work on the farm must be united with the studies of the

recitation room; and lectures on science must be illustrated by experiments performed in daily manual labor by the students. Labor is one of the gifts of God, and the scholar who in the midst of his intellectual culture is afraid to soil his hands, will never be educated for industrial pursuits. If one is ashamed of the appropriate dress for coarse work, or shrinks from the odor of the barn yard, let him not venture to breathe the gases of the laboratory, nor penetrate into the mysteries of the dissecting room. Pass him over all redolent with musk in dandified attire, to the drawing room, to lounge away his time in talk about vulgar employments of rustic laborers.

Work is not so attractive that students will engage in systematic, useful, manual labor, without it is made compulsory —a part of the regular college course; or unless they are compelled to work in order to secure the funds for their support. A serious difficulty in our colleges is, that students who do not labor are inclined to feel themselves to be superior to those who must work. The superciliousness of those freed from manual toil, especially where they happen to be in the majority, is unendurable to a high spirited, enterprising and sensitive scholar, who has to work with his hands to pay the college bills. Such students are often forced into class expenses they can ill afford; and frequently the best scholars feel compelled to abandon their course of study before graduation. There should be a college where all who really desire the boon, whatever their circumstances in life, may obtain a liberal education and pay at least part of their expenses by their work, thus rendering them better fitted for productive employments.

To meet this want of some available method to secure superior culture for energetic young men, is the design of the Maine State College. The institution has a double work assigned to it; it is an agricultural college to teach the science of farming, and an institute of technology to teach the mechanic arts. The student enters after passing an examination similar to that required in other colleges. The

standard of qualifications for admission is not as high as could be wished in order to produce the most thorough scholarships in the course, but it is as high as can well be attained in our free high schools. The first two years are spent in those studies which are preparative and adapted to lay a thorough foundation for subsequent professional studies. During this time the student is acquiring a good knowledge of the ordinary college curriculum in literature, mathematics and the physical sciences. His reasoning powers become developed by the advanced mathematics, his perceptive faculties sharpened by scientific investigations, and his power of expression greatly increased by the studies in language, embracing with the English the study of the French and the German. The next two years are divided into distinct departments of study. Those designing to take the agricultural course have such studies in applied science, as may best qualify them for successful and intelligent farmers; together with lessons in mental and moral science, and in other branches essential to a thorough education. We are sorry there are no more applications for this department.

As one-eighth of the property of the United States is in railroad corporations, and as such momentous interests are connected with the transportation of freight and passengers, there has been a demand for an especial education; and the training of civil engineers receives prominent attention at the college. In this department theoretical instruction is combined with work in the field and the use of instruments. Thus the graduate goes forth prepared for successful work.

In mechanical engineering there is the same thorough instruction in applied science adapted to the wants of the engineer. In the chemical laboratory he can make analyses of ores and metals and materials, while with the philosophical apparatus he can make experiments that have a bearing on his profession. He visits machine shops, takes measurements of engines, makes accurate plans of the different parts and of the whole machine, and learns by their construction how to frame original designs of machinery and apparatus. But to

complete this course one great want has been felt. With all this wealth of information, mental discipline and scientific training, there is no opportunity for one to acquire that manual dexterity without which his knowledge is of no practical use. The graduate goes forth from college, not into business, but to take the lowest position in a machine shop. In the minute subdivision of labor he may spend a lifetime, before he has opportunity to attain ordinary skill in all the different departments. What we most need is a shop of instruction, where manual dexterity in the different processes can be surely attained in a short time, by a regular gradation of practice from the most simple to the most complex exercises, conducted by experts in the several kinds of work. Nor need this be attended with great expense for a shop, machinery and the wages of experts to instruct the pupils a few weeks each year.

A chemical course of study has been arranged for those who wish to become thorough practical chemists.

From the different studies in all the departments a prescribed course in literature and science has been carefully selected, to meet the wants of those students who would lay the firm foundation of an education more general in its nature than the technical training acquired by some definite calling. All the young men labor on the farm during the first year. In the other years they have educational work, in the field, in the laboratory or in the drawing-room. All of them, through their whole course have regular exercises in military tactics.

Such are the provisions made for supplying the demand of this age for the liberal education of those who are determined to fit themselves fully for leading positions as farmers and mechanics in the State of Maine. A course of training has been provided where the theoretical, empirical and practical science are judiciously mingled. The question is asked, what is the result of this education, do the students engage in productive employments after leaving college! The first three classes that graduated prior to 1874 were small; as the

college was then struggling for existence. The whole numbers of graduates in these classes was nineteen. Of these four are now farmers, three machinists or manfacturers, four are civil engineers, four are teachers, two, merchants; one is an editor, and one having been an apothecary, is studying medicine. A larger number than the graduates left college before completing the course of study; a large proportion of these are farmers. Of the last three classes, consisting of sixty-eight graduates, it is too soon to determine what will be their permanent occupation, as most of them are temporarily employed in teaching. Those designing to enter upon productive labor are obliged to earn money before settling down to their life work.

If the results are not what the most sanguine friends of industrial education have anticipated, they are certainly encouraging to every one whose interest in the subject has led him carefully to examine the working of the institution. We expect that harsh criticisms on the methods and aims of the college, will come from those with illiberal prejudices, who would confine the whole education to manual dexterity and muscular development; from the jealousy of those instructors who think the new education a rival of classical learning; from unscrupulous partizans, exciting the prejudices of the ignorant with the cry of economy, and from all who think learning will spoil a farmer or a mechanic.

The Maine State College should have connected with it an experimental station, well sustained; where an accurate test of fertilizers and soils, as well as methods of cultivating plants, of breeding animals and of feeding stock, could be made. As far as the limited means would allow, this has been done; but so far as farm work is made experimental it ceases to be profitable to the institution in dollars and cents; its richer returns are correct principles of science, whose application secures wealth to the farming community. The one who gets his living from the soil cannot afford to try costly and elaborate experiments. He has not the means at command for a successful test. The farmer has his traditional

prejudices that are to be overcome, and the scientist has his wild vagaries that need to be rationalized by intelligent trial. The scientific French engineer, who on the first trial went crushing through the iron bridge he had constructed on an improved plan, crawled out from the debris of his ruined work, and escaping from the midst of mangled bodies and excavations, after two days made his appearance with exultation, exclaiming, "I have found it, I see the cause—the theory is all right, only I put a plus sign where there should have been a minus." The unhappy farmer will be likely to find untried theories all right, only there is a fearful minus where he wanted a plus—on the credit side of the ledger. When one boasts that he can carry enough concentrated fertilizer to dress an acre, in his vest pocket, we can safely predict he will be able to bring home all his increased product in the other vest pocket.

I would urge the importance of the higher education of farmers and mechanics, because I firmly believe this instruction would greatly increase the efficiency of productive labor; and especially would I urge it from the higher considerations of the worth of such an education to man himself. I enter into no computation how much college studies will increase the property of the individual and the wealth of the nation. I rather seek to know how much they will advance the civilization of society, the refinement of manners, the growth of intelligence, the happiness and the glory of humanity. These studies are a refuge in adversity and an ornament of prosperity; they hinder no useful work on the farm, and they will go with one when called to stations of honor or responsibility; they are a guide in darkness, an aid in duty, and a solace in sickness; they are adapted to the ardor of youth, and they shed a halo of glory around the hoary head; they are the ripe fruit of civilization, ministering alike to material wealth and comfort, to intellectual strength and to moral advancement.

THE STUDENTS' EXERCISE.

On the afternoon of Thursday, Oct. 18th, the last day of the Convention, the time was wholly occupied by the students of the State College, and it proved one of the most interesting sessions of the Convention. In accordance with the vote of the Board, which is given in full in the Introduction to this volume, the students of the college reported the results of some of the experiments which have been carried on at the college farm, a selection from them being given below. Others would have been published had the space at disposal for this matter been more extended.

I. STOCKBRIDGE'S FERTILIZERS ON CORN. By P. Keyes, Jr., Richmond.

It has ever been a trait of the human mind to seek for new devices from which to derive benefits, either directly or indirectly. It appears to be just as natural for man to search for new principles, as it is for water to flow from high to lower ground. New ideas and principles tend to interest and open to the mind through conjecture, the possibility of something that may yet be developed. The field of science has never failed to furnish labor for all who have wished to work, and many and valuable have been the results of their toil.

Among all the branches of science, agriculture is not the one that is receiving the least attention. I think it is safe to say, that at the present time, in many respects, agriculture stands in the front rank. Many of its most important facts have recently been discovered, and to-day several of our most distinguished scientists are carefully investigating different topics, which, when thoroughly understood, will add much to

agricultural knowledge. In fact, agriculture is fast becoming a scientific study, instead of the blind traditional practice of former times; and we hope the time is not far distant when the agriculturist will no longer grope in darkness, but illuminate his path by acquainting himself with the principles on which his vocation is based. Before entering into the details of this experiment, it may be well to notice some of the principles of plant nutrition.

