WHEAT CULTURE

IN

TENNESSEE.

By J. B. KILLEBREW,

Commissioner of Agriculture, Statistics and Mines.

NASHVILLE, TENNESSEE:

PRINTED BY "THE AMERICAN" PRINTING COMPANY.

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To His Excellency, Gov. Jas. D. Porter :

No branch of agriculture is receiving so much attention at present in the State of Tennessee as that of Wheat Culture. The production of this important cereal has been steadily increasing for several years. In 1870 the crop barely reached 6,000,000 bushels, while that of the present year will probably reach 11,000,000.

There is a growing sentiment among the farmers that the wheat crop, when well managed, is one of the most profitable grown in the State, and the tendency among them is to extend its cultivation, and at the same time to increase the yield per acre. New varieties of seed are being introduced, and many interesting experiments are being made by the most intelligent farmers. There is manifested on every hand a laudable ambition to improve the quality and increase the yield. To aid in this work of agricultural progress, the following pages have been prepared. It is believed that, with proper efforts among the farmers, Tennessee may yet become the peer of any State in the Union in the production of wheat.

I am greatly indebted to Dr. Wm. M. Clarke, of Williamson county, for valuable assistance in the preparation of this work; also, to many farmers throughout the State for important suggestions.

I have the honor to be

Your obedient servant,

J. B. KILLEBREW.

WHEAT CULTURE IN TENNESSEE.

CHAPTER I.

HISTORY—LIMITS OF CULTIVATION—EFFECTS OF A FAILURE OF THE CROP UPON SOCIETY—TEMPERATURE OF RIPENING — ELEMENTS OF SUCCESS IN WHEAT CULTURE.

Longfellow, in his poem of "Hiawatha," introduces a beautiful and romantic myth in regard to the origin of maize. Many traditions among the Indians furnished him with a foundation for this story. These children of the forest recognized in maize the staff of life—the man's real friend. No time so joyous among them as the corn-dance at the maturity of this cereal; and in view of the fact that it was so essential to their very existence, they had good cause to dance and make merry. It is true, many other plants were cultivated among them, but none so vital. It was their *sine qua non*, their *ultima thule*, of agriculture. Honors and sacrifices were given to the Great Manitou for this noble gift to his forest children. Thus may we as well record the origin of wheat in some poetic Georgic as the great, inestimable gift of the gods to man, or accept the mythological account of Ceres having taught to Triptolemus of Eleusis its cultivation and use. It figures often in the Holy Scriptures, and is placed at the head of all vegetation.

Man is often compared to wheat; and this parable is made because man being the first of creative beings in excellence, so, when he is brought into comparison with individuals of the vegetable kingdom, none is found so well suited as wheat. Moses frequently refers to it in his first recorded account of mankind, and it is there selected as the best of offerings to Deity. In Leviticus ii. it is called meat-offering, and in fact throughout the whole Bible it is spoken of as the best and purest of food. By its means Joseph was enabled to safely pass a nation through seven years of famine.

Chinese history declares it was introduced into China by the Emperor Shin-lung, 2700 B.C.

In existence, it is older than the creation of man. When Adam walked forth a created being, no doubt fields of wavy grain sown by Deity awaited his use. Its *habitat* is almost co-extensive with that of man. It differs so much in its requirements from all other plants, in time of cultivation, that seasons, temperature, and altitude seem subordinate to its convenience. It is found on the bleak shores of Alaska, and on the equatorial terraces of the Andes; on the broad steppes of Russia, and in the fragrant valleys of Cathay. Everywhere that man has moved, or emigrated, it stands as his best friend. When the Egyptian monarch, in ancient days, built his pyramids as mausoleums, he did not deem it inappropriate to lay by his side grains of this blessed cereal. It blesses alike the tables of the rich and the poor. It constitutes the feathery rolls of majesty, and the heavy brown bread of the serf. As the poet designates woman as the "last best gift of God to man," so may we claim that wheat was the first greatest boon of an all-wise, beneficent Being to his creatures—one that could cheer, but not inebriate; sustain, but not destroy.

There are, however, important limitations to its successful growth, even in temperate climates, and these are determined by an examination of the peculiar distribution of heat and

humidity, or amount of rain, throughout the year. Its sensitiveness to extremes of this sort renders its culture irregular in success.

The limits of the successful cultivation of wheat is not determined so much by the cold of winter as by the temperature of summer, 57.2° , being the minimum mean temperature of summer heat in which it will mature. The Southern limits vary between 20° and 25° N. and S. latitude, though a sufficient elevation would, of course, reduce the heat as to bring it to any point even on the Equator. The adaptation of the cereal to so great a diversity of situations gives it a value beyond all other products of the field. It furnishes all the elements of nutrition in a most eminent degree.

The absolute temperature limits of the growth of wheat belong to the summer months, or to those in which it ripens; and for these months they may be very precisely defined. The points of both extremes are not far apart; and, if absolute mean temperatures as recorded for the year could be employed, the district embraced would be narrow, indeed.

Before referring to actual districts of its growth, it may be well to give the apparent temperature limits of the ripening season. We all remember the great outcry made in England in 1853, about the retardation of the ripening of wheat in consequence of the low temperature. The temperature of July and August was 2° less than usual, or about 57° , and as a result a falling off of from one-third to one-half of the crop took place. The disastrous effects of a wheat failure in Europe are well known. It has been said that a failure of the wheat crop in France is always followed by a revolution and by bread-riots in England. In England, a temperature of 57° is not sufficient to mature the grain, on account of the excessive humidity of that climate.

This combination of moisture and low temperature does not exist in any district in the United States where wheat is grown. On the contrary, the United States give good results as to ripening in high temperatures. At the extreme

South May is the ripening month, with a mean temperature of 60° to 70° . In Virginia May and June, with the thermometer at from 63° to 72° , and in Tennessee, 20th May to 10th June, and the heat at from 65° to 80° . In Illinois, June, at 60° to 70° , and in New York, July, at 64° to 69° . From these comparisons it will be seen that the temperature for the last growth of the wheat falls rather under 70° . As we go into warmer climates, the period of ripening recedes until it occurs even in April, as in Egypt.

Thus it may be observed that the mean difference, or range, in the thermometer is only about 15° , so that, were we to take the thermometer as a guide, it would appear that wheat culture would only range between these means. But practical experiment has shown that, in fact, its limits are far beyond, and this difference is explained by the combination of heat and moisture. A dry climate will mature wheat at a much lower temperature than a moist one at the same degree of heat. *Per contra*, a moist climate requires a higher degree to bring it to maturity. In this manner, though the heat of midsummer may reach to a mean of 95° , yet elevations will reduce this mean to a point of successful cultivation. In England and Northern Europe the entire year is embraced in the growth of wheat, and so the temperature of every month must be taken into account. In South Europe there are two months in the year, and in the United States, or rather the southern part, there are three months not required in the cultivation of the wheat crop, while in the northern part of the Union August is not included in the time demanded for wheat culture. A large portion of wheat is grown only during the warm months, such as spring wheat.

It will be necessary to notice the effect of the winter months more particularly, as the winter varieties will grow up to the limits of the spring varieties, and even the difference is more in varieties than otherwise, as either kind can be changed by cultivation into the other. In a list of high

temperature hereafter given, it is not to be understood that wheat will not grow or mature beyond this or the low temperature, but that it will not, above or below these points, be a paying or remunerative crop. Some kinds are grown, as before stated, in every point settled by man.

By a slight examination, however, it will be seen that temperature does not alone decide the success, as the dry plains of Western Texas, or the broad valleys of Southern California, produce wheat equal to the best Illinois lands. The uplands of Georgia and South Carolina will also produce better wheat than the coast lands of the same temperature. This is owing to the difference in the humidity of the climate.

Another element of success that must be noted is the amount of snow-fall in regions of country that have a temperature so low that all wheat vegetation would be destroyed. When the snow is melted by the genial warmth of spring, the wheat plant that has been protected springs up and grows with a marvelous rapidity. Alternations of heat and cold are very prejudicial to the safety of wheat, as it greatly tends to winter killing. The growth of wheat in winter renders it more sensitive to the influence of succeeding cold, and tends to destroy it. So that the line just below the region of continual snow is the point most likely to suffer with winter killing.

In the region where wheat is protected by snow, we select the leading points: Rochester, for New York; Gettysburg, for Pennsylvania; Cleveland, for Ohio and Michigan; and Milwaukee, for Illinois and Wisconsin. These are favorable States, and August is not necessary for the growth of wheat at any of these points. The points where the greatest damage is done by alternations of heat and cold without the protecting influences of snow, are Cincinnati, New Harmony, and St. Louis. These places receive a vast amount of rain from the influences of the rivers and valleys along which they lie. This humidity is combined with a higher

temperature also, so that it retards very much the successful issue of a crop. A large amount of rain and a warm climate are not favorable for its cultivation.

But with all observations and all theories in respect to wheat culture, there are modifications unseen and unknown that render futile all calculation. Only practical experience can always determine its best *habitat*. Soil, climate, temperature, with all its changes and variations, from altitude, depression, etc., etc., will make all places of seeming diametrical oppositeness equally suitable for its culture.

The following table of temperatures for the best wheat-growing districts of the world has been compiled, from which it will be seen that Tennessee has a temperature midway between the extreme limits of the leading wheat-growing countries of the world:

TEMPERATURE OF VARIOUS WHEAT GROWING COUNTRIES.

PLACES.	January.	February	March.	April.	May.	June.	July.	August.	Sept'ber.	October.	Nov'ber.	Dece'ber.	Spring.	Summer.	Autumn.	Winter.	Year.
Rochester, N. Y.	26.9	26.5	36.2	47.1	59.0	66.7	72.1	69.2	61.7	50.1	49.5	29.7	47.4	69.5	50.8	27.4	48.7
Gettysburg, Penn.	28.1	30.8	39.3	50.0	60.0	68.8	73.4	70.8	62.9	49.1	38.3	31.4	49.8	71.0	50.1	30.2	50.3
Cleveland, Ohio.	27.2	30.1	36.4	44.4	56.1	68.1	71.7	68.0	62.1	51.0	37.8	24.0	45.6	69.3	49.6	28.8	48.3
Milwaukee, Wis.	25.2	29.4	34.8	47.7	51.3	64.8	69.8	67.5	61.2	50.7	38.5	23.5	42.3	67.3	50.1	26.0	46.4
NORTHERN LIMITS.																	
Castine, Maine.	21.4	22.5	30.4	41.4	50.3	59.4	64.8	64.6	58.4	48.4	38.0	25.5	40.7	61.9	48.3	23.2	43.4
Quebec, Canada.	9.8	12.8	24.3	38.6	52.8	63.7	68.8	65.5	56.2	41.1	31.5	17.3	38.6	65.3	43.9	13.3	40.3
Fort Conlonge, Canada.	11.5	15.7	28.7	40.5	54.4	63.4	66.4	66.4	56.3	45.0	31.3	17.0	41.2	67.1	44.2	14.7	41.8
Fort Brady, Minn.	17.4	17.0	25.7	38.5	44.5	59.4	65.1	63.2	53.9	43.6	32.7	21.3	37.9	62.6	43.4	18.5	40.6
Fort Ripley, Minn.	8.6	13.7	25.7	36.2	49.7	61.9	66.9	64.7	57.1	43.1	30.7	6.6	37.2	64.5	43.6	9.6	38.7
SOUTHERN LIMITS.																	
Norfolk, Va.	40.4	40.9	47.5	53.1	65.9	74.1	78.3	77.1	71.4	61.7	51.2	43.2	56.5	76.5	61.4	41.5	59.6
Camden, S. C.	44.6	49.9	55.6	60.6	71.0	76.2	79.7	77.8	73.3	64.2	52.3	47.7	62.4	77.9	62.6	47.4	62.6
Sparta, Ga.	42.5	51.2	54.9	63.7	71.9	81.6	82.8	81.8	74.9	61.1	56.7	43.4	61.1	82.1	64.3	45.7	64.1
Huntsville, Ala.	42.0	44.6	51.3	61.3	67.2	74.2	76.4	75.2	70.1	59.5	49.7	41.8	59.9	75.6	59.8	42.1	59.7
Memphis, Tenn.	41.7	45.9	53.3	59.0	68.9	75.8	79.9	78.5	72.5	58.4	53.3	40.2	61.1	78.1	61.4	42.6	60.8
Fort Smith, Ark.	41.6	44.8	50.2	63.1	61.1	75.7	79.5	78.1	72.1	60.3	49.7	40.0	60.8	77.8	60.7	42.1	60.2
Fort Graham, Texas.	47.0	53.1	59.6	63.2	73.3	79.4	85.4	85.2	77.8	65.4	52.1	47.4	65.4	83.4	66.1	49.1	66.0
Cincinnati, Ohio.	33.0	36.7	45.1	51.1	63.3	71.8	78.6	75.5	66.4	55.1	44.6	34.1	53.2	75.3	55.4	34.7	54.7
New Harmony, Ind.	34.1	41.2	52.5	56.0	67.6	76.3	78.8	75.5	65.6	53.7	43.3	37.6	58.7	76.9	54.9	37.6	57.0
St. Louis, Mo.	33.2	34.9	44.3	59.0	65.3	73.8	78.4	76.3	68.1	51.9	49.0	33.8	56.5	76.2	51.4	34.0	55.6
York, England.	33.4	37.0	42.9	48.2	57.0	61.2	62.4	63.5	57.2	47.8	40.8	34.4	49.4	62.4	48.6	35.3	49.1
Epping, England.	36.9	39.4	43.2	48.9	56.6	60.9	62.2	60.9	57.4	50.9	42.9	40.7	49.2	61.0	50.1	39.0	49.8
Dantzic, Germany.	27.4	30.8	35.2	43.4	52.1	59.3	63.6	62.9	56.1	47.0	38.0	31.8	43.5	61.9	47.1	31.0	45.6
Königsburg, Germany.	54.4	26.9	31.4	41.3	51.9	57.4	62.6	61.7	53.6	43.7	37.8	27.1	41.6	60.5	44.3	27.2	43.2
Berlin, Prussia.	27.7	31.6	38.1	47.5	56.7	63.4	65.8	64.4	58.1	49.9	39.3	34.9	47.4	64.5	49.2	31.4	48.1
Moscow, Russia.	13.6	16.0	26.7	41.7	54.4	62.4	66.4	63.1	53.2	39.5	27.1	16.0	41.0	63.9	39.9	13.2	40.0
Tambov, Russia.	12.3	17.5	27.4	42.4	55.5	63.9	67.8	63.8	52.8	41.0	28.1	17.1	41.8	65.0	40.6	16.0	40.8
Kasan, Siberia.	3.5	8.1	29.7	36.3	51.5	61.3	61.8	60.8	49.0	37.1	4.6	7.5	36.2	62.4	36.9	6.3	35.5
Bucharest, Turkey.	24.0	26.3	31.7	41.3	50.3	62.5	68.1	65.4	58.3	49.3	42.8	33.1	44.1	65.3	50.1	27.8	46.8
Alexandria, Egypt.	57.3	57.8	62.1	66.9	70.2	76.2	78.5	80.3	78.1	74.8	68.4	60.4	66.4	78.3	73.8	58.5	69.3

It is known that Tennessee has an isothermal line along the northern shores of the Mediterranean and south of the Black Sea; in fact, near the birth-place of this greatest of all the cereals of the world.