Plants require for their nourishment both organic and inorganic matter, and as far as the plant is concerned, one class of matter is of no more importance than the other. All of the organic elements (carbon, oxygen, hydrogen and nitrogen) are absolutely necessary for plant food, and no one of these elements is of more importance than another; a plant cannot be produced if any one is absent. So far as the cultivator is concerned, that element which nature provides in least quantity in an available condition, and which the plant requires from him in greatest proportional quantity, is of the greatest importance, and that is nitrogen. The substances in most soils in large quantity, when compared with the food-want of the plant, and in an available condition, are lime, soda, magnesia, sulphur, chlorine, scilica and sulphuric acid; while those contained in most soils in small quantity in available form, compared with the wants of the plant, are potash and phosphoric acid. These are soonest exhausted, and if cropping be continued must be artificially supplied. By a careful analysis of a plant of the kind to be grown, it now becomes easy to supply these substances in the exact proportion necessary to produce the plant. Aided by these facts, which have been established only after the most searching and acute investigation, oft repeated, Prof. Stockbridge has carefully prepared his fertilizers. It is maintained that they will produce certain results, and it remains for us to test them for ourselves.

The ground on which this experiment was tried, is sandy loam; slopes toward the west, rendering the drainage quite complete. It was broken from the sward in April, 1876, and

lightly dressed with manure from the sheep pens, then sown to oats. In the autumn following the ground was again plowed, and also in the spring of 1877, the turf being well broken by harrowing. The witch-grass roots, of which the ground was full, were raked and hauled off, then half of the fertilizer used was sown broadcast, and harrowed in with Shares' cultivator harrow. The furrows were made lengthwise the piece, with Chandler's horse-hoe, leaving the rows three feet and a half apart; then a light marker, with teeth two feet apart, was drawn at right angles with the furrows. At each of the points of intersection, five kernels of corn were planted, covered with about two inches of soil. This was done from the 15th to the 18th of May.

About half the field of corn was planted with seed sent to President Allen from New York State, by Mr. C. H. Curtis, known in that vicinity as "Red Glaze Yellow," having been cultivated for thirty years—the earliest selected each year for seed, for the purpose of obtaining thereby an early variety. This corn ripened nearly two weeks earlier than did the corn on the other half, the seed of which came from Nobleboro', sent by L. H. Winslow. The corn came up quickly, and presented a dark green appearance; numerous hills were tinged with dark purple, the cause of which is not known. The remainder of the fertilizer was applied, one-half the 23d of June, and the other half in July, each application being made by hand; the fertilizer was strown between the rows and hills. It was necessary in order to keep down the witch-grass, to make frequent use of the hoe and cultivator. In this way the land was thoroughly stirred and kept from weeds.

A piece of ground planted beside the one just described, received no fertilizer, and will show by comparison the increase where fertilizer was used. The weight of corn raised from the seed from New York, where fertilizer was applied, yielded on an average of 5,850 lbs., or about 61 bushels of shelled corn per acre; where no fertilizer was used it was on an average of 4,633 lbs., or nearly 49 bushels. The weight

of corn harvested from the seed sent by Mr. Winslow, where fertilizer was applied yielded at the rate of 5,639 lbs., or 59 bushels per acre; the same without fertilizer, produced 3,807 lbs., or 40 bushels per acre. The average yield where fertilizer was applied, was 5,720 lbs., or 60 bushels per acre; where no fertilizer was used the yield was 4,221 lbs., or 44 bushels. The gain per acre where fertilizer was applied, over that where none was used, was 1,511 lbs., equal to nearly 16 bushels. The tops were weighed, and found to be about 74 ounces heavier where fertilizer was applied than where none was applied. The quality of the corn grown with fertilizer was decidedly superior to that grown without, being better ripened, so that a part of the weight of the unmanured corn is due to its unripe condition, making the actual increase not less than 20 bushels per acre.

Considering the butts to be in the same proportion where fertilizer was used, regarding weight, the value of the stover would be at least three-fourths more where fertilizer was applied. Reckoning the weight per acre of stover where no fertilizer was used to be two tons, and this worth six dollars per ton, we have a gain of nearly nine dollars on the stover by using fertilizer. The cost of fertilizer per acre was twenty-two dollars; this less the gain on the stover above the natural yield, leaves thirteen dollars as the cost of the sixteen bushels gained. This shows the cost per bushel to be about sixty-five cents.

The ground was regarded as in a poor condition, when plowed producing less than a half ton of hay per acre, and it is a wonder why it produced so much corn without fertilizer. On ground possessing less natural corn-producing qualities, the gain from using the fertilizer would doubtless have been more marked than shown by the present experiment.

II. Report of Experiments in Feeding Swine. By S. P. Merrill, Auburn.

The series of experiments of which the following is a brief report, was commenced by Farm Superintendent Johnson in the year 1870, and it has been continued by him and his successor until the present time. The purport of the experiments being to determine the relative value of cooked and uncooked meal as food for swine.

On the 15th of January, 1870, Mr. Johnson selected four Chester pigs, of the same age, and nearly of the same weight, and placed them in two separate pens. Those in pen No. 1, were fed on warm scalded meal, and those in No. 2 on the same quantity of raw meal. On weighing the pigs the 18th of the following February, it was found that the gain in each pig had been the same—seventy-five pounds. The manner of feeding was then reversed, and the pigs in pen No. 2 were fed on scalded meal, and those in No. 1 on raw meal. Thirty days later the pigs were again weighed, and it was found that the two fed on scalded meal had gained 108 lbs., and those on raw meal but 100 lbs. The result of this trial would at first appear to be considerably in favor of the scalded meal, but one of the pigs fed on the raw material had for some unknown reason been falling behind, and during the last thirty days had gained but 46½ lbs., while his mate had gained 53½, or only three-quarters of a pound less than the average of those fed on scalded meal. During the thirty days ending April 18th, those fed on scalded meal gained 99½ lbs., and those fed on raw meal 122 lbs. The result of this last trial gives the comparative value of warm scalded meal to that of cold raw meal, as 95½ to 100.

On May 23d, 1871, another trial was begun, and continued for ninety days. This gave the comparative value of cooked to uncooked meal, as 74 4-5 is to 100.

For the purpose of continuing the experiment, on the 25th of June, 1872, three White Chesters were selected from the same litter, when seven and a half weeks old, weighed and

placed in adjoining pens. The food was prepared as in the preceding trials, and the same amount fed to each pig daily, the quantity being gradually increased as their appetites demanded it.

A greater increase in weight was obtained this year, but the relative value remained nearly the same, being as 82 is to 100 in favor of the raw material.

June 30th, 1873, three White Chesters from *separate* litters and differing in both age and weight, were selected and treated precisely as were the others, with the exception that for the first four weeks no milk or any food of any kind, excepting meal, was given them, whereas, the others had occasionally been furnished with a little milk. At the end of the twelfth week, pig No. 1 being in poor health, was dropped out of the experiment. The result of this trial, as in the last, was in favor of raw meal. The average cost per pound of increase obtained by feeding raw meal, was to the average cost per pound obtained by feeding cooked meal, as 100 is to 109.

July 8th, 1875, three pigs of mixed breed, being three-fourths White Chester and one-fourth Suffolk, were taken from different litters, being nearly the same age, and not varying more than a few pounds in weight. They were kept in separate pens, each with an open yard connected. Their food consisted entirely of meal, either cooked or uncooked, with occasionally a quantity of grass and weeds. In this experiment the method of alternating the kind of food was adopted; that is, pigs Nos. 1 and 2 were fed for four weeks on cooked meal, and No. 3 on raw meal. Then this was reversed and No. 3 received the cooked meal, and Nos. 1 and 2 the raw meal. The entire gain of each pig was of course not so great on account of the sudden and complete changes in the diet; but by noting their weights at the end of every four weeks, or every time that a change of food was made, a much more satisfactory test as to the relative values of these foods could be obtained, than if each pig had been confined to

one particular kind of food during the whole time. As before, we find the result in favor of raw meal, though the difference is not so marked. The average value of raw, compared with cooked meal, was as 100 is to 101.2.

The following year the pigs selected were a cross between a Yorkshire boar and a White Chester sow. They were all from the same litter, and were eight weeks old at the time of commencing the experiment. The method of alternating the kind of food was adopted, as in the preceding trial, and continued throughout a period of twenty-four weeks. The food was of the same kind as in previous trials, with the exception that the meal was mixed with about sixty per cent. of its weight of skim milk. The result in this case shows a much greater difference in favor of the raw material than any heretofore obtained. The value of the cooked being to the uncooked as 100 is to 130. In the concluding trial, a comparison was also made to ascertain the value of milk as food, compared with raw meal. The four pigs chosen were of the same breed as the last, a cross between a Yorkshire boar and a White Chester sow. Three of these were fed alternately on cooked and uncooked meal, and the fourth on milk. The result with those fed on meal was as 100 is to 102½ in favor of the raw material. Milk compared with meal was as 1 is to 2 2-5 in favor of meal.

III. Top Dressing for Grass Land. By J. D. Cutter, Brewer.

Grass is the greatest agricultural product of Maine and of the United States. The average yearly crop is estimated to be worth seven hundred millions of dollars. Would it not pay for the farmers of Maine to give more of their attention to hay raising? There are thousands of acres of land under cultivation to-day that do not cut more than one ton the acre, and many more that do not cut one-half a ton. Why is this, when the same land can be made to produce from two to three tons to the acre? The reason is, that the farmers do not

apply enough manure to the land. Some say, "Manure costs money, and we cannot afford to buy it to put upon our land." It would be better to put what surplus money a farmer has at the end of the year into manure for his grass land, than into the bank, for it would then be secure, and pay better interest. Some farmers manure land for a certain crop, and then seed it down to grass. They keep taking off the hay, year after year, without returning an equivalent in the shape of some kind of manure, and consequently the land grows poorer each season. It would be better to return each year that which the grass appropriates in growing, and thus keep up the standard of production, or raise it higher. The important question is, what kinds of manure shall we use? The following are the kinds used in an experiment at the College farm in Orono. The experimental plots are each two rods square, containing 1-40 of an acre. They are staked out in two rows, four plots in a row:

MANURES.	Rate per acre.	1873. Weight of Hay.	1874. Weight of Hay.	1875. Weight of Hay.	1876. Weight of Hay.	1877. Weight of Hay.
Cow manure	Five cords.	63 lbs.	150 lbs.	182½ lbs.	122 lbs.	75 lbs.
Horse manure	"	71 "	127 "	152 "	102 "	50 "
Fine old muck	"	83 "	148 "	117 "	76 "	45 "
Fine old muck and salt	Salt, 3 bush.	73 "	121 "	108 "	67 "	35 "
Plaster	2 bushels.	51 "	115 "	79 "	33 "	30 "
Wood ashes	5 bushels.	81 "	97 "	103 "	56 "	35 "
Salt	3 bushels.	87 "	92 "	101 "	43 "	25 "
Nothing	–	87 "	88 "	88 "	46 "	40 "

The muck was taken from a swamp four feet deep, and exposed to the air one year. We see by the table that the average yield was best where the cow manure was applied. Next, in case of the horse manure, and next where the muck was used alone—while the plots where the other fertilizers were applied yield on the average about the same amount as where no application was made.

IV. Different Methods of Cutting and Planting Potatoes. By W. E. Ferguson, Bangor.

The following experiments, comprising the different ways of cutting and planting potatoes, were originated in connection with the Scientific Society of the Maine State College, in the

hope that the methods proposed will be tested, not only at the College farm, but also by farmers in other parts of the State, that by comparison of results obtained under conditions widely differing from each other, definite conclusions may be reached, which shall be of real value to those who wish to practice the best methods of planting potatoes.

The potatoes used for seed were classed as follows: Large, those weighing seven to eight ounces; medium, those weighing three to four ounces; small, those weighing one to two ounces. Where not otherwise stated, large potatoes are cut into four pieces; medium are cut into two pieces, and one piece dropped in a hill. These experiments were arranged with reference to the following conditions, which I will briefly consider under separate heads:

1st—Potatoes divided through the centre, and the product of the seed end and the butt end compared. By comparing the results obtained for the past five years, I find them in favor of the butt end for seed. It gave the largest yield in every trial but one, and a greater per cent. of large potatoes in every trial.

2nd—Large, medium and small potatoes compared, the seed planted each year to be the product of potatoes of a like class. The results seem to be in favor of the medium sized sets, as will be seen by these figures: Large yielded 79½ lbs., medium 82 7-9, lbs., and small 58½ lbs. The large sets yielded about as many potatoes as the medium, but more small ones. The small sets gave a very low yield compared with the other two.

3d—Large, medium and small compared; the seed to be selected from an ordinary pile of potatoes, taking the average result for five years. I find it quite different from the preceeding experiment, the small sets giving heaviest average yield, being 64¼ lbs., the medium next, yielding 61¼ lbs., and the large only 54 lbs.; the large sets produced the least small potatoes, the medium and small sets produced about the same amount of small ones.

4th—The product of large potatoes compared when planted

six, twelve, eighteen and twenty-four inches apart in the row, the average result for five trials are as follows: Those planted six inches apart yielded 81¾ lbs., twelve inches 70 lbs., eighteen inches 75¼ lbs., and twenty-four inches yielded 67½ lbs., showing that six inches apart gave the best results on an average; but this year the best result was obtained from those planted eighteen inches apart; while in 1875 and 1876 those planted twenty-four inches apart gave the best results.

5th—Equal weight per acre, of large, medium and small potatoes planted at equal distance, taking the average for five trials I have the following results:

	Total.	Large.
Large gave an average of	18 3-5 lbs.	14 7-8 lbs.
Medium " " "	17 1-5 "	14 1-3 "
Small " " "	16 2-5 "	9 1-2 "

The result being in favor of an equal weight of large potatoes for seed.

6th—Seed placed on the surface, and covered to the depth of two, four, six, and eight inches. There is not so great a difference in the yield as some would suppose. Those covered four inches deep gave the largest average for the five seasons, being 19 lbs., also the average per cent. of large potatoes. The next best yield were those planted eight inches. Average yield for two inches, 17 lbs; four inches, 19 lbs; six inches, 18 lbs; eight inches, 18½ lbs.

7th—Seed planted below the surface two, four, six and eight inches and covered to same depth. There seems to be a marked difference in the results of this experiment:

The average yield for five years,					below the surface,	2	inches.	16 lbs.
"	"	"	"	"	"	4	"	17 1-2 "
"	"	"	"	"	"	6	"	12 1-2 "
"	"	"	"	"	"	8	"	12 lbs.

showing a rapid decrease below four inches.

8th—Medium cut to two parts and the product of one part in a hill, compared with two parts in a hill. The result of this experiment, averaging the results of the five trials, is in favor of planting two parts in a hill, as regards quantity, but one piece gave the greatest per cent. of salable potatoes; one part gave an average of 16½ lbs., two parts 17 lbs.

9th—Medium potatoes, planted whole, compared with the same cut to two eyes, and one piece planted in a hill. Medium potatoes planted whole gave the heaviest yield on an average, for five years, but the results varied considerably, sometimes being considerably in favor of whole potatoes. In 1874, the result was the same, while in 1875 those cut to two eyes, gave much the larger yield, and in every trial gave the largest per cent. of salable potatoes. Whole sets on an average 13 lbs; cut to two eyes on an average, 11½ lbs; large 9; 8 in favor of cut.

10th—The amount of potatoes produced by planting in flat hills, compared with the amount produced from pointed hills. The latter gave the best yield in every trial, average 19½; 16¼ in favor of pointed hills, the result from pointed hills gave the largest per cent. of large potatoes.

11th—The product of potatoes planted in small hills compared with the product of potatoes planted in large hills. The average results is as follows: Small hills 17½ lbs., large hills 16½ lbs. The per cent. of large potatoes about equal in both.

12th—Large potatoes cut to two parts; the product of one piece in a hill compared with two pieces in a hill. One piece equal 19½ lbs., two pieces equal 19¼ lbs., showing but very little difference in the average yield of the two.

13th—An equal number of eyes planted in each hill, and an unequal number of stalks allowed to grow. Where there were only two to four stalks allowed to grow the yield was the best, and the potatoes were of a larger size than where more than four were allowed to grow.

V. Experiments with Fertilizers on Potatoes, Beans, and Ruta-bagas. By G. W. Lufkin, No. Yarmouth.

It is a fact well known to nearly every intelligent farmer, that plants are composed of certain chemical substances, prominent among which are nitrogen, phosporic acid, sulphuric acid, lime, potash and magnesia. Now, it would seem at first thought, if we wish to fertilize a certain crop, we had

only to apply these elements to the soil in the proportion in which they are found in the crop. But the soil may be deficient in some of these elements, and have an abundance of others. For instance, magnesia is found in sufficient quantity in the poorest soils; sulphuric acid and lime are more often deficient, but can be restored very cheaply by the application of sulphate of lime or plaster; phosphoric acid may be wanting, while potash is in excess. It would be the height of folly to apply a fertilizer which the soil already had in abundance. The principal ingredients, however, both on account of their scarcity and high price, are nitrogen, phosphoric acid and potash.