Scientific men have made researches into the animal, vegetable, and mineral kingdoms, by various means, principally the microscope, and by means of these observations and chemical analyses have been able to classify these different substances into various *genera*—species, orders or families, and classes. In order to do this intelligently, they embraced every known or fancied resemblance in one order; for instance, the cat family embraces many animals that are similar in conformation, having stiff hairs on the upper lip, with toes divided, armed with claws, and such as crouch to spring on their prey. The lion, tiger, panther, leopard—these are as much a feline as the cat itself. So in the vegetable kingdom we find the division into orders, *genera*, classes, and species, founded upon differences in their characters. There are two grand divisions of the vegetable kingdom—those having flowers, *Phænogamous*, and those without flowers, the *Cryptogamous*. Upon the flowers a basis is made for dividing the flowering plants into *genera* and species. It will be readily seen that the similarity between turnips, radishes, cabbages, mustard, and many more have united them under the common name of *Crucifera*, the petals having a fancied resemblance to a cross. The pea, bean, lupine, etc., not only have similar flowers, but the fruit is incased in a pod, or legume, and so this order is called leguminous, from a Latin word meaning to collect. Thus have all vegetables been classed by Linnæus, the great naturalist. Vegetation is further divided into *exogens* and *endogens*, or those whose stem increase or grow from layers of wood deposited between the bark and the heart, and those which do not. In the first class are ash, oak, hickory, etc.; in the latter corn, oats, rye, wheat, etc.

The fruit makes the next division, those having solid

seeds being *monocotyledon*, those having seeds composed of two parts fastened together, such as peas, beans, etc., being *dicotyledon*.

This same method of classification extends through all the various kingdoms, animal, vegetable, and mineral. For instance, the lime family is called calcareous, because lime is the distinguishing or predominating element. This comprises limestone, marble, alabaster, plaster of Paris, sea-shells, marl, etc. The *Aluminæ* are topaz, ruby, emerald, alum, etc., because alumina predominates. And flint, or *silex*, gives the name of *Siliciæ* to sand, onyx, agate, quartz, jasper, and many other gems. Within a few years the theory of evolution, advanced many years ago, has received many adherents, and a great deal has been written to prove this doctrine. According to this theory there is a regular progression from the lowest forms of the mineral kingdom, through the long series of vegetation, to the highest form of animal life.

CHAPTER II.

BOTANICAL DESCRIPTION—HYBRIDIZATION—INTERESTING EXPERIMENTS.

The botanical name for wheat is *Triticum Vulgare*. Synonyms—*Triticum Hybernum*, *T. Aestivum*—*A-S-hweate*, *white*, in distinction from rye and other dark colored grains.

Triticum Sex. Sys. *Triandria Digynia*—Nat. Order, *Graminacæ*. Gen. Ch. Calyx, two valved, transverse, solitary, many-flowered, on a flexuose toothed receptacle. (*Rees.*)

The common winter wheat has a fibrous root, and one or more erect, round, smooth-jointed stems, which rise from three to five feet high and are furnished with linear, pointed, entire, flat, many-ribbed, rough, somewhat glaucous leaves, and jagged, bearded, stipules. The flowers are in a solitary, terminal, dense, smooth spike, two or three inches long. The calyx is four-flowered, tumid, even, imbricated, abrupt, with a short compressed point. In the upper part of the spike it is more elongated; and in this situation the corolla is more or less awned. The grain is imbricated in four rows.

Triticum, wheat belongs to the subtribe of the grasses, hordeinea, from barley, which is in structure closely related to wheat, and rye also belongs to the same division. Besides the grain producing species, all of which are annuals, there are several with perennial roots, which by some botanists have been placed in a distinct species *agropersms*, the most important of which is the troublesome *triticum repens* (couch grass), (wild onion), of which more hereafter. Like other cereals the origin of wheat is deeply involved in speculation. It is found growing wild in various mountain

countries, in some places where from the accounts of travelers it could not have spread from cultivation. De Candolle believed it sprung from the Himalays of Asia, though the pioneer miners of California make notice of seeing it among the western crags of the Rocky mountains and Nevada Sierras. The latter dissemination, however, may have taken place from the numerous missions established by the Catholics in that country.

About 1855 M. Fabre asserted that he had proved wheat was *agilops ovata* (a common grass of Southern Europe) developed by cultivation. He asserted that by successive sowings he had produced forms of *agilops* which passed for specimens of wheat, and by continuing this sowing he had produced wheat. These experiments are not, however, worthy of credit, for it is now known these grasses have been either accidentally or for a purpose hybridized with wheat, and thus he only developed the fact of the disposition of this grain, as of all others, to return under favorable circumstances to its original state. But Nature's laws had been transgressed, and here the new, much valued species, expired. Nature will perpetuate a *mongrel* but never a *mule*.

In the vegetable kingdom the results of such experiments are precisely analogous. The individual plants that participated in the crossing may be distinctly traced in the hybrid. Affiliated plants thus crossed produce fruits that will fecundate, whilst the violation thus produced will not bear fruit, or at least if fruit is borne, the seed will not germinate. Flowers possess a strong attraction for pollen from flowers of its own species, and hence if it is desired to produce a hybrid, it is necessary to use a large quantity of pollen, but there will be no result unless they are of the same genera or species. The earliest record we have of hybridization is in the writings of Cameranus, in 1694. Linnæus wrote of hybrids in 1751, and Kolreuter, eight years later, succeeded in producing hybrids by artificial

fecundation. Since this time, numberless experiments have been successfully made in that respect. In order to succeed in doing this, it is only necessary to bring the pollen which is contained in the anthers of one flower in contact with the stigma of the pistils of the flower to be impregnated. To succeed in effecting this, it will be necessary to select flowers of the same maturity, as those of different ages will not do. The stamens are the male organs, and the pistils the female organs of reproduction and the pollen is an exceedingly fine dust contained in the anthers of the stamen. The stamens of the plant to be hybridized must be removed early in the morning while wet with dew, and then about noon the stamen of the male plant must be shaken over the stigma of the pistils of the female plant. The stigma of the pistils resembles a sponge, and has a powerful absorbent property, so that it will grasp the powder and convey it by a delicate tube to the fruit or seed.

Hybridization is an exceedingly delicate operation and can only be successfully performed by a skillful hand. It often happens in gardens that through the agency of bees, bugs and insects, accidental hybrids are produced. It is so well known that gardeners keep apart all affiliating vegetables, even when they are ignorant of the cause of their mixing. This is most especially the case with cabbage tribes, melons, cucumbers, etc. It is more difficult to produce hybridization of cereals than any other vegetable, but not impracticable. The difficulty arises from the manipulation necessary in removing the unexpanded anthers, and then applying the pollen of another plant.

Mr. Maund, of London, obtained a prize in 1851 for producing hybrids from the annexed varieties of wheat :

Male.	Female.	Result
Old Lammas	Donna Maria	Larger than either.
Pearl White	Oxford Red	" " "
Clustered Red	Satin White	Course, rough, short.
Old Lammas	King's White	Very large long ear.
Boston Red	Donna Maria	Large ear, strong straw.
White Cove	Northumberland	Beardless, ear downey.
(beard)	(smooth)	
Dark Cove	Pearl	Small deformed ear.

His experience was that a strong male and a weak female produced a better result than a strong female and a weak male.

In 1848 Mr. Raynbird, of Loverstoke, obtained a premium from the Highland Society, Scotland, for successful experiments of this kind. He began his experiments in 1846 with the Hopetown, a long eared and long straw white wheat, and Piper's Thickset, a course wheat with thick clustered ears, a stiff straw and very prolific, but liable to mildew. The hybrids thus obtained were intermediate between the two parents, the ears shorter than the Hopetown, and longer than the Thickset.

We would commend the example of these enterprising gentlemen to some of our farmers, and also the public spirit of the English societies in offering premiums to the successful experimenter. It is beyond question within the power of any one thus to originate new varieties having the good points of various kinds. Nor should one entering on these experiments be discouraged at a failure, for it often happens the result will not be satisfactory. But the simple fact that hybrids from accidental fecundation have furnished some of the most prolific and hardiest varieties, should be an encouragement to prosecute such inquiries. When it is considered that during one year in the United States alone the vast sum of \$200,000,000 is spent for flour, any one can readily see the immense advantage the introduction of a new variety that would increase the yield one or two bushels per acre, would be to the producer. Our agricultural socie-

ties should encourage this by offering a suitable medal to any one who is able to bring before the public a good seed suitable to our soil and climate. We have a vast number of specimens of greatly differing qualities both of grain and straw, and nothing would be easier under such a stimulus than to derive from these differing kinds such as would be suitable for all the different soils and elevations.

CHAPTER III.

ANCIENT HABITAT—INTRODUCTION INTO OTHER COUNTRIES—NEW VARIETIES—IMPORTANCE OF SELECTING SEEDS, AND THE BEST METHOD OF DOING SO.

It is a well ascertained fact that those vegetables thrive best in the soils to which they are indigenous. According to a rule adopted by the celebrated Baron Humboldt, to determine the native country of any species, when that fact is in doubt, it is fair to presume it belongs to that country in which the greatest number of known species exists as indigenous to the soil. This rule would place Persia as the place of its nativity. According to Diodorus, Isis and Osiris discovered wheat, barley and other vegetation, growing wild in the valley of the Jordan and carried them into Egypt, into the country of the Nile, and taught its inhabitants their uses and cultivation, and the natives considered this act of such immense benefit to mankind they deified and worshiped these agriculturists ever afterwards. Strabo declares that wheat was found growing spontaneously in Persia, and also on the banks of the Indus. Other writers attribute its nativity to India instead of Persia. But be that as it may, it will readily occur to the reader, judging from the reasons laid down by Humboldt and others, that, considering the many species of *Triticum* spread over both Persia and Northern India; these countries may fairly claim the parentage of this plant. Now the locality of these valleys will lie between the parallels of 30° and 40° North Latitude, and within these same parallels the whole of Tennessee is situated, and though we are the antipodes.

of those countries, the same sun that governs their climate and meteorology gives us the same life-giving principle.

Many plants are produced and flourish spontaneously in certain places on the earth's surface, yet such is the adaptability of most plants that through the interference of man they are capable of being transferred to various points and of growing successfully as in their birth-place. Wheat is a signal example of this character of cereals though not confined to that species. In Asia wheat was only known by a few well defined species, yet by culture it has improved and increased until now largely over two hundred kinds are known and grown. At first botanists divided it into "*hard wheats*," "*soft wheats*," and "*Polish wheats*," but soil, cultivation and climate have developed it into the many beautiful varieties now shown at every county fair.

The hard wheats are the products of the warm countries, such as Egypt, Sicily and South Italy. The soft wheats flourish in the colder, damper climates, such as Sweden, Denmark and North Russia. The Polish wheats are those grown in the country from which its name is derived, and are hard or flint wheats. The hard wheats abound in gluten or flesh-forming principle, and white wheat in starch or fat-producing principles.

The hard wheats will not, according to our Southern method of milling, make as white flour because a large amount of silica and alumina exists in the hull or bran, and this being incorporated in the flour gives it a yellow hue. For this reason the country south of us has been heretofore debarred from cultivating the varieties of wheat best suited to its climate. But a new milling process, of which more hereafter, is fast being adopted by which the wheat is deprived of its hull before grinding, and then the flint wheats will make as white flour and far more nutritious bread than any others. The white varieties of wheat are tender and liable to sprout from damp weather, and are far more subject to the depredations of the weevil. Besides, they

require a much longer time to be dried before grinding or packing for transportation. The hard wheats alone furnish flour suitable for manufacturing into maccaroni.

Some soils are remarkable for the production of good seed, while other soils will cause a constant degeneration, so that a frequent resort to new seeds is required. This is so well known in England that the produce of a certain parish in Cambridgeshire is sold for seed at a larger price than can be obtained for it for milling purposes. It will be to the interest of farmers to take advantage of this hint and always buy their seed from some one who uniformly makes good crops. It has been ascertained that all kinds of seed wheats of the same variety contain the same relative proportion of gluten and starch. For bread making the excess of gluten would be no objection, but to create a perfect vegetation a due proportion of these constituents is necessary and is essential to perfect maturity. So that, if this fact can be ascertained, it will at once be known there is an excess of nitrogenous or animal manure in the soil or of vegetable humus. In either case the remedy is easily applied by the addition of the deficiency.

By selecting seed from ears that show a superiority to the surrounding field, and sowing it carefully, we may be able to perpetuate a new species made by a fortuitous impregnation or some peculiarity of the soil.

Many instances of this kind occur, and it is beyond belief the amount of wealth given to a single county by a careful attention to this simple hint. In many of the Basin counties an average of 25,000 acres are annually sown. Before the introduction of the Boughton, Tappahannock, Fultz and other good varieties of wheat, fifteen to twenty bushels were considered an extraordinary yield. Since then from twenty-five to thirty-five are not uncommon on properly cultivated land. It is true the pride of having a superior variety will stimulate to a careful preparation of land and a proper attention to its culture. It

is one of the legitimate results of good seed. Attention to this will increase the production for each county from 20,000 to 100,000 bushels annually. We have many recorded instances of the very valuable results from selecting good, large, plump grains for seed. In some instances the crop has been quadrupled in quantity and quality by the use of choicest seed selected in the manner stated.

“Mr. J. B. Armstrong, of Wicomico county, Maryland, from one ounce of Fultz wheat, sown in drills, obtained 84 ounces of wheat. From one ounce of Clawson he obtained 76 ounces. The moles destroyed some of the latter or it would have been as good as the former. Mr. L. M. Wilson, of the same county, obtained two bushels of Clawson from $1\frac{1}{2}$ pints of seed. This variety is a hard white flint, and has a very strong straw.”—*American Miller*.

In selecting imported wheat for seed care must be exercised as to the place whence it originated. Wheat grown in England, which has a moist, cool climate, would not suit the warm, dry soil of Tennessee, but possibly if grown a year or two in Canada or Northern New York, it might be a valuable addition to our granary. Wheat sown year after year in moist soils will degenerate very rapidly. It behoves farmers to pay more attention to the causes of the deterioration of wheat. It may be that each variety is adapted to a specific climate where it grows perfectly, and where it will not degenerate if supplied with a sufficiency of proper nourishment. Causes are ever at work to modify the germ and it requires constant and unremitting care to counteract these causes. Should wheat not yield as well as the land would seem to justify, new seed should be selected that is grown on a soil of different character and, if from a slightly different climate, all the better. The product will be improved both in quality and quantity.

It is generally conceded that wheat grown on a sandy soil will succeed well on a heavy clay soil, or on the black soil derived from limestone. Seed from a damp soil will be

late in maturing and is liable to rust. It would be a good change for the black and mulatto lands of Middle and East Tennessee to be supplied with good varieties grown in the sandy lands of West Tennessee. The selection of new varieties either by choosing from superior kinds the spontaneous growth of nature, or by judiciously crossing varieties, each possessing qualities that are desirable and worthy of being perpetuated, offers a fine field either for botanical experiments or for the exercise of that philanthropy which impels one to the service of mankind. The extraordinary success of improvements in our garden vegetables, the production of innumerable new varieties of various esculents gives matter of surprise that the attention of the farming world has not been heretofore more particularly directed to an equal amount of experiments on the cereals, such as oats, wheat, barley and rye and the grasses generally. What has been effected—can be done again. When a person by any sort of process is able to make 50 or 60 or 70 bushels per acre, others by pursuing as near as possible the same process can do the same, or at least approximate it.

Seed properly selected should never have been through a thresher. It will not only mix but will convey many noxious seeds, such as "cheat," "cockle," "couch grass," etc. These seeds will lie dormant in the ground for years and then coming within the germinating power of the sun spring up to annoy the farmer. As an evidence of the facility of threshers to sow seeds, the attention of every one has been drawn to the large amount of these troublesome weeds growing on the places where threshers have been set.

Any man who will establish in his garden an experimental plot, can select the best heads of the most prolific wheat, sowing the next year the best heads alone, and still selecting from this the best heads, using the balance for field use, and in this manner keeping always one year ahead. This will make good seed. A practice that has re-

sulted in a largely increased production has prevailed in some sections, and merits special mention.

Select a few bundles and strike them over the head of a barrel lightly. The heaviest, best matured grains will fall out, leaving those not fully ripe in the bundle. A few minutes will suffice to secure seed in this manner that will improve the ordinary yield very largely. This proves the necessity of seed wheat being allowed to get fully ripe before cutting.