The question now is, when is it necessary to apply these fertilizers, and how can it be done the most cheaply. This question can only be answered by experimenting on different soils and comparing results. The Connecticut Agricultural Experiment Station, observing the need of some such work, caused sets of the fertilizers to be prepared, which were furnished to a few persons willing to make a trial of them. Experiments with one such set, forms the subject of this essay.

The spot selected for this trial, was situated a little to the south of the new barn. Soil, a sandy loam. From the time it was cleared till it was broken up in the fall of 1874, it had been pastured. In 1875 it was summer tilled, and in the spring of 1876, received a light dressing of stable manure, and was sowed to a mixture of wheat, oats and barley. This spring, 1877, it received a light coat of stable manure, which was thoroughly cultivated in. After plowing, the ground was divided into strips 22 rods long by 3 feet wide, equal to 1-40 of an acre; between each plot was a space sufficient for a single drill. A drill was then made lengthwise of the plots, and the fertilizers were sown on the sides and bottom of the drill, and thoroughly incorporated with the soil by the use of garden rakes. Plot No. 1 received 20 lbs. dried blood, containing 10.5 per cent. nitrogen; No. 2, 20 lbs. dissolved bone black, containing phosphoric acid, 15 per cent.

soluble; No. 3, 20 lbs. chlorate of potassium, containing actual potash, 52 per cent.; No. 4, 10 lbs. each of dissolved bone black and dried blood, containing phosphoric acid 7.5 per cent., and nitrogen 5 per cent.; No. 5, 6⅔ lbs. each of dried blood, dissolved bone black and chlorate of potassium, containing nitrogen, 33 per cent., phosphoric acid, 5 per cent., and potash, 17 per cent.; No. 6, sulphate of lime, furnished by 20 lbs. land plaster; No. 7, 20 lbs. kainite, or sulphates of lime and magnesia; No. 8, 20 lbs. Bradley's Superphosphate; No. 9, 20 lbs., Cumberland Superphosphate, and No. 10, 20 lbs. Rafferty & Williams' Superphosphate. All the fertilizers were applied at a uniform rate of 800 lbs. to the acre. Each plot was divided into 3 equal parts, designated as sections A, B, C. Section A of each plot was planted to Early Rose potatoes; B, to yellow-eyed beans, and C was sown to ruta-bagas. Each unmanured plot was planted to correspond to the manured ones. The planting was done between June 7th and 9th.

Through the growing season, the nitrogen and phosphoric acid seemed to do best on the potatoes and beans. On the ruta-bagas, the phosphoric acid and the mixture of phosphoric acid and nitrogen did finely, while on those plots where the nitrogen and potash were used separately, the plants grew well till the middle of July, when for some cause or other they came to a complete stand-still. The potatoes were dug the 8th of September.

The following table gives the results of this experiment:

FERTILIZER.	Yield in weight.	Gain in yield over unmanured plots.	Cost of manure per acre.	Market value of increased product.
Nitrogen	61 lbs. 8 oz.	33 lbs. ⅓ oz.	$20 00	$49 50
Phosphoric acid	86 lbs.	57 lbs. 8⅓ oz.	21 00	86 40
Potash	52 lbs.	23 lbs. 8⅓ oz.	26 00	35 10
Nitrogen and phosphoric acid	79 lbs. 12 oz.	51 lbs. 4⅓ oz.	21 50	76 80
Nitrogen, phosphoric acid and potash,	77 lbs.	48 lbs. 8⅓ oz.	22 33	72 80
Plaster	56 lbs. 2 oz.	27 lbs. 10⅓ oz.	6 00	40 78
Kainite	36 lbs. 12 oz.	8 lbs. 4⅓ oz.	18 00	12 30
Bradley's Superphosphate	82 lbs. 8 oz.	54 lbs. ⅓ oz.	22 00	81 00
Cumberland Superphosphate	79 lbs.	50 lbs. 8⅓ oz.	22 00	75 90
Rafferty & Williams' Superphosphate,	63 lbs. 7 oz.	34 lbs. 8⅓ oz.	22 00	51 90
Unmanured	28 lbs. 7⅔ oz.	–	–	–

In this table the cost of applying the fertilizers is estimated at $2.00 per acre; market value of the potatoes, 75 cents per bushel. By examination, it will be found that the market value of increased production is greatest under phosphoric acid. Of the mixed fertilizers, nitrogen, and of the superphosphates, Bradley's, give the best results. Value of increased production is least under kainite. The greatest net gain from the use of fertilizers, phosphoric acid, $65.40 per acre; the least, potash, $9.10; while kainite shows a net loss of $5.70 per acre.

The beans were picked September 14th, and after being thoroughly dried, were threshed and weighed; the vines were pulled, and after drying were also weighed. The following table gives results:

FERTILIZER.	Yield in weight.		Gain in yield.		Cost of manure.	Value of increased product.	Value of loss in product.
	Beans.	Vines.	Beans.	Vines.			
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.			
Nitrogen	1 10	2 14	3	1 5	$20 00	–	$16 09
Phosphoric acid	9 10	9	5	4 13	21 00	$27 60	–
Potash	2 2	3 5	2 8	14	26 00	–	13 24
Nitrogen and phosphoric acid	8 2	8 7	3 8	4 3	21 50	19 62	–
Nitrogen, phos. acid and potash	6 8	7 2	1 14	2 15	22 33	10 75	–
Plaster	6 2	6 1	1 8	1 14	6 00	8 43	–
Kainite	4 10	3 8	–	14	18 00	–	25
Bradley's Superphosphate	8 6	7 8	3 12	3 5	22 00	20 59	–
Cumberland Superphosphate	8 6	6 8	3 12	2 5	22 00	20 23	–
Rafferty & Williams' Superphosphate	8 12	7 2	4 2	2 15	22 00	22 39	–
Unmanured	4 10	4 3	–	–	–	–	–

The market value of the beans is estimated at $2.75 per bushel of 67 lbs. The market value of increased production is greatest under phosphoric acid. Of the mixed fertilizers, nitrogen and phosphoric acid give the best results; of the superphosphates, Rafferty & Williams'. Nitrogen, potash and kainite show a loss in production. The greatest net gain from the use of fertilizers, phosphoric acid, $6.60; the least, Rafferty & Williams' Superphosphate, $0.39. The greatest net loss, potash, $37.24; the least, Bradley's Superphosphate, $1.41. The increased product from any of the fertilizers, except phosphoric acid, plaster and Rafferty & Williams' Superphosphate, was not enough to cover their cost. The whole crop was not up to the standard, and it was hardly a fair experiment.

The ruta-bagas were harvested October 5th. The following are the results. As plots 1 and 3 failed to come to maturity, they have been omitted:

FERTILIZER.	Yield in measure.	Gain in yield over unmanured plots.	Cost of manure per acre.	Value of increased production.
Phosphoric acid	3 bush. 1½ pks.	2 bush. 1½ pks.	$21 00	$63 60
Nitrogen and phosphoric acid	4 bush. 1 pk.	3 bush. 2 pks.	21 50	104 40
Nitrogen, phosphoric acid and potash,	4 bush. 1 pk.	3 bush. 2 pks.	22 33	104 40
Plaster	2 bush. 1½ pks.	1 bush. 2½ pks.	6 00	49 20
Kainite	2 bush. 3 pks.	2 bushels.	18 00	60 00
Bradley's Superphosphate	3 bush. 3 pks.	3 bushels.	22 00	90 00
Cumberland Superphosphate	3 bush. 2 pks.	2 bush. 3 pks.	22 00	82 80
Rafferty & Williams's Superphosphate.	2 bush. 2 pks.	1 bush. 3 pks.	22 00	52 00
Unmanured	3 pks.	–	–	–

Value of turnips per bushel, 25 per cent. The market value of increased production is greatest under the two mixed fertilizers; while of the superphosphates, Bradley's gives the best result; it is least under plaster. The net gain from the use of fertilizers is greatest under nitrogen and phosphoric acid, $82.70; the least under Rafferty & Williams' Superphosphate, $30.80. With the exception of plots 1 to 3, this was a very satisfactory experiment.

By comparison of the several tables, it will be seen that phosphoric acid gives the best result, except in the case of ruta-bagas, where nitrogen and phosphoric acid is best. As a general thing all those fertilizers containing phosphoric acid succeeded finely. As the ground on which the experiment was performed was old pasture land, we may safely conclude that a large part of the phosphoric acid of the soil has been carried away in milk and bones of the cattle which grazed there. Considering the cheapness of plaster, it gives a fair result, while nitrogen and potash seem to be of but little value. Of the superphosphates, Bradley's seems to be best for potatoes and ruta-bagas, and Rafferty & Williams' for beans. It is, however, only carrying these experiments through a series of years, and comparing results, that we can hope to learn the true needs of the soil.