CHAPTER IV.

HISTORICAL ALLUSIONS — PLANTS ALLIED TO AND INFESTING WHEAT, ÆGILOPS, COUCH GRASS, COCKLE.

Mention has been made heretofore of the probable habitat of wheat; but it is by no means a conceded point. Columbus never had his place of birth claimed by more cities than countries are claimed for the origin of wheat. We have good reason for believing much of this ambiguity results from two causes. In the first place, wheat either existed before the creation of man, or was so nearly his coeval in antiquity that it is prehistoric. We have the example of the fossils under our hills to prove that with each era in the creation the formation of any particular being was preceded by the creation of some special food suited to that creature. Diatoms and Algæ, the mosses of the sea, preceded infusoria; these served as food for the Radiata, which in turn sustain the more highly developed denizens of the sea. When the ocean had been sufficiently stocked for the formation of carnivora, the sharks made their appearance. In like manner it was repeated on the land. Vegetation, suited to the many different animals, began to fleck the earth, and it is a reasonable supposition that, inasmuch as man was not able to digest the grasses of the field as do cattle, other more readily digestible food should be supplied to him in a form more suited to his limited powers of assimilation.

In this manner, when man made his appearance upon the scene of creation, he found not only the flocks and herds ready for his consumption, but an abundance of cereals, and it was only necessary for him to find their uses.

This was effected by the gradual discovery of the properties of the various growths of the earth. No doubt many fell victims to their experiments, as in the present age; but mankind reaped the benefit of their success, until all that is esculent has been added to the repertory of agriculture. As a matter of necessity, these discoveries long preceded the art of recording them; hence, the origin of the old world cereals is left mainly to conjecture. In a paper addressed by Sir Joseph Banks to the Historical Society in 1805, he speaks of having received some seeds from a lady, among them a package labeled "Hill Wheat," the grains being about as large as the seeds of our ordinary grasses, but which, when looked at through a magnifying lens, were found to resemble the grains of wheat exactly. He sowed these seeds in his garden, and was greatly surprised to find the produce to be spring wheat of ordinary size. He made every inquiry possible to ascertain the history of these seeds, but could only elicit the fact that they came from India; but whether they were the result of cultivation, or the spontaneous production of nature, he could not discover. The explorations and discoveries of modern scientists are conducted with much more systematic care than formerly, and the results being constantly given to the world, excites a spirit of inquiry in others, and thus many important facts are annually added to the store of knowledge. Everyone has heard or read of the numerous specimens of wheat being found in the pyramids and the sarcophagi of the Eastern potentates, and these deposits of the world's food have lain here many thousands of years. It has often, also, been found among the lacustrian habitations of the aboriginal inhabitants of Germany and Switzerland, side by side with the many implements of the Stone Age. We may gather from this that it early found its way both east and west from its native home in Asia. When Cortez made his conquest of Mexico, a negro servant of the great conqueror discovered in his rations of rice a few grains of wheat, which he care-

fully planted, and continued to plant for several successive years, and hence came the supply of Mexico and its neighboring States. Whether these few grains were brought by Cortez from Spain, or were collected from the natives, does not appear in the history, but it is to be presumed the rice was brought from their colonies.

Sicily has also laid claim to its parentage, from the fact that Ceres was a native of that island, and she is credited with having brought it thence to Greece and its provinces. It may have been cultivated in Persia or Egypt, and some of the seeds being scattered along the roadsides by the caravans that traversed the hills and deserts, germinated and continued to grow in these places, not accessible to cultivation; and though it does not under such circumstances lose its proper characteristics as wheat, yet it may be readily comprehended by similar instances that it would become small and weak. Our large pippins, weighing a pound or more, together with the many hundreds of delicious apples, are all developed from the unpromising and bitter crab. A very small poisonous root in Chili gave us the starchy potato, that has so often come between the poor of Europe and starvation. The juicy, sweet, highly prized parsnip springs from a root that, from its resemblance and similar smell, has killed its thousands, being highly deleterious to human life. The luscious peach, more delicate in its flavor than all tropical fruits, more generally cultivated than even the apple, originates from the worthless bitter almond. If science can make such an improvement in these luxuries, how much more may we expect from the care that would naturally be bestowed on such a necessity. And yet, with all the wonderful advancement made in the character of these and other cereals, we have reason to believe, left to themselves, they would, after a lapse of sufficient time, revert to their original state. Everyone has seen a garden in its bloom and beauty, filled with the most delightful species of roses. Roses red, roses yellow, and pink, and

white, with all the intermediate tints, full of petals, running over with loveliness and perfume. Yet these same roses, deprived of the hoe and spade to battle with legions of weeds, seeking the destruction of these favorites of man, would soon, by these vandals, be choked to death, or they would lose their delicate petals, and others would take their place, the stems would arm themselves in their own defense, with long, sharp thorns; in fact, they would lose all but their delightful odor, which they would still offer up as an incense to their Maker. It is by no means a conceded point that no species can be entirely changed by cultivation on the contrary, a numerous and intelligent class of botanists claim to be able to effect a permanent departure from one species into another, so that, instead of there being one or more species, there will be one or more varieties of one species. Prof. Henslow's experiments would tend to show this doctrine to be so, but the species selected by Prof. Henslow were so nearly allied that it was not a positive fact that one was only a hybrid of the other. If, however, such a result should be effected, it might be that, through the agency of man, and under proper climatic influences, wheat itself may have been developed from some wild native grass, so different now from wheat, that their relationship should never be recognized.

ÆGILOS OVATA.

Many botanists have long contended wheat is the offspring of the grass known as *Ægilops Ovata*. It grows spontaneously in Sicily, and though a coarse grass, growing only about eight or ten inches high, though much smaller, is precisely similar in appearance to wheat. There are several species of this grass. The rough-spiked *Ægilops* grows in the Levant, and is perennial. There are other species of *Ægilops* called *Cretan*, long-spiked, oval-spiked, cylindrical-spiked, etc., to be found respectively in Candia, Italy, Hungary, and Southern Europe. In some places the

seeds are roasted, and used for human food. All these seeds are precisely like wheat, except that they are very diminutive. It had often been asserted by various persons that wheat was *Aegilops*, altered by cultivation; but from the fact that the latter was only a bitter, miserable grass, ten or twelve inches in height, no botanist of respectability could be induced to make such an assertion. In fact, they declared their dissimilarity to be so great that they belonged to different genera. Beauvois, in 1812, in a dissertation, said there was no difference, except artificially, between the two.

A Frenchman, by name Fabre, who was a gardner, a careful, punctual man, without any education, undertook to discover the difference for his own satisfaction. So, in 1838, he gathered the seeds of the *Aegilops Ovata*, and and sowed them in his garden. There was but little change, except as to height, it being two and a-half feet high. There were but one or two grains to the head, and these unlike either wheat or *Aegilops*. He saved them carefully, however, and continued to plant from year to year, preserving specimens of each growth until 1845, when the plant was adjudged by all to be true wheat. The last change that occurred was from a pithy to a hollow stem. This experiment was conducted with great care, in enclosed places, carefully excluding all grasses, or anything likely to hybridize with it. It was known of many, and his proceedings were closely watched by the neighbors. He was an uneducated man, and had no pride or desire to establish any particular theory on the subject; and so, when an article appeared in the proceedings of the Royal Agricultural Society, it had a powerful effect in shaking the theory of botanists in the immutability of genera. However, when it is known that the culture of wheat largely predominated in that department, and often in the rays of sunshine large clouds of pollen are seen rising from the wheat fields and floating lazily with the wind, it is readily understood how

the plants become not only hybridized after cultivation, but that the process had been going on for some time before. The truth or falsity of this theory may be questioned or not, but the consequence of it, if true, would be very important to the culturist in more ways than one. It would explain in a most sensible manner the disposition of wheat to degenerate, and to become diseased after cultivation in one section of country for a long time, and it would suggest the remedy.

It hardly seems possible that all botanists of so many years should have made such an evident error in their classification, and that it should have been left to a simple gardener to discover this error, and expunge from the botany either *Triticum* or *Ægilops*.

Lieutenant Mayo, of the United States Navy, spent some time visiting the plains of Troy, while his vessel was cruising in the Archipelago. He gathered a few grains of what he supposed to be wild wheat growing there, and gave them to Dr. Wilson Waters, who has planted them for several years. He now (1831, *American Farmer*) has about a bushel of wheat that is larger than that derived from wheat grown in this country, but not so large as that derived from Chili. The stalk is nearly solid, has a large base, and is more tapering than ordinary wheat; has a head with long beard, fully six inches long, and it averages about forty grains to the head. It is thought it may be valuable from its heavy stalk, protecting it from the depredations of the fly, and from lodging.

COUCH GRASS (*Triticum Repens*).

This is a most troublesome grass, introduced from Europe, infesting many wheat fields and meadows, and is known by a different name in almost every locality. It is called witch-grass, twitch, quitch, quack, quake, squitch, dog-grass, chandler-grass, and wheat-grass. The plant is two feet

high, having rough leaves, somewhat hairy, and trailing at the lower joints, is perennial, and propagates itself both by its seeds and jointed stems and roots. Although it is a grass, its leaves are too coarse for fodder, and it performs the office of a vile weed, being an insidious creeper, multiplying and ramifying itself in all directions. Its scraggy roots go deep into the ground, and take firm hold. Each joint can produce a new plant, which in turn, if not destroyed, will produce others without number.

The only way to destroy this pest is to gather, dig, and burn. If land is well plowed, and turned often during dry, hot weather, it can be got rid of. But to dig or plow it up in wet weather, will only assist its propagation. Its roots strike so deeply that it is almost impossible for it to be broken. In the early autumn its roots strike horizontally and obliquely in all directions, and continue to run until the cold weather interferes with its growth.

The roots are succulent and quite nutritious, and are by some people dug, cleaned, and fed to horses and cattle, while in the poverty-stricken countries of Northern Europe the peasants dig the roots, dry them thoroughly, and grind them into meal that they may have cheap bread, and be enabled to sell their wheat to the rich. Hogs will plough up the ground with great zest in search of its rich joints. Its ashes contain about 10 per cent. of lime, 5 per cent. of potash, 20 of bone, and balance silicates. This explains why clay is so congenial to its growth. Where land is foul with it, it is known that turnips do well. It belongs to the family of *Triticum*. It is susceptible of hybridization. It may be seen in the corners of the fences of most of our grain fields, and though it has not troubled us to the same extent it has our Northern States, yet it is well the farmer should keep an eye on it lest it should take hold. Its seeds once mixed with wheat would soon give it such a set as would give employment for years to the thriftless farmer, who lets it steal upon him.

COCKLE (*Lychnis Githago*).

This weed belongs to the Pink family (*Caryophyllaceæ*), and derives its first name from *Lychnos*, a Greek word, meaning light, from the flaming color of its flowers in some species, and its heavy fur of cotton on the leaves. The ancients made wicks of the *Mullein Lychnis* for use in their lamps. Its second name, *Githago*, is from *Gith*, which means Guinea pepper, from the size and color of its seeds.

Every farmer in the country is well acquainted with this pest, and it is one that, with but little attention, can be effectually destroyed. It is an annual, and to be propagated must be sown each year. This preservation is secured with great certainty by the farmer, for when once harvested, and it ripens with wheat, it, being of same size with wheat, passes through the seive, and, being heavier, it resists the efforts of any fan to separate it. Thus the farmer perpetuates it himself, and being so black, if in quantity, it gives a bluish tinge to the flour. It proves that great maxim of farmers not to put off until to-morrow what should be done to-day; for when the cockle is once safely shocked with the wheat it is secure, it will do the balance of its hiding, and come up with its companion, the wheat, the next year. But if the farmer would, while the cockle is showing its beautiful, purplish flowers all over the field, spare a few hours with his boys, he could soon go over the wheat, and by pulling it up, effectually destroy it, root and branch. There is no difficulty in detecting it. It raises its own flag of defiance, and it would be fun for the boys to pull it up. Much more difficult to destroy, and far more troublesome to the farmer, is the chess or cheat.

CHAPTER V.

CHESS OR CHEAT (*BROMUS SECALINUS*)—BROME GRASS—
DESCRIPTION OF—ERRORS REGARDING.

This plant belongs to the order *Gramineæ* or grasses, and to the tribe *festuceæ* or fescue grass. There are many varieties of this grass, but the one above is sufficient for our present purpose. Willard introduced it into this country under the impression it was a good forage grass. But it was soon discarded as being worthless, and not only worthless, but injurious. The characteristics of this genus are: Spikelets with 5 to many flowers panicle; glumes not quite equal, shorter than the flowers, mostly keeled, the lower with 1 to 5, the upper with 3 to 9 nerves; the flowers lanceolate, compressed; the paleæ herbaceous, the lower keeled with 5 to 9 nerves, awned or bristle pointed from below the tip; the upper palea finally adherent to the grain, straws three, styles attached below the apex of the ovary. The grasses of this genus are coarse, with large spikelets, generally somewhat drooping when ripe.

From the facts the grains of this grass are smaller than wheat, it is very difficult to separate it, and thus it seriously injures the sale and quality of wheat. As before remarked, it was brought to this country by Willard under the impression it was a good addition to our list of feed grasses, and the seed were sold at an enormous price, and so eagerly was it sought after that it very soon became disseminated all over the country. Its worthless character was soon ascertained and its cultivation abandoned, but not until it had stocked nearly every grain field in the Union. Its seeds have several thicknesses of husk, and being very small and of low vitality, it will remain dormant in the soil for years until brought within the vivifying influence of

the sun. In this respect it resembles clover seed, that will produce a stand of clover after undergoing wonderful chances for destruction. A gentleman once fed clover hay to his horses during the autumn and winter and in February he dug the manure up and placed it in a frame to make a hot bed. It there performed its office for the season, but lay until the following February, when it became necessary to remove the beds, and the old manure was scattered in the garden. He looked upon the whole pile as being a *corpus mortuus*, but to his surprise the entire garden came up thickly with clover, and continued for a year to send up fresh plants with every stirring.

Esq. Carothers, in Williamson county, sowed a piece of new ground in the corner of his woods lot with turnips in 1861. The turnips, after laying through the winter, made seed, but the occupation of the county by the Federal soldiers destroyed the fences, and the turnip patch stood exposed to stock during the war. In 1871 the patch or corner was again broken up, this time included in the corn field, and after laying awhile it gave a full and heavy growth of turnips. Now if clover can withstand the digestive apparatus of a horse, the heating of a hot bed and come up, and if turnips can lay in the ground ten years and then vegetate, why, one need not be astonished at the powers of self-preservation of the chess.

Mr. Thos. Hamlet, of Davidson county, bought a lot of wheat with a few grains of chess in it. He sowed it and with it of course the chess seed. He continued to sow the same quality of wheat for several years, gradually increasing the quantity of chess until his crop was almost totally chess instead of wheat. Now, although he had deliberately contributed to effect this result, his farm was spoken of far and near as an instance in which a variety of wheat had been converted into cheat. It became so greivous an evil he had to abandon for a few years the cultivation of wheat, and during the interval the cheat continued to grow as any

any other grass would. But finally it departed and he was able to resume wheat culture.

It is a well known fact that this is treading on tender ground, when it is sought to convert this time honored theory of the conversion or degeneration of wheat into cheat, but the duty of a truthful and faithful officer compels him to apply the surgeon's knife to all errors, in hopes, if the true theory is once established, we may by a united effort not only eradicate the error, but the vile pest also. Every one is liable to jump at conclusions from hasty observations, and where once the inference is made and accepted, it is a difficult matter to correct it.

The most common opinion is that wheat that has been pastured early, or over which a wagon has been driven, is more subject to this change. The fact is cited that if a gap occurs in the fence through which stock mostly pass, the path made by them has the most cheat in it. They explain it in the following manner: Wheat that is covered deeply sprouts and sends up its plumule to the air and its roots spread from the grain around. The depth of the seed and roots is so great that the plumule sends out another set of rootlets near the surface soil. In treading on the ground around grains that have taken on this process of double roots, the stem of the wheat becomes severed between the grain and the surface roots, and it then degenerates into cheat. This is an assumption not warranted by the facts. It is only forming a theory of explanation for an assumed fact when there is in reality nothing of the kind.

In the first place, cheat is a hardier plant than wheat, and a continual battle is going on between the two for existence, none the less deadly because it is silent. The wheat being a cultivated plant requires more protection or assistance to maintain its life. The amount of injury it receives from the depredations of stock tends to weaken its hold on life, while the cheat takes advantage of its weak condition and thrusts up its noisome head and makes good its hold on

the field. If the field is trod through the entire winter, it thus gives the cheat more and better opportunities, of which it never fails to avail itself. If one part of a field could transmute its wheat into chess, the whole could just as easily, and there remains yet to be a record of a whole field undergoing this degeneration. Besides, chess makes its appearance in all wheat fields where the wheat, from any cause whatever, has become weak and feeble in its growth, on the principle above stated. It is asserted by some that the chaff of chess does not contain any seed; but this assertion is not borne out by the facts, and is never asserted by any one who has submitted the reproductive organs and flowers of chess to microscopic observation, for in this respect it is just as perfect as any other plant, and the thick chaff seems to protect its abbuminous body for years. Not only so, but under favorable circumstances, during mild winters, the plant deprived of its head before maturity of its seed, will remain green and vegetate again in the spring. This is especially the case in meadows, where the roots are protected by a swathe of hay. Meadows in this manner have been effectually ruined by chess. And yet no wheat had been sown here to give it birth, it having been deposited by the droppings of stock. If the treading of cattle could change wheat into chess, why could not the same cause change other plants? We never hear of clover degenerating into timothy, or timothy into herdsgrass, or herdsgrass into orchard. Yet these are all grasses and as liable to degenerate into one another as wheat or cheat into each other. Nor do pumpkins go into melons, or cucumbers into squash. Each and every plant has its distinctive character and maintains it through all time, only modified by changes of location, climate or soil. Cheat requires a large amount of moisture to reach through its thick husk and cause its seed to germinate; hence moist places are favorable to its growth, and its rankness is such that it overshadows and chokes out the wheat, therefore a farmer

passing in the early spring a place of this kind and seeing an abundance of wheat growing, and afterwards in harvest seeing nothing here but cheat, will easily persuade himself the wheat has changed to cheat.

Again, the nature of this husk is to protect it, and hence it will lie in the crop of birds and in the stomach of horses and cattle utterly unchanged until evacuated. Birds passing over wheat fields drop them as well as animals, and thus it is common to see cheat growing especially around stumps or dead trees in newly cleared fields.

It is an unquestioned fact that all allied species of plants and animals will hybridize and produce offspring partaking of the characters of both parents, and this is exemplified in the case of the horse and the ass, both being allied—species of the genus equine. But who ever saw a hybrid from chess and wheat? That it has every facility for hybridizing will not admit of a doubt, growing promiscuously with each other, flowering at the same time, and being each enveloped in a cloud of pollen. Yet it never mixes. The distinctive features of each has always and ever will be preserved, as are the characteristics of all the animals and plants created in the earth for man's use or adornment. If farmers would cease to yield to this fatalism of belief, and instead of blindly accepting the inevitable, as they think, set themselves to work, in a few years, by sowing habitually clean wheat seed, the genus *Bromus*, or chess, would disappear from our grain fields altogether.

Another argument which I have failed to notice in its proper place: Some will tell you that treading does produce cheat, for it is always found thickest around a threshing machine, and the treading of men and horses produced it. If any one will look into the joints and cogs and seams of the thresher, the secret of its propagation will be at once detected. The seeds of the cheat lie there hidden in sufficient numbers, and only the shaking of the machine is necessary to put the seed on the ground.

CHAPTER VI.

DEGENERATION OR DETERIORATION OF WHEAT—IMPROVEMENT OF WHEAT.

Although it may seem that wheat to a certain extent degenerates, it really does not actually occur; the genus remains the same unaltered and unalterable, but the species undergoes certain changes from influence of climate, soil, altitude and cultivation. A frequent and subtle cause of apparent change may be found in a simple circumstance. A man procures a fine variety of wheat, and being much pleased with it, he sows it from year to year. However, he begins after a year or two to notice a change; it becomes deteriorated, and after a sufficient length of time his wheat, so much admired at the outset, becomes another species entirely, and yet he would declare that he had carefully preserved his seed. This is easily explained. The threshers are carried from field to field, cleaning wheat crops of various kinds, but never cleaning out themselves, so that in the cracks and crannies many a grain becomes transported to a neighbor's bin, of which he is entirely ignorant.

There are many varieties of wheat that, though coarse and inferior, have much more vitality than the finer kinds. This vigorous coarse wheat once introduced with a superior wheat will make its own way, and though the change began with only a few grains, it soon shows to the farmer his favorite wheat is fast losing its beauty; the miller gives him a smaller price for it, and he tirades against the degeneracy of wheat, and says no kind will remain good. Now whose fault it is may be readily seen, and only the careful farmer who uses the necessary precautions, may expect to perpetu-

ate a good variety. It is not the less true that wheat does undergo changes from a change of soil and other contingencies. It is known that red wheat, by high culture and good land becomes less red, and this improvement can progress until it settles into a white wheat. A case of this kind came under my observation a few years ago. A gentleman who had paid much attention to the selection of his seed, let a farmer in a neighboring county have some seed of Mediterranean. They both continued to sow the same wheat for a few years and then meeting at a mill, it was found on comparison, the wheat of one had become darker and that of the other lighter, making such a marked distinction between the two, it did not appear they could be from the same seed.

Although there may be no positive evidence that bearded wheat ever changes into smooth heads, yet many believe in this very variety it is the case, as the wheat has every mark of Mediterranean except its beard. A variety of wheat is cultivated in France that loses its beard the moment it becomes ripe. It is a long head, has very long awns or beards, and an exceedingly thick husk or chaff, and is white and heavy. It does not withstand the cold very well, or it would make a valuable addition to the farmer of Tennessee, for it yields on moderately good soil from 30 to 45 bushels per acre. The straw is long, heavy and of remarkable whiteness. It is cultivated near Brionde.

It is astonishing what effect climate and soil have on the production of the same variety. Tennessee embraces as many essentially different characters of soil and climates as any State in the Union. Altitude also has its influence not only on wheat but other productions. Every one is familiar with the difference that exists in the same variety of apples on the low lands of Middle Tennessee and the same apple on the Cumberland table land. A higher degree of latitude is more congenial to the growth and maturity of apples than Middle Tennessee, and although on the table lands of

the Cumberland you are in the same latitude precisely, yet in effect you are further north, as altitude compensates for latitude. In like manner peaches succeed far better south of us in a sandy soil. West Tennessee, though in the same latitude, being lower in altitude than Middle Tennessee, and having a very porous, sandy soil, succeeds far better in producing peaches than Middle Tennessee. The causes that will affect one vegetable will affect all. Suppose this or any other wheat was sent from France to Canada, Tennessee, Florida and California. The products of these several places would be unlike. And if the same wheat were cultivated for fifteen or twenty years, there would be four varieties of wheat, all differing from one another, and still all differing from the original. The Canada would probably ripen about the first of August, the Tennessee about the first of June, and the California and Florida about the first of May. And more than this. If the varieties acclimated in these several places be brought to Tennessee, that from Canada will ripen a few days earlier than the Tennessee variety, and that from Florida a few days later, because the Canada wheat being used to a colder climate is stimulated by our warm sun to a quicker growth, while the colder climate here retards the Florida wheat that has been basking under a sub-tropical heat.

Thus it so often happens that wheat, imported from a country so essentially different in soil, climate, and other material qualities from our own, fails to come up to our expectations. We bring here a beautiful wheat from England, a cold, moist climate, and sow it in our warm, dry soil, and it proves a perfect failure. On the other hand we bring it from the parched, hot climate of Egypt or Syria which, compared with that of ours, is cold and moist, and we have another failure. It is not the variety of wheat that creates such a marked difference, but it is the different environments. Hence its quality is owing to local conditions, and not to the better quality of the wheat. Therefore there is

little to be gained by this change. Success can be attained far easier in propagating different varieties here, than by importations. The principal difference between red and white wheats consists in the amount of gluten and silex in the skin or bran. Gluten is found to be two or three times as thick in some varieties as in others. It is thickest in the coarse, heavy, red wheat, medium in amber, and least in white wheat. There is much more silex in the red than in the white wheat; but climate, soil and culture, modify the amount of gluten and silex as well as all other characteristics of the plant, and in this way new varieties are formed. So long as the conditions under which these varieties are formed continues, the wheat remains the same, but a change in that regard would cause them to revert to their original state. Other causes than climate, soil or culture sometimes operate to get up a new variety.

A farmer sows one variety of wheat a number of years without any change or degeneration. At last he finds a single head or a bunch different in every respect from the balance. He secures it, and from its produce for several years he starts a new variety. He cannot account for its presence, for had it been set there by a commingling made by a thresher, he would have found others of the same sort. Hybridizing would be an impossibility without another kind to hybridize from. Pollen blown by the wind would possibly have changed more than one stem, and the variety would still in part be like the parent. One set of theorists account for it by attributing it to the droppings of migrating birds. This is hardly to be admitted, from the fact that when a grain of seed passes through the active digestive apparatus of a bird, there is not much probability of its being able to germinate. Yet it is possible, and it is an admitted fact that seed brought from the north to the south any considerable distance will greatly improve in size and vigor, surpassing that already acclimated. In this manne

the celebrated Fultz wheat originated. A blacksmith named Fultz, passing from his shop to his house, cut across fields. He noticed a bunch of heads in a neighbor's field, presenting a marked variety, differing from that around it. It was so much more thrifty looking that he marked it, and on maturity he secured it. Sowing it in his garden, carefully preserving it from year to year, until he had enough to make a respectable field of wheat. It did not disappoint his expectations, and it was eagerly sought by the community. Its popularity very soon ceased to be local, and some of it being secured by the Department of Agriculture, was distributed all over the United States. We all know the success it has achieved, and its popularity is now only in the beginning.

Every effort to improve the varieties of wheat does not meet with the same degree of success, but the discovery of this is so beneficial that others should be incited to the same laudable efforts. But we will discuss this under the head of varieties of wheat, to which we devote a chapter. We come now to the subject of the nomenclature of wheat.

CHAPTER VII.

CLASSIFICATION OF WHEAT—DIFFERENT VARIETIES GROWN
IN THE STATES, WITH THEIR DISTINCTIVE CHARACTER-
ISTICS.

I sent out to every county of the State, during the summer of 1877, questions soliciting information in relation to the wheat crop. Many correspondents have replied with a fullness of detail which, added to my own personal observations, gives me ample means of forming a correct estimate as to the condition of wheat culture in the State. It would seem a simple matter to the uninitiated to properly classify the different varieties grown in the State, but when it is reflected that every variety has a local name for each neighborhood, unless the correspondents will describe the named varieties, it is utterly out of our power to be at all times accurate in our nomenclature. For instance, while we have from different parts of the State some thirty-five or more varieties mentioned by our correspondents, we are able, by our personal knowledge, to resolve them into six or eight, while several with which we are not acquainted may, under the guise of a local name, resolve itself into one or others of our old friends. With this explanation we shall first enumerate the standard and known varieties, which are acknowledged to be such, botanically, and then to adopt the local cognomens of these standards. In this manner only can we become thoroughly understood when we speak of any kind as one of a well-known variety in East Tennessee, which, in West Tennessee, would be called by an entirely different name, and hence lead to the confusion of a supposed new sort. In this manner much money is spent and time lost in securing a variety from a distance

that is already generally cultivated in the neighborhood. A farmer visits a distant county from his own, with all the elements of the soil different, and being pleased with a growth of wheat, he takes it home, and succeeding well, it is sought by his neighbors, and they, to distinguish it from others, call it by the introducer's name.

This system of naming is carried to so great an extent that the commonest kinds of wheat have a name for every section of country. We propose to try to remedy this by giving generic names to the leading varieties, and then giving the sub-varieties a number attached to the local name, and in this manner one name can be substituted for all synonyms. In thus establishing a nomenclature for Tennessee, we will also give the names most commonly used in other States to prevent confusion, and also to prevent fraud in sending to other States to purchase through advertisements. We know, in doing this, we are undertaking a very difficult and laborious task, and we doubt our ability to make it satisfactory; yet the matter has not been attempted in the State, and we hesitatingly try, hoping our effort will be properly construed. We well know the very difficulty we are trying to remedy will subject us to much criticism. It will probably be seen that a species of wheat is here classed differently from what it is known in some localities. In some sections of the State a variety is known by half a dozen names, each differing from the one by which it is known elsewhere. Under these circumstances it will readily be seen the necessity for a revised classification. The importance of assisting the farmer in the selection of his seed-wheat will alone justify the undertaking. If one should visit the grounds of any of our leading nurseries, he will find the gardener careful in labeling all the many varieties of apples, peaches, pears, grapes, berries, etc., even their particular flavors and colors are mentioned, and this is carried to such minutia that one can select from the catalogue just such fruit as he desires. Yet we find that great

staff of mankind, more universally cultivated than any other cereal, "the only produce of land which necessarily and always affords some rent to the landlord, actually, as it were, without a name. It may be stated as an adage, in selecting seed-wheat, "Take care of the pecks, and the bushels will take care of themselves."

I have already given the botanic description of the genus *Triticum*, which we deem all that is necessary to say on that subject, although there are seven species of this genus. Flint, in his excellent treatise on grasses, gives his classification of wheat also, but as a grass. We propose to treat this in a common-sense manner, avoiding as much as possible all scientific technicalities, so as to enable every one, the practical as well as the amateur farmer, to comprehend the meaning. What the farmer mostly wishes to know is the appearance of each variety, and its capacity of making good bread.

With these explanatory remarks, we will proceed with our classification, after making one explanation in regard to winter and spring wheat. They are essentially the same, and it will be unnecessary to divide them into a separate class. Spring wheat is made such by sowing winter wheat in February, or early in March. Of course a failure would be made the first year, the heads being for the most part barren, but there will be found here and there a few plump grains. These sowed the next year will make a rather better show than before; and thus it will continue to improve, and in a very few years a fair spring variety will be produced. Spring wheat is converted into winter in precisely the same manner. It is sown in the autumn, and a small portion possibly survives the winter cold, but that will assist in gradually converting the variety into a winter wheat. In Tennessee, spring wheats are almost unknown, only one county in the State considering it of sufficient importance to report. As a rule, they do not suit our soil or climate, and the winter varieties are so far superior, both

in yield and quality, that there is no inducement to produce them. Besides, even where most grown, they only serve as a substitute when the other is winter-killed. Then, at the usual time of sowing spring wheat, our farmers are busily engaged in preparing their ground for the summer crop. On the other hand, the winter wheat is put in at a comparatively leisure time. For all these reasons it does not pay to produce it, therefore it will occupy a small place in our list of valuable wheats.

FAMILY NUMBER 1.

WINTER WHEATS.

FAMILY NUMBER 2.

SPRING WHEATS.

Number 1—Winter Wheats.

Class 1—White wheats, smooth heads.

Class 2—White wheats, bearded heads.

Class 3—Amber wheats, smooth heads.

Class 4—Amber wheats, bearded heads.

Class 5—Red wheats, smooth heads.

Class 6—Red wheats, bearded heads.

Family 2—Spring Wheats, all Bearded..

Class 1—White spring wheats.

Class 2—Amber spring wheats.

Class 3—Red spring wheats.

The sub-varieties should be given a number and a name, which number should be first added to the local names given to each, for which one common name should be substituted.

ARRANGEMENT.