VI. The Sugar Beet. By D. S. Jones, Dennysville.

The sugar beet was first found in Turkey, growing in a wild state. It was introduced into France and Germany in the latter part of the sixteenth century, and cultivated to some extent. A few factories were started for the purpose of separating the sugar from the other constituents of the beet; but the process was slow and laborious, everything being done by hand power, and the machinery being very imperfect, a very large part of the sugar must have remained unseparated in the pulp or refuse, as the amount obtained was only from one to two per cent. of the weight of the beet.

But by the introduction of improved machinery, by the careful cultivation of the beet to obtain the largest per centage of sugar, and by the knowledge and experience gradually obtained by the producer and manufacturer, they at the present time obtain from seven to ten per cent. of sugar, and this, too, at a cost which enables them to compete with any country that obtains its sugar from the cane.

It is noticed by many writers on this subject, that in France those farms that take the principal prizes offered by agricultural societies, are those on which sugar beet culture is carried on. It requires deep tillage, clean cultivation and heavy manuring. The pulp is brought back to the farm and fed to stock, thus keeping up the fertility of the soil.

The United States has done but little towards its cultivation and manufacture, having at the present time but one manufactory in successful operation, which is in California. But looking at what it has done for France, and at the results of a number of experiments that have been conducted in our own country, we can see many of the benefits which she or even Maine would derive from it, if once successfully started and carried forward.

The main object of the experiment conducted by myself through the past season on the College farm, is to determine what variety of sugar beet, what method of cultivation and what fertilizers applied, will give the largest percentage of

sugar at the least cost. Of course this cannot be determined by the results of one experiment, nor by those of two; but to determine it satisfactorily we must get the average of a number of them, and this will be *one* of the number.

The plot of land taken for the experiment was a piece upon which strawberries had been grown for quite a number of years. It has a slight easterly slope. The soil is a sandy loam. The strawberry plants were removed and the land deeply ploughed, about the 20th of May, 1877. It was then well pulverized and the stones and lumps of earth raked off. The plots were then staked off, each two feet square, and lying in pairs, as shown on the plan. May 24th, the fertilizers were applied. The rates per acre at which they were applied are given on the plan. As each plot contains one hundred square feet, the quantities applied to each would be $\frac{100}{43560}$ of those applied per acre. They were carefully reckoned and weighed separately, then mixed and applied broadcast as evenly as possible, each plot of the pairs receiving the same kind and quantity. Those applied on the first and second pairs, Nos. 1, 2, 3 and 4, were raked into the soil with a garden rake.

The barnyard manure on Nos. 5 and 6, was worked into the first eight or ten inches of soil.

The second part of those applied on Nos. 7 and 8, were worked into the soil about ten inches deep, while the first part was simply raked into the surface. The last pair received no fertilizer.

May 25th, the first plots of each pair, Nos. 1, 3, 5, etc., were marked by drawing an eight inch marker lengthwise and crosswise of them, making intersections eight by eight inches apart; and the second plots, Nos. 2, 4, etc., by drawing a ten inch marker lengthwise, and a twelve inch one crosswise of them, making intersections ten by twelve inches apart, in which the seeds were to be dropped. Each plot was then divided into three equal parts, as A, B, and C, making thirty sub-plots.

On A was planted Vilmorin's French White Sugar Beet.
On B " " Improved (imported) "
On C " Carter's Prize Nursery Beet.

Two seeds were dropped at each intersection of the marker, and covered by hand. They germinated well in all but the first and second plots, where a great many did not germinate at all.

About the first of July all the vacant places were filled, by transplanting the same variety from where more than one was growing at an intersection on the same plot. Soon after this they were thinned out, leaving one plant at each intersection, which in Nos. 1, 3, 5, 7 and 9, would be eight by eight inches apart, and in Nos. 2, 4, 6, 8 and 10, ten by twelve inches.

Summing up what has been done, we find that there are *five* different fertilizers applied, *three* varieties of beets growing, and *two* methods of cultivating the same, making thirty different results to be obtained. Nothing further was done to the plots, except keeping them free from weeds, until they were harvested October 6th. The beets from each sub-plot were weighed separately: first, the roots and tops together, and then the roots alone. About the tops: I will simply say that on No. 1 they weighed exactly the same as the roots, but in most cases they weighed from that down to three-fourths as much. The yields given pertain to the roots only.

It is now taken as a fact, having been proved by both scientific and practical experiment, that phosphoric acid, potash and nitrogen, are the principal, and in most cases the only constituents of plant food which are not found in abundance in the soil and air. These, then, must be supplied in an available form for the plant to feed upon, or after having taken up all of any one of these that the soil contains, it will cease to grow, no matter how many other kinds of plant food there may be for it to feed upon.

From a table made up of the average of a number of results obtained by European chemists, on the exhaustion of the soil by the different crops, we find 1000 pounds of sugar beets take from the soil:

Roots,	Phos. acid, 0.8,	Potash, 3.9,	Nitrogen, 1.6
Tops,	" 1.3,	" 6.5,	" 3.0

The three pairs, Nos. 1 and 2, 3 and 4, 7 and 8, on which the commercial fertilizers were applied, have superphosphate, muriate of potash and plaster, common to all. The plaster contains a large quantity of lime and of sulphuric acid, but is used here principally as an absorbent of the ammonia gas in the air; and it also acts upon the potash which is in the soil, and renders it in a suitable form for plant food. The superphosphate supplies the phosphoric acid, and the muriate of potash the potash in available forms for the beet to feed upon. Let us now look at the sources from which the nitrogen is obtained.

On the first pair, Nos. 1 and 2, nitrate of soda, containing about 15.5 per cent. of nitrogen is applied at the rate of 500 lbs., containing 77.5 lbs. of nitrogen per acre.

On the second pair, Nos. 3 and 4, sulphate of ammonia, containing 20 per cent. of nitrogen, is applied at the rate of 400 lbs., containing 80 lbs. of nitrogen per acre; each pair receiving about equal quantities of nitrogen, 80 and 77.5.

On comparing the yields per acre of the two, we find No. 1 of the 1st pair yields 43,125 lbs.; No. 2 of the 1st pair yields 37,026 lbs.; average, 40,075 lbs. No. 3 of the 2nd pair yields 45,738 lbs.; No. 4 of the 2nd pair yields 44,867 lbs.; average, 45,302 lbs. Giving an average yield of 5,227 lbs. per acre in favor of applying nitrogen in the form of sulphate of ammonia, rather than in the form of nitrate of soda. It is said to be a fact, that nitrate of soda furnishes more available nitrogen to the young plant, and sulphate of ammonia to the old, than an equal quantity of nitrogen contained in either alone would furnish in an available form throughout its whole growth.

On the fourth pair, Nos. 7 and 8, that part of the fertilizers containing sulphate of ammonia at the rate of 200 lbs., which contains 40 lbs. of nitrogen per acre, was worked into the soil quite deep, being left in a suitable position to be taken up by the plant in the latter part of its growth. While that

part containing nitrate of soda at the rate of 230 lbs., which contains 36 lbs. of nitrogen per acre, was left near the surface, or in a suitable position to be taken up by the young plant. Taking the sum of the quantities of nitrogen applied in both ways, we find it to be 76 lbs., or very nearly equal to the quantity applied to each the first and second pair.

On comparing the average yields per acre of these three pairs—average of Nos. 1 and 2, 40,075 lbs.; of Nos. 3 and 4, 45,302, lbs.; of Nos. 7 and 8, 48,787 lbs.; showing an average yield of 8,712 lbs. per acre in favor of applying nitrogen in the manner applied on Nos. 7 and 8, over applying a nearly equal quantity in the form of nitrate of soda as in Nos. 1 and 2; and of 3,049 lbs. over applying a nearly equal quantity in the form of sulphate of ammonia, as in 3 and 4. The average yield of Nos. 5 and 6 is 43,778 lbs. per acre.

Experiments have shown that in order to get the full benefit of barnyard manure it should be applied the year before the beets are grown, and that the sugar is not so easily obtained from the beets grown on it, as from those grown on the commercial fertilizers.

The average yield of Nos. 9 and 10, where no fertilizer was applied, was 47,262 lbs. per acre, which is next to the best. This is accounted for in some measure by the fact that it was the lowest pair on the slope, and received the wash from those above.

In regard to the variety of beet: The best average yield per acre was—

Carter's Prize Nursery, 61,298 lbs. = 30 tons, 13 cwt. (about.)
Vilmorin's French White, 39,144 lbs. = 19 tons, 11 cwt., 44 lb.
" Improved (imported) 34,439 lbs. = 17 tons, 4 cwt., 39 "

The average weight of each variety is as follows:.