1. The name, or names, of the wheat, and the particular soil or climate for which it may be suited, the proper period

of sowing it, whether it be liable to injury from drought, moisture, or frost in its earlier or later growth, and its liability to disease.

2. Its period of flowering and ripening.

3. The height and nature of its straw, whether it be white or dark-colored, brittle or tough, if liable to lodge or fall in wet weather, its uses, etc.

4. Nature of the ear, whether compact or scattering on the head, its length. This, of course, is greatly modified by some soils, but it will be interesting to know such variations and the produce per acre. And right here I wish to state that our statements of produce is not founded upon what it may yield in indifferent soil, but in the best, and with the best culture.

5. Color of the grain, this also varying with change of soil, whether coarse or thin-skinned, whether round or oval, large or small, whether liable to shatter or not.

6. Nature of flour and bran, with their relative qualities.

7. Whether the dough rises well or not.

FAMILY 1.

CLASS 1.—WHITE WHEAT, SMALL CHAFF.

1. *Deihl*.—A valuable white wheat, introduced from Canada several years ago, and gaining in popular favor. It requires to be sown early, so as to allow it to ripen early, as it is rather late, and as such liable to be attacked by rust. On mulatto or gravelly loam it will do much better than on alluvial soil, as it is less liable to rust. It has done well here, and on rather thin land made thirty bushels per acre. In Canada, its general yield is forty bushels per acre. It makes a fine, white flour, and dry, good bread. It has an ear from three-and-a-half to four inches in length, small grain, thin skinned; a bushel weighed sixty-six pound. If over-ripe it shatters, the husk not being very thick.

2. *Tappahannock*.—This wheat has been sown largely of

late, and is probably the most popular wheat of the State. It originated in Pennsylvania, and was popular there many years before it was distributed. The Agricultural Bureau has the honor of having drawn it from its obscurity, and given it a more general cultivation than it could have received in the usual way in a generation. Bags containing a pint were sent all over the Union, and careful husbandmen found this supply amply sufficient to start the whole country in its use. It has an ear about three inches long, full, round grain, thin skin, rather large, quite hardy, tillers well, ripens about the 10th of June, straw light-colored, about four feet high, and stands up well. The millers place a high estimate on it, and the flour from it is most excellent and dry. Eighteen pounds of flour has made twenty-four pounds of bread. The soil best suited for it is black loam, though it does well on any rich moist soil. It has, in the State, produced 30 to 40 bushels, and on clover land, will almost always do well.

3. *Boughton or Bowden*.—About ten years ago a Mr. Boughton, of Virginia, raised this wheat and gave it a great popularity. Where he derived his seed is unknown to the writer, but in other States, west, it is called Oregon wheat. It is almost, if not identical with the preceding; in fact, many farmers and millers claim it as identical. On examination of two samples presented the similarity was great, but it appeared the Boughton was rather shorter and rounder than the Tappahannock. However, the description of one will answer for the other. There is no practical difference. The Boughton was introduced into Middle Tennessee from Virginia and Kentucky simultaneously, and at once achieved great popularity. This was in 1866-7. From 30 to 40 bushels were occasionally made per acre. It has maintained its high character. Within the recollection of the writer, there has been but one failure of this crop, and that was not general, but followed the course of a

drought. It is but little liable to rust, as it ripens quite early in June. The remarks about Tappahannock will apply so completely to this variety the reader is referred to the description of the former.

4. *Early White May*.—This has a white chaff, the heads somewhat heavier than white flint. This is a good variety, and from the beautiful and large proportion of extra flour to the quantity of grain, the White May is unequalled. It was at one time grown quite extensively, but from some cause, has given place to others. It ripens quite early, and so escapes rust and fly, but is liable to be winter-killed. It yields on good ground, 20 to 25 bushels per acre. It is low, three to three and a half feet high, and has a small grain. It weighs from 60 to 67 pounds per bushel.

5. *White*.—There was, about 25 or 30 years ago, a wheat known as white wheat, grown all over the State, and from the beauty of its berries was very much sought for as seed. Since then it has almost disappeared, though still cultivated in some counties. It was very tall, has light straw, long heads, and yielded well when the season suited it. Its extreme lateness, however, rendered it liable to rust, and it was badly attacked, as a rule, with smut, though the discovery of the efficacy of blue-stone will render this objection nugatory. It yields from 18 to 35 bushels per acre. It is excelled by no wheat as a flour-maker.

6. *White Smooth Head Mediterranean*.—A flint wheat, once known in Middle Tennessee as the Gad Frierson, and very popular. It is supposed to be a hybrid of the Mediterranean and White wheats, and partakes of the character of both parents. It is not really white wheat, but rather belongs to the class of Amber wheats. It ripens with the Mediterranean, and yields 20 to 25 bushels per acre. It has so greatly deteriorated that it has almost “run out”

7. *Blue Stem or Purple Straw*.—The straw is tall but

stands well; the grain is short but plump, with a very thin skin; chaff white, and the straw near the head blue, hence the name *Blue Stem*. The flour is of the very best quality, and the wheat always commands a good price. It was carried to Pennsylvania from Virginia, many years ago, became acclimated there, and was carried thence South, and therefore has since been called *Pennsylvania Blue Stem*. It is late, however, and like all late wheats, subject to rust. At one time it was extremely popular, and in some localities maintains its popularity. It is called by many names in various localities. North of the Ohio it is yet a very popular wheat, and probably more raised than any other white wheat. It ripens with the Mediterranean. It is the same as the "Flint," "New York Flint," "Durst" and "Genesee," according to locality.

8. *Shaker*.—A variety of the Little May, twenty years ago cultivated to a great extent. No doubt it is the Little May modified by soil and culture. It made on good ground a fine yield. It is little sown now.

9. *White Amber* is mentioned by one of our correspondents. From its name we suppose it is one of the Amber wheats, grown on soil that induces a paleness in the color of the grain. Some soils have the quality of converting Amber, or even Red wheats into white. It is highly probable this is the Smooth-head Mediterranean, or some of that class of Flint wheats.

10. *Genesee Flint*.—All remarks about No. 7, or Blue Stem, apply to this. This name is also applied to a white bearded variety, and to a red bearded. The name, however, properly belongs to the Smooth-head Blue Stem.

11. *Clanson or Clawson*.—This is a new variety originated by Stephen Clawson, and stands at this time without a rival on the wheat farms of the Lake Shore. A great discussion took place last year in the *Country Gentleman*,

as to the relative value of Clawson and Deihl. The advocates of the Clawson claimed it would yield at least ten bushels per acre more than the Deihl, and substantiated their assertions by facts and figures. Northern wheat, as a rule, is much improved by bringing South, and it appears this variety would well repay any enterprising farmer who would make the experiment. It has never been cultivated to any extent in Tennessee, but deserves a trial. It is said to thrive well on alluvial lands, and readily yields from 40 to 50 bushels per acre. A small quantity sent by mail could be used to make a start, and by the time one would have enough to sow a respectable field, it would become acclimated. It is related to the Mediterranean and is a white flint.

12. A species of wheat called the *Rainbow wheat*, is thus described by Mr. Winstead, who raises it: "The Rainbow wheat was brought into this country from Southern Russia. I got a small quantity of it, and have been raising it for four years. The stalk is strong, and the wheat grows very tall on poor land, and has never been known to have smut or rust since its advent into this country. It is a beautiful white wheat, very plump berry, and will weigh 66 pounds to the measured bushel. I regard it as the best wheat grown in the State."

13. *Australian White Wheat*.—For the same reasons stated above, it is proper to include in this list the beautiful "Australian White Wheat." This wheat secured the premium at Philadelphia last year, over more than one thousand competitors, and stands preeminent as a prolific variety. The grain is rather small, white, thin-skinned, but the heads are very long and it tillers luxuriantly. Captain Thomas F. Perkins, of Franklin, Williamson county, gave a dollar for a thimble full, and John B. McEwen, Esq., got three or four grains of it. Thomas F. Perkins, Sr., sowed the balance in his garden, and unfortunately the mules

breaking into the garden destroyed a large quantity of it. Yet he was able to secure, and now has half a bushel. John B. McEwen got from one grain over fifty stalks, and gathered one pint of seed. It is fair to presume, from one or the other of these sources, we may expect in a few years to be able to tell whether it will suit our climate. The probability is that it will suit our thirsty, gravelly hills, it being the general character of the Australian lands. This ends the Smooth-head class, and we now come to the second class, or

CHAPTER VIII.

CLASSIFICATION OF WHEAT CONTINUED—CLASS 2.—WHITE
WHEATS, BEARDED HEADS.

No. 1. *Quaker*, very similar to the Mediterranean, equally as hardy and very prolific. Like all white wheats it is more subject to rust and other diseases than the red. It is only raised in a few counties in the State.

2. *White Mediterranean*.—This, it is highly probable, is nothing more than an ordinary Mediterranean, that is converted into a white by change of location. It is a flinty wheat, and ripens with the red variety. It is not superior to the red in any respect, and owing to the thickness of its skin, it does not make a good flour by any mills now in use in the South, but stands weathering in shock well.

3. *White Quaker*.—Same as Quaker described under head of No. 1.

In addition to these may be mentioned the "Old White Flint," "Rock," "New York," "Kentucky White," and various others, but they do not belong to the list of Tennessee wheats, and we attempt in this work to give a list of such wheats as are grown in Tennessee, or likely to be grown. This rule, however, will not prevent us from calling the attention of farmers to an extra and promising variety, when the occasion seems to justify it, as in the case of the Clawson and Australian, although these wheats may not be cultivated in Tennessee.

CLASS 3.—AMBER SMOOTH HEAD.

No. 1.—*Amber*.—This is more a generic than a special term, yet there is a variety generally known by this name, and is quite popular, both with the farmer and the miller.

It is only within a few years that the Amber has been recognized, formerly it being classed light red or yellow. This is a medium wheat as to time of ripening, but a very sure producer. The grains are round, plump and full. The straw is not disposed to lodge, and yields at best from 20 to 35 bushels per acre. It is a sure crop almost any year, and commands the highest price in the market, not yielding in value even to the finer whites. A more attractive-looking wheat might be raised, but as a general thing no better wheat is grown, and the farmer cannot do better than to give it a place every year on his fields.

2. "*Yellow Lammas*," "*Old Lamme*."—This wheat is one of the oldest wheats in the State. Forty years ago it was raised quite extensively in Middle Tennessee, but not from any defect of its own, it gave place to others. It has to a small extent been restored to cultivation here, but it is not of a sufficiently remunerative kind to take its old place. It originally came from England, and is there one of the standard wheats now.

3. "*Golden Straw*," "*Whig*," "*Golden Chaff*," "*Shot*."—An old variety that was universally cultivated thirty and forty years ago, but has long since grown into disfavor. It became very subject to disease, especially rust. It is late in ripening. The straw is tall and heads long, grain good and makes fine flour. It is still cultivated in a few localities, old farmers being loth to give up an old friend. But there are so many new and better varieties, it would seem to be the policy of the farmer to go to the better.

CLASS 4.—AMBER-BEARDED HEADS.

This class in Tennessee is almost wanting. There are a few varieties cultivated in other States, but except as a matter of curiosity it is seldom raised here. The disposition of all bearded wheats to sprout in the shock, from the great amount of moisture held by the awns or beards, makes it

certainly to the farmers' interest to secure the smooth head, especially as the bearded is so disagreeable to handle.

No. 1. *Pennsylvania*.—There are several wheats by this name, both smooth and bearded. Having described one of that name under the head of "Blue Stem," it will be proper to place the other here. It is a bearded variety, yellow grains and heads short. It is early, and a medium producer.

No. 2. *Yellow Bearded*.—This is quite extensively cultivated in the Northern States, to a very limited extent here, and yields quite handsomely. It is very much like the Mediterranean, and ripens about the same time. Makes, however, more and better flour. It is singularly exempt from insects and diseases.

No. 3. *Wheatland Yellow*.—Chaff a pale yellow, short beards, heads very large, and the grains very large. The usual objection to bearded wheat would not hold in this variety, as the beards are very short, almost no beards at all. It is a hardy wheat, yields well, and the flour from it is good.

CLASS 5.—RED SMOOTH-HEAD.

No. 1. *Walker*.—This variety, nearly amber, is very extensively raised in East Tennessee, and to some extent through the State. It is a medium wheat, but quite early, hence escaping to a great extent the great dread of wheat-growers, rust. There seems to be some discrepancy among my correspondents with regard to this wheat, some classing it as an amber. But the large majority calling it a red. It may be supposed there are two varieties called Walker. It yields a fair quantity, and is suited to rich land.

No. 2. *Fultz*.—This is a new variety, unless, as Mr. Allman says, it is nothing but the Walker. But the history of this wheat is too new, and too well authenticated to be disputed, and then it may be supposed that while all varieties of wheat descend from the same parents, it is not unreason-

able to find two kinds so nearly resembling each other as not to be easily separated. In a previous page, the manner of the discovery and the dissemination of this variety was related. It has proved to be all that was represented so far. Still it requires several years before it can gain complete confidence. Hitherto it has not come into the hands of the miller to any great extent, all being reserved for seed, but it is their province now to pass on it. It gave complete satisfaction to the farmer until 1877, when it was seriously affected by rust. It grows well on thin soils, and the yield is generally large. Many planters have secured this year from 25 to 40 bushels per acre. With Boughton, Amber and Fultz, it seems nothing is left the farmer to desire in the way of seeds. Still it will be years before all can be convinced of this fact.

3. *Red May*.—This is a most excellent variety, but varies very much in yield. On the alluvial bottoms it will give 20 to 25 bushels, while on rich up lands 10 to 12 bushels per acre is considered a good yield. It has a short head, short straw, small berry. One prime quality is that by the 4th of June in the midland counties it can be harvested. Some years, in dry weather, it will come in the middle of May. It is not much liable to any of the diseases to which wheat is heir. It is a very certain crop, though not the heaviest. It does not tiller well, and hence must be sown thicker than the usual kinds. One and a half bushels are not too much on average land. It is better not to sow it on poor land, as it will not do well. It originated in Virginia. It was a favorite among the Shakers for many years, and is one of the wheats to which their name was attached.

4. *Little Red May*.—A variety of No. 3, only it was brought into Tennessee by Joseph Jacobs from Missouri, no doubt having been taken there from Kentucky or Virginia. It had, however, improved by its visit, and is a very prolific, and in some sections a very popular variety.

5. *Red Chaff*.—This is one of the oldest and was one of the most substantial varieties we had. The straw is long and stands up well; chaff slightly brown. It makes a beautiful flour, very white. The great objection to it is its lateness in ripening, and consequently its liability to rust and other diseases. It is by many thought to be the same with "Golden Chaff" and no doubt it is, though it differs in some respects, from difference in locality. It has been superseded by more desirable varieties.

CLASS 6—RED BEARDED HEADS.

No. 1. *Tucker*, mentioned by one of our correspondents, but the name certainly being local, we are not able to define its character or history.

2. *Andrews' Red* is a medium high straw, good grain, early to ripen, and yields well. It is said to have been originated by a Mr. Andrews, of Williamson county, and has a good local character. We are inclined to think it is the same called in East Tennessee, Quaker. At least it resembles it very much. It is such a common thing for wheat to receive the name of its introducer that it is a difficult matter always clearly to define the several characters claimed for it.