	Planted 8 by 8 in. apart;	10 by 12 in.;	Average.
Carter's Prize Nursery,	9 1-2 oz.	16 8-9 oz.	12 1-10 oz.
Vilmorin's Fr. White,	6 8-25 oz.	10 2-5 oz.	7 4-5 oz.
" Improved (imp.)	5 8-25 oz.	9 6-11 oz.	6 5-6 oz.

These figures show that Carter's Prize Nursery beet gave by far the largest yield and the largest root, although they were

not of so handsome a shape, as a general thing, as the other varieties. The average yield of those planted 8 by 8 inches apart in the plot, was larger than that of those planted 10 by 12 inches apart, by 1,642 lbs. per acre. Of course they were smaller beets, but the number considerably larger would be obtained per acre.

Six of the medium sized beets were selected from each of the sub-plots, and packed in sand to be analyzed by the Professor of Chemistry in the College Laboratory, and the percentage of sugar contained in each ascertained, which will probably be reported in due season.

WHAT SCIENCE MAY DO FOR FARMING.

By Prof. Henry Carmichael, Bowdoin College.

There seems to be the impression abroad, that the State of Maine is an excellent State to emigrate from, and that no man in the full possession of his senses would seek here his home. It is pictured as a land of terrible winters and inconstant summers; its coast, rock-bound and inhospitable; its interior a succession of barren hills; its inhabitants hugging their poverty, as the ivy clings to its mouldering support, and deluding themselves with the vain hope of better days. But these are the representations of strangers or of enimies; the experience of every one here present would, I doubt not, give them the lie. We need not take a physical chart in hand to show that the lines of equal, average temperature run with us not east and west, but along our coast, so that the climate of Portland shall be less severe than that of Albany, N. Y. So to those who have sound, well-nourished bodies, our winters have no terrors, and every summer brings within our borders hosts of tired strangers, who seek vigor from the favored atmosphere of our State. The frost, indeed, comes early and retires late, and yet there are few products of temperate climes that may not be raised here in excellence and quantity. Our water-powers, still untaxed, are capable of giving rise to a thousand industries. Rich mines and quarries abound. If beautiful surroundings be an inducement to residence, where upon our eastern coast, outside the State of Maine, may be found nature so nobly personified as at Camden, Castine, or Frenchman's Bay? Coming here in the evening, I have not as yet seen the village of Fryeburg, but I know its reputation, and I ask where will be found a place that better

holds its inhabitants, and more attracts visitors by its scenery, its cultivation and its associations, than does this town?

Yet, it must be admitted that the tiller of the soil has here a laborious task. The earth requires more than a tickling with the hoe, that it may laugh with corn. Happy is the farmer, who, after removing the boulders, finds a soil capable under the most skillful and assiduous cultivation, of yielding more than the most ordinary competence for the education and comfort of his family. Unremitting work and economy are the Maine farmers' lot. If patient industry is to have its reward, I deem that man a philanthrophist, who shall make this life sweeter and more remunerative. I suspect if each one of you gentlemen should be pressed for a frank and candid answer, you would say: "I really think nature might have treated me a little better, so far as dollars and cents go."

Yet, what claim, I ask, has more industry for reward? That we may give an unprejudiced reply, let us take a distant illustration. High up on the sides of the Alps, upon little shelves of rock, apparently no larger than swallows' nests, the traveller sees the chalets of the Swiss peasants. By dint of hard labor he reaches the small patch of green, where one of these miserable hovels has been perched. Heavy stones rest upon the roof as if to anchor down what would be carried away by the terrible storms that sweep the mountain sides. Frequently they are without windows or fire, in the midst of winter. One room answers for the cattle and their keepers. And now, vanish Oh Poesie! The ruddy peasant of song and story is ragged and greasy, and his face is brutalized by overwork. The peasant girl, beautiful in anticipation, is a wrinkled crone, no better than her fellow, the fine texture of a woman has been ground out by hardship. "Their lot is worse than they deserve," says some one. "Are not the valleys fertile? If descending they find no foothold, is there not room enough in America? Why do they cling to the squalid home of unrequited labor? If they choose to stay they must be content with their reward. Their lack is a lack of intelligence; their toil has not received, for it has not deserved, remuneration."

Let this logic be applied to our unfortunate farmers. If the land is altogether infertile, if there is no soil to be developed, let it be known, for there are other lands that invite them. They deserve no sympathy for their unwarranted toil, they are fools for their pains. Many have accepted this logic. Nature says—"Remain in Maine and use your wits as well as your hands, or go West where the soil will do the thinking for you." Unwilling to undergo the rigorous training of the mind for scientific farming which alone is called for here, our young men have forsaken the homes of their fathers, and gone out by hundreds to the Western States.

It was my fortune the other day to ride through one of the oldest agricultural districts of our State. It is a rocky region, but it possesses valleys of natural fertility and well wooded slopes. Near sea and river, it is both beautiful and accessible. It invites occupancy and trade. Yet in spite of its natural advantages the blight seems to have fallen upon it. Its few habitations are rotting to the ground. On the one side and the other may be seen piles of bricks covered with brambles, and massive stone walls, indicating where once was thrift and industry. There was one flourishing feature—an abundance of grave-yards. A curious friend counted thirteen in a ride of eight miles. Every family seemed to have a private burying ground. There is a world of meaning in such cities of the dead. What was the result of the privation, the toil, the hard-fought lives of which these lichen-covered tombs are the only memorials? Their very names are forgotten, and their possessions are abandoned as not worth the inheritance. This is not a rare occurrence. The traveller journeying hither and thither through Maine, too often passes the moss-chocked orchard and half-filled well, significant tokens of an agricultural, and perhaps a life's failure.

What is the contest that has desolated our State, taking from it its young blood and sinew? It is but a peaceful rivalry of a surface of rock and sand, with a surface of fertile mould, yet our loss is greater than from the carnage of war.

Do you say that this is an exaggeration? that the number of farmers is greater to-day than it was ten years ago? True, for the census shows the number of farms to have actually increased from 55,698 in 1860, to 59,804 in 1870. Yet we must remember that many of the latter are occupied by newcomers who fill but numerically the places of their predecessors.

It is relatively that we have suffered loss. To illustrate,—who would infer from the census that a gigantic civil strife had lately taken from our midst a host of young braves? No more will it tell of the loss we have sustained in this peaceful contest of which I have spoken. It is only by computing the natural increase that we may infer our loss. During the ten years from 1860 to 1870 the increase of farms throughout the United States has been one-third. Instead of 59,000 there should be over 70,000 farms in Maine to-day.

To estimate the full measure of our loss we must inquire of Illinois, Iowa, Colorado—the great prairie and mining States, as to the antecedents of those who are leading their great enterprises, conducting their huge farms, building up this gigantic civilization. We shall find that a goodly proportion of them are sons of Maine. They will tell us that they have left home reluctantly, tearfully. The temptation—a solid yard of rich loam, they could not resist. They have left home, friends, kindred, and though their hearts may burn for the mountains and rivers of their boyhood, they will prefer probable affluence on a surface of muck to probable poverty on a surface of sand.

Now mark the result. If there were taken from us annually our criminals and good-for-nothings, such as foreign countries delight to send to our shores, we might consider it well. But our refugees from poverty are men of spirit and daring—a few hotspurs and dreamers, perhaps, but mostly of the class we can ill afford to lose. Historians depict in most glaring colors the terrible woes that have befallen France and Spain from the loss of the Huguenots. Similar evils are surely entailed upon our States by the exodus of her best

sons. Numbers do not represent our loss, and it behooves every good and patriotic citizen to devise means for profitably occupying our young men. Our own welfare demands this, for we can retain them only by proving the profit and nobility of farming. Our most selfish and most worthy motives are at peace. Thus the presumption is formed that there is something lacking that must be supplied—something wrong that must be reformed. Let us then, as the physician would say, complete the diagnosis of the case. Having ascertained the difficulty let us inquire—"May science remedy it?" and if so, "How is science to be applied?"

What is the great allurement that calls our young men to the West? At the centennial exhibition you may have seen in high glass tubes, veritable sections of western prairie soils. To give their height, color, per centage in salts and vegetable matter, conveys no hint of its wonderful richness. To be appreciated it must be seen with the giant growth of corn upon it. Such a soil is better than mines of gold or rubies, and it is a part of our problem to show how it may be imitated if not quite equalled.