3. "*Mediterranean Cuba*."—We are at no loss however in placing this correctly, as it has been cultivated a great many years, and has during all that time maintained its reputation as one of the surest and best wheats we have. It is a flint, has a large, long, heavy grain, very thick skin, and makes a yellowish flour that is rather yellow, but the dough rises exceedingly well. The mills South are not prepared properly to make first-class flour of the Mediterranean or flint wheat, but will no doubt soon prepare themselves, if a sufficient inducement is held out to them by the cultivation of spring wheats, which are all bearded flints. In fact this variety has in some localities been converted into a spring wheat by cultivation. The new process of grind-

ing is by granulation, the husk being first stripped from the grain, and the kernel then cracked and afterwards pounded into the rounded granulated flour. By this process more and better flour can be made of the flint wheats than of winter wheats. While the Mediterranean is ground as other wheats so much of the husks containing a large quantity of gluten and silica goes into the flour that they give it a yellow hue, and so it cannot be passed as more than middling. There is no doubt that by change of locality and cultivation the dark red of its grain is lost, and it has changed into the white Mediterranean. A gentleman in Williamson county whose land is creek bottom—a black alluvium—had been cultivating this variety several years, and it was almost amber in color. He sold some seed to a gentleman in Rutherford county, and the latter sowed it for a succession of years on cedar land, a mulatto soil. They met at a mill with the same wheat after several years sowings, and the mulatto land wheat had regained its natural dark red color, and could not have been recognized as having sprung from the other.

This wheat has no significance whatever in its name. In fact it is of Danish or Norwegian origin, from whence it was introduced into Holland, and from the latter kingdom into the United States under the name of German wheat. In a short time it was known as the “German fly proof wheat,” and then by the singular and indefinite cognomen of “Fly proof wheat,” and lastly it is now universally known as the Mediterranean. The following from one of the old volumes of the “American Agriculturist,” furnishes the history of its introduction in the United States: “Several years ago, about 1819, an American gentleman who was traveling in Holland, was asked why, with our fine climate and soil, we so often failed in having good wheat crops. He replied it was doubtless in a great measure attributable to an insect which it was supposed was introduced into the United States in the wheat sent from Holland during

the Revolutionary war for the subsistence of the British army, which was known in this country as the Hessian fly. The Hessians admitted that some kinds of wheat in that country were liable to injury by insects, but that there was a species in very general use that resisted their attacks. The American gentleman was presented with some of this wheat, which he brought into this country and sowed on his farm in Delaware. It was subsequently introduced into Virginia by James H. Taliaferro, Esq., and its ability to resist the attacks of the fly successfully tested.

“A gentleman who was supplied by us with a part of the lot received from Virginia, informs us that there has been great improvement in the appearance of the grain since its introduction on his farm.”—*American Agriculturist*.

One quality which this variety possesses in an eminent degree, is its capacity for resisting pasturing. Many farmers sow it for the purpose of wintering stock as a substitute for rye, and taking off the stock about the 1st of April, make a good crop of wheat. It is from the want of proper machinery for grinding that it has lost ground as a wheat, but it can confidently be predicted it will yet recover its wonted popularity, and be as extensively raised as in former years.

4. *Treadwell*.—We have not been able to trace the cultivation of this wheat out of Middle Tennessee. It is not properly speaking a bearded or a smooth head. In fact it is both. A Mr. Treadwell found two kinds of wheat growing together, most probably mixed by a thresher, and the grains being exactly alike and ripening at the same time, and yielding very handsomely, he started the variety, gave it his name, and hence the Treadwell. It is medium as to time of ripening, has a good stiff straw, and is very prolific.

CHAPTER IX.

CLASSIFICATION AND DESCRIPTION OF WHEATS CONTINUED.

Family 2—Spring Wheats.—So far as Tennessee is concerned, Spring wheats may be considered a nullity. In the whole State, but one county, Marion, reports the cultivation of any. As before stated the mills of the country are not prepared to grind spring or flint wheats, and besides, they have been tried and found not to succeed well. They are well suited to the inhospitable climate of Canada and Northern United States, but here the winter wheat is rarely killed out, and the growth of our vegetation is so rapid in the spring, that it all goes to straw. It is only a dernier resort that will justify anyone to venture on its cultivation. There is, in the Central Basin, one man, a renter, who sows it simply because he changes his home very often, and cannot sow the winter varieties. He says he has made as much as 10 bushels per acre. Still, as we set out to give all we know about wheat, we will enumerate all that have been tried. But the simple enumeration is all, for one word covers them all, with the single exception mentioned, of Marion county, and this word is *failure*. Our correspondent from Jasper gives the names of three or four wheats with which we have no acquaintance, and we suppose them to be spring wheats, at least we shall give them in the list, and if we are in error, this explanation will give the reason.

CLASS 1.

No. 1. Spring Bearded.

" 2. Harris,	} Marion county.
" 3. Orleans,	
" 4. China.	
" 5. Tea.	

No. 6. Canada Club.

“ 7. Italian.

“ 8. Stock.

“ 9. Talavera, without beard.

“ 10. Red bearded.

“ 11. Spring Club, extra fine.

It is often the case that a late sown crop, say put in from 1st to to 25th December, shows no signs of coming up until spring, and then it will make a good crop, better often than the early sown wheat. This is in effect spring wheat. But we know how seldom this late sowing will prove profitable. But, then, all kinds occasionally fail, however careful we may be in the selection of seed in the time of sowing, and in the preparation of the land, and there is no explanation for it, except that it was not a good year for wheat. The Northern farmers can make spring wheat of any winter wheat, by allowing it to slightly germinate in the fall, and then allow it to freeze and remain frozen until spring, and then sow. It is on this principle our late sown wheats sometimes succeed.

The cooler the weather in which wheat ripens, the heavier the grain, and it might be that if wheat was sown as late as millet is, we might get, after a while, some seed that would ripen in September. If millet is sown early, the straw is yellow, scant and spindling. If, however, it is sown in the latter part of June to the middle of July, it will be deep green, rank, coarse and luxuriant. Why should not wheat do the same way, sown say in May? We know that oats will do it. Wheat is being experimented on in this manner in some of the Northern States. It is possible that should it be so rank, it would, as usual, suffer with rust, but it could be treated according to the German method, with lime and cow urine. The latter is made into a paste with lime, and the seed wheat is rolled in it until it is thoroughly saturated, and then sown. This has never, in our knowledge, been tried, but it is frequently done in the Ger-

man States. It would at least be a fine stimulant to its growth.

This completes the list of Tennessee wheat, with the exception of those unknown to the writer, but mentioned by some of our correspondents, and if they are favorites we would be pleased to hear from some one on the subject. Such are "Tubman," "Moore" and "Phelps."

These are enough, and as good a variety to select from as the list of any other State. Tennessee, from the favorable latitude, and the great diversity of her soils, presents as many favorable advantages to the wheat-grower as any other State in the Union, and the only reason why she has not made more wheat, is because our people have got in the habit of cultivating large crops of corn, cotton and tobacco. It is an exceedingly difficult matter to shake off the shackles of habit. But the continued impoverishment of our lands, the uncertain character of our labor and its cost, will gradually bring us to our senses. It is no easy matter to break up old customs and practises, and revolutions are not the offspring of a day. It has to be a gradual process. The people must be convinced it is to their interest, as it certainly is. Mills will gradually accumulate, and instead of sending our wheat to the North to be converted into flour, and then returned and sold to us, it will be ground at home. It is a suicidal policy not to build mills, grind our wheat, and then, after supplying our own wants, export the surplus flour.

To select good seed and to improve the varieties, it is best to gather a few good heads that combine the greatest number of desirable qualities, as regards grain, flour, length and shape of ear, quality and stiffness of straw, hardihood and liability to disease, cultivating from these alone.

The average in England per acre is 36 bushels. In the United States about 12, while in Tennessee, from our reports, we are obliged to put up with eight. In England 50

bushels per acre are as common as 25 bushels here. Climate may have something to do with this great difference in yield, but cultivation more. The idea of exhausting soils by cultivation there, is scouted as absurd; the soil on farms constantly under cultivation, increasing constantly in fertility.

When the farmer deems it necessary to change his seed, it will be a good idea to import it from the North. The reason of this, as before stated, is obvious; the North being colder, requires a longer time to mature the wheat than it does here, consequently wheat brought here will mature earlier than there. In like manner, it being warmer in the South, wheat matures earlier, and when brought here does not succeed well, being after one or at most two trials abandoned. For this reason many of the wheats distributed by the Agricultural Bureau do not succeed well, only in particular localities. It is highly probable that if wheat could be imported here from Turkey or from the northern shores of the Mediterranean, it would succeed at once, as the latitude is near the same, and the Isothermal line is precisely the same with Tennessee, and not only these localities agree with our State, but Japan and the southern slope of the Himalaya Mountains, the birth-place of man and nearly all vegetation necessary to man's sustenance. If Tennessee occupies geographically and geodetically such a favorable situation as a wheat-producing State, why has she not already taken her proper stand as a producer? The causes of this have been stated, and also the influences that are at work, silently but surely, to propel her into her natural birthright.

It is very extraordinary that some varieties have a predisposition to sprout, or alter their appearance. In confirmation of this, and also to show the great importance of carefully selecting pure seed and how it pays, we beg leave to present the following account of an experiment from the work of Prof. LeCouteur, a celebrated English writer and farmer:

"But it had escaped him to consider it in its properties with relation to the food of man. This practical view the author took of it, and determined to attempt to discover which were the most farinaceous and most productive varieties, by comparing their characters and produce one with another. The usual mode with the generality of farmers is to procure any seed that any neighbor enjoying the reputation of being a good farmer may have to sell. A more intelligent class procure their seed from a distance, and require that it be fine, perhaps even pure; they also have thought of changing or renewing their seed occasionally. A still more intelligent number have procured the best seed they could obtain of those sorts which observation and experience have led them to know as being best suited to their soil and climate; having further observed that mixtures in their crops prevented their ripening at the same moment, and having endeavored to remedy this defect, by making selections of seed, by hand, of those varieties which appeared to them similar, and thus have greatly improved their crops in produce and quality. A few farmers have proceeded a step farther, and from having observed a stray ear of apparently unusual prolific habits, have judiciously set it apart, and have raised a stalk from it. Hence the Hedge wheat, Hunter's, Hickling's, and twenty more that might be named; but it is contended that it is not sufficient merely to have grown them pure for a short time; it is necessary to keep them permanently. So, if after a comparative examination as to their relative production, grain and meal, they shall prove to be the best, or otherwise to discard them for more valuable varieties. This was the chief consideration which led me to make comparative experiments in order to obtain the best seed. Hence, as a first step towards improvement, Professor LaGasca, having shown me four ears of those he considered the best and most productive, I sorted as many as I could collect, of precisely the same varieties, judging from their external appearance. Such was my anxiety to attempt to raise a pure crop, that in the month of November I rubbed the grains from each ear of all the four sorts I had selected, throwing aside the damaged or ill-looking, and reserving only the plump and healthy."

"The first selection was apparently one of the Dantzic sort, white and smooth-eared. In the process of rubbing I was surprised to find that, though most of the grains were white, they differed greatly as to form, some being round, some oval and peaked, some plump, but very small, some more elongated, some with the skin or bran much thicker than others. There were also many liver-colored, yellow and dark grains among the white.

The second sort was from a square, compact variety of wheat, the berry plump, round, of a coffee-like form, very thin-skinned and white. There was a pale red inferior kind among it, much thicker skinned, but without any perceptible inferior external appearance in the ear.

The third was a downy or hairy variety, one of the "Velantes" of the and "*Triticum Cœleri*" of Prof. LaGasca, a velvety or hoary sort, which is supposed to be very permanent duration, as relates to keeping pure. I found, however, that there were a few red grains, some yellow and some liver-colored sorts among this, in small proportions, it is true, but being of prolific habit, subsequent experience has taught that they would soon have destroyed the purity of the crop, if cultivated without constant attention.

The fourth selection was from a variety of red ear, with yellow grains, more peaked than the "Golden Drop". These were all plump and well grown, but though of productive habits, afford less flour and more bran than the white wheat varieties. I discovered a red variety among it bearing white grains, which I suspect to be very prolific and hardy. I gave a sample of this to Sir John Sinclair, who greatly encouraged me to prosecute my researches, as being of the highest importance.

There were also red ears bearing liver-colored grains, but these were chiefly lean and ill-grown. I generally, but not invariably, found that the grain of white wheat was the plumpest, or possessing the greatest specific gravity, or largest quantity of flour.

The aspect of the grain in that dry season led me to think that white kinds of wheat will succeed best on dry soils and warm climates, and that red and yellow, or the darker colored, for wet seasons or moist soils. The care I took in making these selections, and the great number of sorts I found of all shades and colors, forming sub-varieties, as they are named by Prof. LaGasca, confirmed my conviction that the only chance of having pure sorts was to raise them from single grains, or at least from single ears. It is but fair to add that even the pains I took in making those first selections amply rewarded my labors, as the products of my crops were increased from an average of 23 or 25 bushels an acre, to 34 bushels. And since I have raised wheat from single ears carefully selected sorts, I have increased my crops to 40 and 50 bushels per acre. Hence I have no doubts that with extreme care in obtaining the best and most suitable sorts, that land in high tilth with fine cultivation, may be made to produce 60 or 70 bushels per acre."

One more species of wheat will close our chapters. Nor can it be properly called wheat, as it is used for stock. It is the "Canaile" or "Indian wheat." I give an account from the "Country Gentleman." "This grain was introduced into the United States from Canada about twenty-three years ago, I think; since when it has been constantly cultivated by some of our farmers, and now nearly all our farmers raise it, although a few, after trying it a year or two, discontinued it, some because they thought it would over-

run their whole farm, and some because the "women" could not use it, neither of which I consider valid objections. It will live in the ground over winter, so that it may be sown at any time, from the harvesting of one crop to the gathering of the next, but we usually sow it after all the other crops are in, and harvest it before it is so ripe that it will shell off from the straw, it being necessary to cut it while the dew is on. Our farmers often keep the same piece of land in it for several years in succession, and it seems to do as well so. If the soil is too rich, it "runs to straw" too much. The average crop is from 45 to 50 bushels per acre, about the same as oats, although it often produces from 75 to 110 bushels per acre on our soil. The average weight is 48 lbs per bushel, and 16 to 18 lbs. superfine flour per bushel. The "Canaile" I think worth more per pound than oats as feed for stock; it is quite bitter, and seems to act as a tonic and sharpens the appetite very much. I think this grain worth fully one quarter more than oats for horses, possessing to a good degree the property of corn that makes fat, and that of oats that produces muscle."

CHAPTER X.

DESCRIPTION OF THE INTERIOR STRUCTURE OF THE
WHEAT GRAIN—ANALYSIS OF THE WHEAT GRAIN—
THEORY OF FERTILIZING.

We deem it proper here to give a few instances of the analysis of wheat and wheat-straw, so that the farmer will be able to see for himself, the elements necessary for suc-

FIG. 1.—MAGNIFIED SECTION OF A WHEAT GRAIN.

cessful growth of wheat. The subject of analysing wheat has, next to that of discovering the philosopher's stone, by which all things could be transmuted into gold, perhaps, engaged the attention of chemists beyond any other. That it can be easily done, is attested by the analyses that appear in almost every number of an agricultural journal. There are two great principles in grains of wheat, the "meal" and the "bran," which are subdivided according to their chemical constituents. Starch and gluten form the valuable constituents, and as the relative quantities of these vary, so does the value of the wheat. If you will cut across a wheat grain you have a view of the constituents of wheat. Suppose we make a section of a grain of Wheat vertically and magnify it as in our cut, fig. 1, we shall then have a correct view of the *make-up* of a grain. We observe at the upper end the *beard*, which consists of very fine hair tubes. These vary in color from a dirty white to a brown. These capillary tubes are possibly intended to place the interior of the grain, during its developments, in communication with the atmosphere, and hence the nature of the beard is such that, when the grain is taken from the ear, and freely exposed to the air, the beard soon becomes thickly coated with minute particles of dust and dirt. If this dust is not removed from the grain, the quality of the product will be impaired considerably, and an inferior appearance will be given to the flour. Referring again to fig. 1, it will be noticed that at the lower end of the grain there is situated the *germ* or *embryo*. The inner part of the germ will be readily distinguished from the other portions of the grain being a hard, yellow, gristly, oily substance, of disagreeable flavor. This portion cannot be easily stripped off the grain while the latter is in a dry condition, and like the *beard*, being harder than the kernel, it grinds under the stones into very small particles, which not only give a dull, dark shade to the flour, but are also very injurious to the quality of the latter, being indigestible. By a somewhat closer ex-

amination of the body of the grain we shall discover a number of hulls and skins, enveloping the kernel.