If by artificial means we may supply to our clay, gravel, sand, substances that will make the land as fertile as that in the tube, no one would wish to leave. With us, indispensable elements of plant food must be supplied which with them, are already in the soil. Here the streams coursing down the valleys year after year, have washed the earth's surface. This process of denudation has been carried on upon a still greater scale in times past. One who attentively observes the surfaces of the granite hills is sure to find grooves and scorings on the compact rock which have the direction always of north and south. Now, these indicate that in times before history began, a sheet of ice higher than the highest mountains covered the land. It swept slowly, remorselessly to the sea, carrying with it the soil and elements of fertility on the surface. If we could restore to it those treasures of which past times have robbed us, we would not acknowledge any land as our superior.

Let me premise, that I do not stand here to-night as a teacher of practical agriculture ; I profess before you the deepest ignorance of your calling. Well I recollect the last agricultural attempts of my boyhood. A whole package of celery seed were planted in a frame a few feet square. Every seed seemed to sprout, and when it came time for weeding, I could not have done it with a microscope. I could not take a scythe in my hand to-day, without feeling that my toes were insecure, and I never engage in weeding without feeling a profound sympathy for a fossil-hunting friend, who sighs for a cast-iron back with a hinge to it. Nevertheless, as an unprejudiced looker-on, (deem it presumption, if you will) I shall tell you that many of your practices are entirely wrong. As a student of chemistry, and of those forces which underlie the growth of animals and plants, I know them to be wrong.

Science may in the first place teach the farmer to observe and experiment.

Science is not, as many imagine, a dry, musty collection of odds and ends of truth. It is much more a living method for discovering truth, which is as applicable to farming or theology, as to bugs or stones. The practical man and the philosopher, alike desire to get at the truth but for different ends.

How few men there are, who can make good use of their eyes. Untold treasures are trodden under foot, while the laborious seeker is fooled by pyrites. One will foretell you the weather from the cry of a bird, another forcasts the winter from the nest of the muskrat. Both prophets will fail ten times, yet distrust their senses rather than their delusion. Farmers discuss fertilizers, muck, fencing, breeds of domestic animals ; all give close attention, make trials. Years roll by, and their opinions are more diverse than at the start ; coincidence is mistaken for causation. This follows that, and the unsuspecting says it results from that.

A young man comes to me and would learn chemistry. He has read all about it, and would now practice it. I make him a few experiments, and he says to himself, "Is it so simple?" The materials are placed in his hands, and he is left to his own

resources. Now, if that pupil comes to me after a time and confesses that he cannot trust his fingers or his eyes; that his knowledge is vain, then there is hope of his commencing at the bottom and working to the top of this science, like those who have made it. It is the merit of science, that it enforces this self-distrust upon all its faithful votaries. With them as with Socrates, knowledge consists in knowing that we know little.

This wholesome conviction guards from error, and the theories that have been unhesitatingly received by theologians and metaphysicians, have been held aloft, until their true character became known. Thus it is, that while religion has sects, philosophy schools, and almost every capital subject disputants, science is one, and its facts endure with the ages.

A cautious, systematic investigation of the mooted questions of agriculture, taking into consideration all the peculiar circumstances of the cases should put them beyond discussion. This has already been done with a number of them at the experimental stations of Europe. For working out these problems, there is necessary at the outset, an intelligent scepticism towards commonly received maxims, and the other disbelief in signs, superstitions and old wives' traditions.

In the second place, science will tell the farmer why a thing is to be done. There is too much farming done on the pinch to suit the taste principle of the kitchen. To know how to do a thing is most excellent, but it is vastly better to know why a thing is done. The first is like the action of a brute, mechanical instinctive; the second is an act of intellect, —human. Plodding labor is a most desirable quality; intelligent labor is unmeasurably superior.

It is true, bountiful crops, delicious fruits, and beautiful flowers may be raised by one who cannot tell how it is done, but such a one placed under different surroundings, on a new soil, in another climate, where the season is unusual, or the soil has become sterile, in the presence of a new seed or a devouring worm, knows not what to do. Like the beaver, which in a man's study, builds a dam of books and carpet

against floods, which never come, his very instincts lead him astray.

Science gives the reasons for reasonable actions. It tells just why one fertilizer is used rather than another, the relation of preparing and planting the land, and its products. If you will intelligently tell a chemist the composition and structure of your soil and the situation of your farm, he should be able without experience to tell you what can be raised on it as it is, or what must be done to increase the yield, and this with perfect confidence and security.

It is not enough that man labors until his muscles yield from exhaustion, and then look to Providence for results. Nature has no pity for mistakes. She demands foresight.

3d. Science will enable the farmer to distinguish between good and bad advice. It was my pleasure, not long ago, to listen to some good, earnest advice to farmers, from the lips of an able and distinguished professor. He demonstrated that by the application to land of certain materials in certain proportions, abundant crops might be secured. His statements were verified by figures. Many practical farmers were present, and so far as I could learn, all were agreed that the facts stated were true, and the advice given was honest. Presently there appeared among the assembly of farmers, an agent for a fertilizer. This created suspicion, and the intimation was thrown out that he was an agent of the professor. I knew the latter to be an entirely honorable man, but the suspicion of the farmers once aroused, the good that might have resulted from the proposed plan, was in a great measure destroyed. We have no means of judging, but it is probable that but for this charge, hundreds of farmers would have improved upon the advice given them. But worthless fertilizers are urged upon the farmer, as well as valuable ones, and unless he possesses scientific knowledge, he cannot distinguish between good and bad articles, or good and bad advice.

4th. Science will show to the farmer the particular needs of animals and plants. With plants, an ignorance of the distinction of sex, frequently lies the cause of failure. I am

familiar with a case where there was a large field of valuable plants which yielded neither flowers nor fruit, though every plant produced a good growth. One thing had been neglected: all the plants were of the same sex. A mere smattering of botanical knowledge would have saved the cultivator from failure.

5th. It will enable the farmer to select fertilizers and retain the fertility of the soil. To ascertain the needs of a plant is a simpler thing than to ascertain what our own body demands. The plant requires carbon, but the farmer does not need to supply it to the soil in the form of carbonic acid, it is abundantly present in the atmosphere. The plant needs oxygen, and finds it in air and water. The plant also needs nitrogen; that is contained in the air, but the plant will not touch nitrogen in its pure state. It must be supplied in combination with something else, or in the form of ammonia.

The plant must also have a supply of phosphate. This can be obtained solely from the excreta of animals or their bones. There was a time when the supply of phosphate proved inadequate for the increasing demand. A great cry was raised in the land for phosphate. Diligent search was made for it. Fortunately, in South Carolina an extensive deposit has been found containing the bones of huge animals that formerly haunted the sea where now is land. These fierce monsters have now become extinct, and better in death than in life, have left their bones for the benefit of agriculture. The enterprising English reaching the Orient, brings home ship loads of mummies for their phosphate. The bones of generals, priests and kings, who have retained their power and majesty long in death, are dragged from their resting places that vegetables, the food of late men, may fatten upon them. Thus has the world been ransacked to supply a want indicated but a short time since by the chemist, Liebig.

There is one other element, potash, in which the soil is frequently deficient. Without this substance, which can be seen in nearly a pure state in the leaching of wood ashes, no plant can grow. Potash was formerly obtained by burning

plants, but recently inexhaustible deposits of potash salts have been discovered in Germany. It is brought largely to this country, and from this source potash may be cheaply supplied to soils that have lost their natural fertility.

In connection with the enumeration of the substances necessary to vegetation, it is of importance to observe that the distribution of them is no unimportant matter. If the soil contains everything else, yet lacks one of them, there can be no growth. Again, though all be present, yet there will still be no growth should one be in excess. Fertilizers are good, then, if they are needed; if already present they may poison the plant. The farmer must be able to give to his plants the food they need just as he gives to his domestic animals the food that is best adapted to promote their growth, to enable them to perform the labor he requires of them. For supplying the numerous needs of the crops, we find him depending almost upon the accumulation of barn-yard manure. Were there enough of this substance, it would indeed answer every purpose. Consisting originally for the most part of useless water, it loses so much of its important constituents by exposure, that if the substances the plant wants were to be taken out from a bushel of the costly manure, they would not fill a snuff box. Thus it is, that most farms are in a state of constant starvation. By experiments, properly conducted, these needs may readily be ascertained and supplied, and the waste of valuable elements of fertilization stopped.

Maine is the sixth State in the production of potatoes, and the eighth in the production of hay. She has, then, great advantages for the production of these two crops, and both of them are shipped in large quantities from the State. Now, how much value is thus taken away to other States? Every bushel of potatoes contains one-third of a pound, and every ton of hay contains 44 pounds of solid potash. Yet the farmer sends these away year after year and expects potash to be supplied. Where is the potash to come from? It was not originally in the soil, it was deposited there, and if he has taken it out he must put it back again. Some other sub-

stance will not answer. It is not silica the plant needs, it is potash. What a beautiful economy could be carried out on a farm if the knowledge of the composition of soils, and the proper application of manures, could be applied to the art of farming.