The first of these, or outer hull, "*epidermis*" marked 1, in fig. 1, appears rough, wrinkled and colorless, while it shows no cells, and being partially disengaged, can be easily stripped off. The second hull, "*epicarpium*," marked 2, although smoother, is similar in its character to the "*epidermis*," and like the latter, envelopes the grain loosely, so that it, too, can be readily removed. The third hull, "*sarcocarpium*," marked 3, is also smooth, but shows cells of a yellow color; while the fourth hull, "*endocarpium*," marked 4, is of a similar nature to the "*sarcocarpium*." The third and fourth hulls adhere to the grain more closely than the first and second, and their separation is not so easily effected. The combined weight of these sluggish hulls mentioned, is about three per cent. of the entire weight of the grain, and they possess no nutritive value whatever. The four hulls we have enumerated form the bran proper, and they are followed by the 5th skin, or *testa*, which is more or less of an orange-yellow color in the different kinds of wheat, and which has a cellular structure, as shown. The *testa* adheres to the kernel very closely, and it is succeeded by another very thin and colorless skin indicated in our figure. This skin being also very closely united to that which follows, so that the two can only be separated with difficulty.

The most important, however, of all the skins is the last, marked 6, in the figure, the embryo membrane. This embryo membrane is quite colorless, has a cellular texture, and contains a very high percentage of phosphoric acid and gluten. It extends from the embryo or germ, to the other end of the grain, and forms an envelope which is impermeable by water. Thus, if a grain of wheat be immersed in water, the five outer envelopes will be penetrated in a few hours, while the embryo membrane will resist further permeation, and the kernel may be found dry and brittle after

several hours' immersion. Even if the outer hulls or skins be removed, the embryo membrane still retains its power of resisting the entrance of water or moisture. The only point at which the water can gain access to the kernel, and then only after long immersion, being at the embryo, where the embryo membrane does not protect it, as shown in figure 1. In the event, however, of the embryo membrane being damaged, partly removed, or even scratched, the water will gain immediate access to the kernel, and the latter will be penetrated instantly.

According to Mege Mouries, the embryo membrane plays a most important part in the process of germination and alimentation, for it belongs to that class of organic substances possessing a kind of life, and it is thus capable of such action and conversion in the bodies with which it is brought in contact, as is necessary for the development of the plant. The farinaceous matter of the kernel, which comes into immediate contact with the embryo membrane, is somewhat hard and brittle, and although not perfectly white, it is most nutritious, and would make bread of the highest quality if it could be separated from the bran; being, however, as we have said, hard and brittle, it breaks up under the stones with the husks, and thus not only gives a dark appearance to the flour, but reduces its quality by causing it to be largely intermingled with bran, besides the quantities of dust and dirt which are mingled with all grain.

Further, the close connection with the farinaceous layer, with the envelopes, is the reason that it forms part of the bran to a considerable extent. That part of the farinaceous matter beneath this, is neither so hard nor so nutritious, but it yields a white flour, as it is not so largely mixed with particles of the bran. The interior or centre of the grain is softer than the parts around it, and it is the least nutritious, yet it yields the finest and purest quality of flour for the reason stated,

which will explain itself in a different grinding system to that practiced in this country. If it were possible to effect a complete separation of the farinaceous matter from the envelopes which surround them, it would be found that they amounted to 90 or 92 per cent. of the entire weight of the grain, the other matters, or bran, forming 8 to 10 per cent. of that weight; in ordinary practice, however, the bran amounts from 20 to 25 per cent. while the flour is about from 75 to 80 per cent., and is, moreover, of a much lower quality than it would be if a perfect separation could be effected. Hence, it follows that ordinary bran contains at least 10 per cent. of the most nutritious farinaceous matter, a fact which is due, in a great measure, to the bran being largely mixed with the layer of farinaceous matter, which cannot be separated from it by ordinary methods. The gluten is present in a higher proportion in the bran than in fine flour, and from this, it might appear that wheat having thick hulls, or affording a high percentage of bran, would possess a high nutritive value as food for man, as its muscle-forming power is determined principally by the amount of gluten which it contains.

In 1658 an ordinance of Louis XIV, of France, prohibited, under heavy penalties, the grinding of bran a second time. Moreover, until quite recently, it was very generally supposed that bread made of the whole meal was more wholesome than that made of the flour; but Moleschott has shown in his physiology that mixing the bran with the flour is a mistake, as, although bran is richer in nutritive matters, yet that a man cannot digest the thick cells of the hulls unless he possesses unusually strong digestive powers, and leads an active life. On the other hand, moreover, the mucus membrane of the digestive organs become greatly irritated by the bran, and thus undesirable results attend an abundant supply of substances which, although nutritious, are digested with difficulty.

We have caused these constituencies to be engraved in

a more highly magnified manner, so as to show the parts plainly, and also to exhibit in a more marked degree the importance of the new method of “decortivating” the grain before grinding.

FIG. 2—SECTION OF WHEAT GRAIN HIGHLY MAGNIFIED.

Figure 2 gives a part of a section of a grain of wheat. In this the different hulls are plainly visible, *c* being the embryo membrane that is albumen, it being waterproof, and the protector of the gluten and starch cells; *d* is the gluten cells, and *e f* are the starch cells, with here and there a few gluten cells sticking to them. It will be observed that the cells of starch are hexagonal, and contain many ovoid globules of starch each. In the new milling process these cells

are simply broken and the globules crumbled out retaining their shape.

From the wheat grain we obtain from chemical analysis:

	Wheat.	Flour.	Bran.
Water	14.83		
Gluten	19.64	13.04	20.0
Albumen	0.95		
Starch	45.99		
Gum	1.52	73.20	28.8
Sugar	1.20	4.20	
Gil	0.87	5.6	
Vegetable Fibre	12.34	2.1	5.5
			45.7

These substances may be still further resolved until we arrive at the approximate organic elements which enters into their composition.

	Gluten.	Albumen	Starch.	Gum.	Sugar	Veg'ble Fibre.
Carbon	53.27	.74		42.68	36.1	53.23
Hydrogen	7.17	7.11	42.80	6.38	7.0	7.01
Nitrogen	15.94	15.66	6.35			
Oxygen	}	23.62	50.85	50.94	56.9	16.41
Sulphur			23.50			23.35
Phosphoras						

The oil for the greater part consists of carbon. The gluten and starch is found to vary very considerably in different kinds of wheat, as well as in wheat grown in different climates. If 100 pounds of wheat are burned, one or two pounds of ashes are left, which give the following analysis:

Potash	29.97	per cent.
Soda	3.90	"
Magnesia	12.30	"
Lime	3.40	"
Phosphoric acid	46.00	"
Sulphuric acid	0.33	"
Silica	3.35	"
Per Oxide of Iron	0.79	"
Chloride of Sodium, or salt	0.09	"

From this it will be seen that wheat is richest in phosphoric acid, magnesia and potash. Wheat, as I before

stated, is valuable in proportion to the amount of gluten it contains. In some varieties it is more tough and fibrous than in others. A very simple method to determine this is to make a paste of a small quantity in your hand, pull it out and its toughness will determine the length of the thread it forms, and the value of the flour.

Anyone may, in a small but correct manner, analyze wheat flour in a very simple way. Make a stiff dough of a given quantity of flour, put it in a linen bag, and let the linen be thick. Then knead it in water until the fluid that runs out ceases to have a milky appearance. Let the water settle and you will have the starch of the flour. The gluten remains in the bag, as water only swells it, but without dissolving. Let the water stand, and a white sediment will settle to the bottom. This is the starch, the principle ingredient of flour, and of all meals. Separate the water from the starch and boil it, and it becomes turbid and flocculent. This is *vegetable albumen*. Separate this from the water by filtering, and boil the water remaining until it becomes a thick syrup, and then add alcohol. The alcohol will take up the sugar, but not the gum. Filter the alcohol and the gum remains. Evaporate the alcohol and you have the sugar. Of course these are not chemically pure, as the saline matters remain. Let us go back to the bag that contains the mass. Here are the vegetable fibre and the gluten. Gluten is *vegetable fibrine*, and corresponds to the fibrine or muscle of animals. It is also seen in the clot of blood, while albumen being the serum or watery part of blood. Thus we have in this little grain all the elements of nutrition, fibrine or muscle-food, starch and albumen, fat or heat-makers, cellulose, same as starch chemically, but insoluble only by digestive fluids. It is this cellulose that envelopes the starch germ, etc., and is also called *vegetable wool*. It is the pith of wood, the fibre of cotton, hemp, flax, etc.

As to the theory of fertilizing wheat, we may say that the wheat plant contains, as before stated, carbon, hydro-

gen, potash, soda, lime, phosphoric acid and other substances. These constituents are derived from the food upon which the plant feeds, for plants feed as well as animals. They both eat and drink. Knowing the composition of a given plant, we can partially determine the kind of food it needs. If potash, for example, is a characteristic constituent, it is plain that in some way the plant must have access to potash. So will lime, phosphoric acid and the others. If the plant cannot find these or any one of them in the soil it will not thrive or bear fruit. The absent substance or substances be supplied, and this is what is meant by fertilizing.

In the wheat plant there is a *volatile* part that burns away; that is to say, a part converted by burning into invisible gasses, which pass into the air and disappear. These gases are combined acid and watery vapor mainly, with sometimes ammonia and certain compounds of sulphur and phosphorous. The elements comprising these gasses and existing originally, are carbon, oxygen; hydrogen, nitrogen, sulphur, phosphorus.

Again, there is a *fixed* part remaining as ashes. In wheat this part is from four to four and a half per cent. of the whole. The ashes of this plant, taking the mean in round numbers, of many analyses are constituted in pounds, as follows :

Potash.....	16	pounds
Soda.....	3	"
Magnesia.....	5	"
Lime.....	5	"
Oxide of iron.....	$\frac{3}{4}$	"
Phosphoric acid.....	16	"
Sulphuric acid.....	$1\frac{3}{4}$	"
Silica.....	52	"
Chlorine.....	$\frac{1}{2}$	"
Total.....	100	

It may be presented in another form. Take a stack of wheat straw, chaff and grain weighing 1,384 pounds, burn

it, and there will remain only $57\frac{1}{2}$ pounds of ashes, containing the following constituents :

Potash.....	9	pounds.
Soda.....	$1\frac{3}{4}$	"
Magnesia.....	3	"
Lime.....	3	"
Phosphoric acid.....	9	"
Sulphuric acid.....	1	"
Oxide of iron.....	$\frac{1}{2}$	"
Silica.....	30	"
Chlorine.....	$\frac{1}{4}$	"
Total.....	$57\frac{1}{2}$	

By far the most important ingredients in the list are potash, magnesia, lime, phosphoric acid and sulphuric acid.

Generally it may be said that the volatile constituents are mainly derived from the air and the fixed from the soil. The former supplies an abundance of carbon food and of oxygen. It also supplies some nitrogenous food, ammonia, nitric acid, etc. The soil supplies, or ought to supply, nearly all the other constituents of the plant. In the aggregate, all these may be called soil food. Soil food differs from air food in being made up of a greater variety of ingredients, while in weight, excluding water, it is far less. The air is a constant invariable quantity, and always presents an abundant supply in food peculiar to it. In the consideration of fertilizers, therefore, the air food may be eliminated. The soil is an inconstant quantity, and is very variable. It may or may not contain the ingredients necessary to the full development of plant life. To supply these is one the chief duties of a successful farmer.

The following is an analysis of a very fertile soil. In the second column the quantities of most of the substances are given, which are necessary to produce 30 bushels of wheat. It ought to be remarked that most of the silica is used in the production of straw. The soil is, from an acre to the depth of one foot.

Soluble Silica.....	81,900 pounds	— pounds
Lime.....	143,220	9 “
Potash.....	35,910	27 “
Soda.....	68,920	5 “
Ammonia with nitrogen.....	2,100	49 “
Phosphoric acid.....	16,310	27 “
Sulphuric acid.....	31,360	3 “
Nitric acid.....	?	?

This soil ought to produce very many successive crops of wheat. Should one ingredient be absent, the wheat crop would be sickly, and in all probability not pay the cost of production.

Soils are most frequently deficient in potash, phosphoric acid and soluble compound of nitrogen. Bones, ashes, guano, animal excrement, blood, gelatine, oil of vitriol, salt-petre, and many other substances scattered over the soil supply these constituent elements, and so increase the yield of crops. But this yield will largely depend upon the physical condition of the soil. It should be thoroughly pulverized in order that the roots of the plant may extend their pasture grounds, so to speak, and fatten upon those numerous ingredients which its nature may require. A poor crop may be grown upon a very fertile soil, as we witness every day, and with proper tillage a good crop may be grown upon a comparatively poor soil. A proper stirring of the earth, and plenty of moisture, are by far the most potent fertilizers, for without these no other fertilizer will be worth anything.

CHAPTER XI.

GERMINATION OF WHEAT — WHEAT FROM EGYPTIAN TOMBS — EXPERIMENTS WITH SEEDS BY THE BRITISH ASSOCIATION—PROCESS OF GERMINATION AND HOW THE WHEAT PLANT GROWS—TILLERING, ETC.

All seeds kept in a certain state of dryness and darkness will remain sound. No change will take place apparently in their condition, being an inert body. In this condition they are capable of being transported to any distance and preserved for years, almost indefinitely under proper conditions. But suppose we apply a certain amount of light, heat, moisture and air, what takes place? Were it not that this is an every day experience, our wonder would never cease at the miraculous change that ensues. By the action of that incomprehensible, subtle principle called vitality, germination begins. But in order to be started all four of these conditions are necessary. If wheat has air, moisture and light but does not have sufficient warmth, no germination takes place. Nor is it necessary that it should be absolutely frozen, the simple absence of all warmth is sufficient. Water freezes at 32 degrees Fah., and the force exerted by this action of nature is ample to break water vessels, etc. This force is utilized by rock masons to quarry rock, and a cannon filled with water and left to freeze would be rent as would a bottle. Mercury congeals at minus 40°, so that it requires 72° more of cold to freeze mercury than it does water. Such a degree of cold is known in this country only experimentally. It would soon depopulate the whole of America, as the human system could not long endure it. But as small and insignificant as a grain of wheat is, it is able to withstand it and yet

live. An artificial cold of minus 58° , or 90° below the freezing point is necessary to destroy its power of germination.

But it cannot so successfully withstand the influence of heat, as water raised to the temperature of 122° , 24° more than our natural heat, will, in fifteen or twenty minutes, kill wheat. But this is not the case with all vegetations, as in the hot springs of various countries, some higher than boiling water, various low kinds of vegetables grow and reproduce themselves. But to destroy wheat, it must be moist, as it will endure a heat as high as 170° if it is dry. All vegetation requires a certain degree of warmth to germinate; generally 60° or 70° are required—always somewhere between 32° and 100° .