The farmers have a strong prejudice against concentrated fertilizers. It is not easy to bring the proofs to bear to dislodge this prejudice from the mind. It was a long while before science could bring people to believe that all the medicinal properties and virtues of a large quantity of Peruvian bark could be concentrated in a single pill. We are now going through a similar experience with fertilizers. We have been so long in the habit of fertilizing with a large quantity of material that we are slow to understand that we can accomplish the same results, more surely and more easily, by a small dose.

6th. Science may arm the farmer against his foes. Every now and then, there comes from some obscure quarter a devouring worm. It seems as if every beautiful or desirable thing that grows is an especial object of pursuit. Some of you can recollect, perhaps, when peaches were produced in Maine of considerable size. The peach, the plum and the currant have met with their foes. The apple is left, but I fear every day, something will come and take this, our last fruit. The scientist studies the habits of these pests, finds out what they eat, and when they are produced, and often he is able to inform the farmer that by planting a little earlier or a little later, certain worms may be avoided. There was a time when it appeared as though the silk industry in France would be destroyed. The silk-worms sickened and died. No farmer could tell what ailed them. They were just as well the night before, apparently, as the others. The population dependent on the silk industry was on the brink of famine. The French Government was at its wits end, but with the sagacity which it has always displayed in such emergencies, it selected one of the most expert scientists of the day to make microscopical investigation. He found that the blood of some

of these insects was diseased. He devised means for destroying those that were so diseased, and, by the use of the microscope, for saving those that were well. The silk industry is now flourishing through that man's discoveries.

Farmers have frequently good intentions in regard to a difficulty, without such knowledge as will guarantee them success in their efforts to surmount it. Take the case of the wheat rust. The German peasants had been for a long time suspicious of the barberry bushes that were grown in hedges beside the railroads, until so great had come to be their hatred of them that they frequently assailed and destroyed them. As the hedges were extended the devastation of crops increased. The peasants did not know that there was any connection between the two; they had only a vague distrust of the barberry bushes. Now comes an obscure scientist and looks into the matter. He finds that the bushes are, at a certain stage of its development, essential to the growth of the rust. By his direction the bushes are cut down and the disease is removed. The farmers were right in their suspicion, but that did not help them. Science was called in, the bushes were cut down, and the rust disappeared as science said it would.

Scientific men have often entered upon a given investigation without hope of reward for the sake of information, but by the result of that investigation agriculture has been greatly benefitted. It is not the province of the scientist to help the farmer. His province as a teacher is an important one, but he has another that is still more important—to ascertain new facts. The farmer ought not to taunt science with—"Why do you not come to my aid?" That is not the office of science. The farmer ought to come forward, to invite science and give her a place on his farm.

7th. Could science be only rightly understood and appreciated on the farm, many new industries might be introduced into our State.

I had the honor not long since of calling the attention of the Board to the desirability of introducing on the continent

a great industry—the manufacture of beet root sugar. Many individuals have asked me—"Can it be brought into the United States?" Millions of dollars worth of the sugar are made every year, and all of our Northern States are adapted to the culture of the beet. It can be grown economically. Why is it not done? Because there is no one to do it. No one farmer can do it successfully. It is an industry that must be conducted on scientific principles. What has it done in other countries? In France it has twice saved the State from bankruptcy. The experiments were first made by scientists. When it was laid down by one, it was taken up by others, until under circumstances that gave it a special importance, it was taken up by the Great Napoleon and has come to assume the place it now holds, as one of the greatest industries of the nation. Their is one point of view in which this industry is of importance to us. I have spoken of the need of potash in our agriculture. But there is no need of furnishing potash to the sugar beet. With its deep tap root the beet reaches a sub-soil untouched by other plants, and scarce indeed must be the potash if it finds none. The refuse material left after the sugar is extricated is excellent food for cattle. So you gain, not only in the production of sugar, but in the raising of cattle, and the enrichment of the soil.

There are a good many points that if I had time, properly to present them, would show how in different directions science could help the farmer. I should like to show, as I can only indicate, what the discussion of the theory of evolution has done for the farmer. There came up the question of how much an animal could be changed. It has been found that the nature and form of animals and plants are pliable, and if time is given you can mould them as you will. The other day I saw a machine into which you place the material, and out comes a box, with bottom, sides and cover, all complete; and another from which if you supply an iron rod, it comes out a box of tacks. In a certain sense, these machines think; the inventor has breathed into them of his spirit; he has substituted the indefatigable arms and fingers of steel for feeble

flesh. Now nature is more intricate than any human contrivance, yet if man will but study and discern, he may fashion her products according to his desires. If you would have a cow with large bones and gaunt body able to run like a deer, you can have such a one, or if you would fashion her with graceful lines, well covered with flesh, and capable of producing a constant supply of rich, creamy milk, it can be accomplished. You may grow bristles on your sheep, or you may give its fleece the fine texture of cassimere. The flesh lies before us as the sculptors' marble, out of it may be wrought the ideal. If the result is wrong, it is because *man* has failed. If his processes are right, he may substitute for his laborious and inefficient efforts, the tireless and unfailing forces of nature.

I wish now simply to suggest one or two methods, by which these possibilities may be realized. In the first place, our young people, and especially the sons of farmers, must be taught science.

But teachers say, "We hav'nt time or place for scientific study in our schools." If there is a demand for it these will be found. Indeed, natural science may be so presented, as to economize time. Natural science begets an interest in the teachings of the school, and a willing mind like a willing hand does double work. I believe that teachers may be found who have a fitness for giving such instruction, and for the services of such we should be willing to pay liberally. Your boys and girls have the same faculties as young men; they are often better observers, and they can study science with profit. It may be presented to them in its most attractive form, before they are fitted to study it from books. So unnatural and repulsive has our common system of education been made that it has been well said, that there was but one more feature needed for the protection of ideas in our public schools, and that was a police officer to make the children go.

There should be no delay in substituting for Algebra and other obstruse studies, the elements of the natural and physical sciences. The former can render the every-day citizen

but slight services, while the latter opens up a new sphere of observation. Observation begets investigation, and the latter would be especially profitable to the farmer.

Much may be learned from our common schools. We Americans call ourselves practical, yet when we do come at a practical point in inventing or in using a thing, we find that some German chemist or philosopher is at the bottom of it; he has made investigations, but for which it could not have been.

A study of nature commenced in infancy cannot but have had an important influence in determining the scholars and savans, who have made Germany the centre of critical research. How may science be brought to the farmer, who has not his youth before him? The holding of scientific fairs, and a thorough geological survey of our State, are means that might be advantageously employed. The operations of educating young men in practical agriculture, is another way that would assist in making science practical. It is to be hoped that a larger proportion than heretofore, of the graduates of our State College at Orono, instead of becoming professional men and civil engineers, will turn their efforts in this direction. I think that the proportion has been but about one in ten. If so, it has cost the State some $10,000 to get an educated farmer. Such an education involves an unequel tax on the people. It seems to the speaker, to be a matter worthy of discussion, whether it might not be better to make agricultural institutions chiefly model farms, where farmers young and old may have the benefit of an inspection of scientific methods, and carefully conducted experiments. We ask too much of our friends, when we expect them to do the work of a college and of an experimental station. I know they are capable men, but they are poorly paid, scantily supplied with books and apparatus, and over-taxed with routine instruction. It seems to me it might be desirable, if we could make a division, and could have men who should give their whole attention to practical agriculture; or if we could have agricultural experts employed by this Board, who should go

among the farmers and teach them the principles of the sciences, which bear directly upon their profession.

And thus, gentlemen, I have stated the alliance between science and farming, which I deem essential to the future progress of agriculture in Maine. Hitherto this alliance has not been so close as that between science and the other great industries. As a consequence, agriculture is not held to be so honorable as of old. It must be again brought into association with literature and art. The agency by which this may be accomplished, is trained intelligent labor. Such labor creates independence. I would insist that you have money:

"Not for to hide it in a hedge,
Nor for a train defendent;
But for the glorious privilege
Of being independent;"

so that you may employ it for good purposes. I would have you labor with the security of attaining a desired end; I would have you increase your crops by the use of the implements and devices which science and reason bring within your reach. When you have done these things, then will it have become possible to build on this lower stratum the higher possibilities of the human being. Those possibilities are what ennoble a calling, If I did not believe that they might be; if I did not believe that they would be realized, I could not stand here and ask you to conform your practice to the principles of science. Guided by right principles, an advance in one direction is an advance in all. By material prosperity, intellectual power and moral susceptibility are enhanced.

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