The peculiar sensitiveness of wheat to warmth may explain why it is that wheat does not succeed well in the Torrid zone. If wheat has once been incited to germinate and then dried, it can never start the second time. It is therefore important to keep seed dry, for without moisture it is safe. And not only must wheat be moist to germinate, but it must be kept moist. If wheat is sown on the surface it will, from the ordinary moisture derived from the air, germinate, but should it turn dry, the grain, being deprived of its moisture, will lose its vitality. In this manner much of the wheat seed last year was destroyed, the stands were bad, and hence, in thirsty soils, short crops. Therefore to both germinate and continue the vitality of wheat, it is necessary that it should be protected by soil enough to preserve its moisture. But here comes another fact essential to its success, and this fact it will be well enough to bear in mind. Not only are warmth and moisture necessary to the germination of wheat, but air and light are equally necessary to its development. Many eminent botanists believe that darkness is essential to the process of germination, but almost every one has seen grains of wheat placed in a bunch of cotton in the mouth of a jar, and those not buried in the cotton, stimulated by the moisture evapo-

rating from the jar, begin very soon to send down the rootlets to the water. In this simple manner all the phenomena of growth are made patent to every one taking the trouble to test it. Atmospheric air, therefore, is essential to the sprouting of seeds. It is true that seeds will sprout in water, and it is equally true that no water exists, unless made so, free from air. Fish breathe by passing water over their gills, and aquatic plants extract it in the same manner. De Saussure boiled water so as to expel its air and then sealed up, putting seed in it, and the seed failed to germinate. Petri's experiment, though old, is good and trustworthy. If wheat is sown on the surface, birds, insects, animals and the heat of the sun will destroy much of the seed. Should the land be simply harrowed the same objection would hold good with at least half the seed, for the harrow would not cover any except that which falls into a depression. Should the wheat be plowed in too deep, as is the practice of many, it will be deprived of the other necessities of vegetation, light and air. There must, therefore, be a proper and just medium to secure in the best possible manner all these pre-requisites to full growth. The proper depth is seen in the table by Prof. Petri:

Seed sown to the depth	Came above ground	No. of plants came up.
of $\frac{1}{2}$ inches	in 11 days	7-8
" 1 "	" 12 "	all
" 2 "	" 18 "	7-8
" 3 "	" 20 "	6-8
" 4 "	" 21 "	4-8
" 5 "	" 22 "	3-8
" 6 "	" 23 "	1-8
" 7 "	" 25 "	3 seed out of 100.

From this table only one-sixth as many seeds germinate at six inches as at three inches. A great difference of opinion prevails as to the proper depth. The Germans contend the deeper the better to the depth of four inches. About three-fourths of the seed will come up at the depth of three inches, and nearly all at from one to two. The warmer

the soil is the sooner will it germinate. An experiment was made in Sweden, a cold climate, and that sown on the 28th of April came up in eighteen days, that sown the 21st of May required eight days, while that sown on the 4th of June came up in six days.

Light also has a wonderful influence on the sprouting and growing seeds. In dark rainy weather, long continued, the crop will begin to turn yellow and fade, while a bright sun for a few days will restore them their rich green color. In "Researches of Light" we find the following experiment: "Some seeds being placed in the soil, in every respect in their natural conditions, duly supplied with moisture, and a uniform and proper temperature maintained, we place above the soil a yellow glass, a cobalt blue glass and a glass colored a deep blood red and allowed one portion to be exposed to the ordinary influence of the solar rays. The result was that the seeds under the blue glass germinated long before those exposed to the sunshine, a few seed struggle into day under the red glass, while the process of germination is entirely checked under the yellow glass."

I have the opportunity to copy the following letter from one of the most trustworthy seed merchants in the old world. His manner of proving the wheat seed he sells is here shown, and the trouble is so slight we would commend it to all our farming friends before sowing their wheat. It will save many a disappointment:

EDINBURGH, SCOTLAND, May 4, 1876.

DEAR SIR: I am favored with yours of the 5th relative to my practical experience in the effect of chemical agency of colored mediæ on the germination of seeds and growth of plants.

I must first explain that it is our practice to test the germinating power of all seeds which come into our warerooms before sending them out for sale; and of course it is an object to discover with as little delay as possible the extent that the vital principle is active, as the value comes to be depreciated in the ratio it is found to be dormant. For instance, if we sow one hundred seeds of any sort, and the whole germinate, the seed will be the highest current value; but if only ninety germinate its value is 10 per cent. less, or 90 per cent., if eighty, then 20 per cent. less, etc.

I merely give this detail to show the practical value of this test, and the influence it exerts on the fluctuation of prices.

Our usual plan formerly was to sow the seeds to be tested in a hot bed or frame, and then watch the progress and note the result. It was usually from eight to fourteen days before we were able to decide on the commercial value of the seeds under trial.

My attention was directed, however, to your excellent work "On the Practical Phenomena of Nature" about five years ago, and I resolved to put your theory to a practical test. I accordingly had a case made, the sides of which were colored blue or indigo, which case I attached to a small gas stove used for engendering heat. In the case shelves were fixed on the inside, on which were placed small pots wherein seeds to be tested were sown.

The results were all that could be looked for: the seeds freely germinated in from three to five days only, instead of from eight to fourteen days as before.

I have not carried our experiments beyond the germination of seeds, so that I cannot afford practical information as to the effect of other rays on after culture of plants.

I have however made some trials with the yellow ray in preventing the germination of seeds, which have been successful; and I have always found the violet ray prejudicial to the growth of the plant after germination.

I remain, my dear sir, very faithfully yours,

CHARLES LAWSON.

Not as a matter of practical value but merely to gratify a laudable curiosity, it will be proper to give the opinion of men eminent in science, as to the possibility of seeds of wheat, found buried with mummies in the the pyramids, germinating. It was at one time confidently asserted that new varieties with several heads to each stalk had been started from this source, but when proof was demanded it was always wanting in some important particular, a link lost that could not be supplied. Martin Farqnhar Tupper, the poet and Christian gentleman, whose word cannot be doubted, claimed to have raised one stalk from seed given him. Sir Gardiner Wilkerson, when in Egypt, opened a tomb himself, that had lain undisturbed for 3,000 years. He got some seeds of wheat and barley from an alabaster sepulchral vase with his own hands. Portions of this came

into Mr. Tupper's hands, 12 grains direct. He sifted soil, and placed it in pots so that it was impossible any other seeds should remain in the soil. He took every precaution possible, by marking the spots where the seed would come up, and securing the pots against being tampered with, and then, 7th March, 1840, planted the seeds. On April 27, one sprout showed itself above ground, and the remaining eleven rotted in the pots. On the 5th July the heads began to form, it having in the meantime been transferred to the garden, and though weak and feeble, showed signs of health. It was somewhat different from any known varieties. The stalk was three feet high, and the heads, two in number, two and a half and three inches long. So soon as Mr. Tupper published his report he was assailed all over England as having been deceived at some point, and Sir Gardiner Wilkerson being applied to by the British Association for some seeds, furnished some that contained maize. This being a new world plant, showed signs of having been deposited for the deception of travelers, and the well-known character of the Arabs for deceiving tourists convinced many that it was a deception. Many scientific men of various times have attempted to raise wheat from these mummy seeds, but no perfectly authenticated case ever occurred.

M. Denon, a scientist of France, accompanied Napoleon in his expedition to Egypt, and had every facility possible given him to collect all kinds of remains of antiquity. He paid especial attention to the Graminacea, and used every possible precaution to ensure success. He never did get one single seed to germinate, and was of the opinion, from a chemical analysis made of them, that they were charred to preserve them, before being encased in the tombs.

At a meeting of the British Association this subject engaged so earnestly the attention not only of England, but of its members, that an experiment was ordered to establish beyond controversy the age at which seeds would grow. This committee expended much time and money in making

a fair and thorough research, and published the result of their work. It is needless to give in detail their report, but it will be sufficient for our purpose to append the result of their labor, so far as the usual farm grains are concerned. Their experiments embraced no less than two hundred and eighty-eight genera, illustrating seventy-one natural families, and including nearly every species of plants cultivated both for culinary use and for ornamentation. Of course, these experiments consumed several years, as they continued to sow until, at the lapse of eight years, only four species continued to grow. We give below their report on Graminacæ:

	Years Old.	No. Seeds Sown.	Seeds Ger- minated.
<i>Zea</i> Maize, Indian Corn.....	3	300	127
Coblets Corn.....	2	27	12
<i>Phanaris</i> Canariensis, Canary Seed.....	3	300	147
“ “ “ “	8	200	19
“ “ “ “	9		nil
<i>Panicum</i> Miliaceum, Millet Seed.....	2	400	173
“ “ “ “	3	200	100
<i>Avena</i> Sativa, Oats.....	3	300	237
“ “ “ “	8	200	37
“ “ “ “	9		nil
“ “ “ “	3	300	210
<i>Triticum</i> Æstivum, Wheat.....	3	200	163
“ “ “ “	8		nil
“ “ “ “	9		nil
“ “ “ “	3	300	139
“ “ “ “	3	300	140
<i>Triticum</i> , Spring Mummy Wheat.....	2		nil
<i>Secale</i> Cereale, Rye.....	3	600	4
<i>Hordeum</i> Vulgare, Barley.....	3	300	167
“ “ “ “	8		nil
“ “ “ “	9		nil
“ “ “ “	3	300	236
“ “ “ “	48		nil
“ “ “ “	50		nil

It will be seen here that corn at three years of age sprouted less than half; millet seed, less than half; oats at three years, about three-fourths were good, and at eight less than one-sixth; wheat at three years, a little over half, and at eight and nine years did not germinate at all; rye at

three years, practically none; and barley at three years, from one-half to two-thirds, but at eight and upwards did not germinate. It is unnecessary to say these experiments are entirely to be relied upon. The seeds were carefully kept in waxed cloth and in sealed jars. This exhibits in a marked degree the necessity of securing for farming purposes fresh seeds. If they lose one-half of their vitality in three years, they certainly lose some in two years. So the better plan is to always secure fresh seeds of the previous year's growth, and not later at least than two years. This plan not only relates to wheat, but to corn, oats, rye, barley, and millet seeds.

Let us note for a few moments the germinating process in a grain of wheat. Lay down the grain on the furrowed side, with the hairy end from you. We will suppose it has been moistened, and has the proper amount of heat. You cannot see inside, but we already know the anatomy of the parts, and can therefore see what is taking place. Water has penetrated through the different skins of the wheat, and has reached the embryo membrane, but cannot pass this, but is led to the embryo. Here the water is decomposed, and some of its oxygen unites with the carbon of the seed, heat by the escape of carbonic acid gas is generated, and a minute portion of the albuminoid substance—Leibig says, 1-500th part of the grain—is converted into diastase. This is a bitterish sort of yeast, and causes a fermentation to take place that converts the starch and cellulose into sugar and gum. This sugar and gum is the food of the young plant, until it has sufficient strength to feed itself by means of its roots. So, although the delicate shoots of plants have no mother to gather food for them, Nature has provided for them all the same, and they are able through this wise provision to live and grow; and this very storehouse of plant food that is provided in all vegetation serves also for man's food. Now, let us observe what processes take place externally. The little spot, or depression, on the

point and back of the grain is the germ, or rather, it is just under the hull at this point. Presently a small white point starts out from the nearest point, and turns down;

FIG. 3.

that is the main root. For a short distance the cellulose tissue of the grain follows it, but it soon outruns it, and, turning down, starts into the ground. This root has on the end a little sponge-like ball, full of holes, or tubes, and, as the root progresses, other sponges with short stems start out on its sides. These sponges are suckers, and through these suckers,

or mouths, the young plant seeks in the soil its proper support. Very soon after the main root has started out; we see a modest little greenish point protruding just above the point of exit from the main root. This also pushes out a little cellular tissue from the grain, but soon leaves it, and as it grows it begins to expand and takes a decided green color, and looks so much like a feather it is called a "*plumule*," or little plume. It is seen at *a*, figure 3. This is the embryo stalk, and although it is only a single leaf, and looks smooth and shining, yet it is, through this magnifying glass, a perfect honeycomb of holes and tubes, just as the root has. This leaf is hunting in the air for food, just as the roots are in the soil. Maybe it is different food, found by different means. Here are two more roots starting out, one on each side of the main root. These are marked *f*, in figure 3, and are the "*true roots*," and these at *e* are sending out numerous rootlets. Very soon the store of sugar in the grain will be exhausted, but then these rootlets will be able to support it, for, in the soil mixed in proper proportions, the tiny roots will hunt out and absorb,

through their tubes and sponges, all that it requires, and thence it is carried into the body in the form of sap, and the leaves through its pores will absorb from the atmosphere carbonic acid gas, which, uniting in the body of the plant with its proper elements, potash, phosphorus, magnesia, etc., forms the substance of the plant. Now, this carbonic acid gas is one of the most deleterious elements in nature to animal life, and in the proportion it is mixed with the air, just so noxious and unhealthy is that air for the respiration of man. But without this acid plants could not live. Thus it will be seen what kills animals will sustain plant-life. The one is a balance, or compensation, for the other. Carbonic acid gas is formed in animals, and is thrown out in their respiration. So soon as it comes in contact with leaves, however, it is re-absorbed, and stored away in the form of wood, to be used by man for producing heat, when it is again set free to be re-absorbed by plants.

There is one thing necessary to call attention to, in connection with the appearance of the little sponges at the extremity of the roots. Let it be borne in mind, that nearly all the nourishment taken into a plant is through these minute cell-bulbs, and yet they are so small as to be invisible with the naked eye. It is plain that the plant food must be in convenient apposition to these rootlets, or it cannot be taken up. Therefore, in order to be reached, the soil must be thoroughly well pulverized. It is an indisputable axiom, that a well-pulverized *poor* soil will grow better produce than a stiff, cloddy one well fertilized. There can be no sort of doubt that certain kinds of food are as essential to the health of plants as to animals, and it must be supplied to them, and the rootlets, in order to take advantage of it, must have the utmost freedom of action. Not only must the roots feed the plant, but they must also act as a scaffolding to support erect the plants against storm and wind. Pull up a wheat stalk so as not to sever the roots, and we are

struck with wonder at the manner in which they branch out, interweaving and thrusting themselves around or through obstacles of all kinds. A gentleman made an experiment to ascertain whether the roots took up nourishment along their course or at the ends of their spongioides, and he did it by watering with colored water. After a few days he examined, and found that only the ends or spongioides were colored, the roots themselves having none. So soon as the true roots, already mentioned, have attained sufficient growth, the main root dies or shrivels up. This, however, is the case with all cereals.

When the plumule comes out of the ground an inch or two, the true leaves begin to appear, and the central bud forms the stalk. Just under the soil a joint or knot is formed, and another one just above it. The one just under the soil gives rise to the surface roots, or crown roots, and these are the chief agents in caring for and nourishing the plant. If the plumule is broken off, it does not put out another, the plant then has to depend on off-shoots, and if all the suckers are broken off the plant withers and dies. This is on account of injury to the cell tissue. This is why the presence of grasshoppers is so destructive to wheat. They eat out the heart of the plant. And for this reason the presence of cattle, after certain stages, destroys or greatly injures the stand. Sheep, especially, are injurious, as from the peculiar manner in which they draw out the blades, the whole heart is often pulled out and the plant dies.

On the subject of "tillering," it may here be laid down as a known fact that the tillers or suckers all spring from the "true roots," those that come out on each side of the grain after the first root has been sent into the ground. Look at Fig. 3, and the roots marked *F F* will show the ones that give out the suckers *e e e*, and the position will be readily understood.

The importance of this fact is well understood when it is reflected that the depth of grain governs the "tillering,"

and also the coronal or surface roots. Wheat lies in the ground after the two sets of roots, viz., main root *C* in Fig. 3, and *F F*, the true roots, have come out with but little change until spring. Of course these roots send out rootlets in every direction seeking food, and also throw up a few blades, but the great change takes place in the early spring, when the warm sun begins to stimulate its growth. Then "tillers" begin to shoot up all around the main stalk, and the first joint, if under the ground, throws out numerous fibres which soon become a mass of roots, that both support and sustain the weight of the stem. Now, if the grain lies on or very near the surface, the coronal roots fail to come, for the first joint of the stem is above ground, and if the grain is buried deeply in the soil but few or no tillers make their appearance. These "tillers" throw out coronal or surface roots, and become independent stalks, capable of sustaining themselves if separated from the parent stem, so when an experiment is made they can be drawn out and transplanted with ease. For this and other reasons it is best the wheat should be at least two inches under the surface. Spring wheat does not "tiller" to any extent.

CHAPTER XII.

NUTRITION OF PLANTS—CHEMICAL CONSTITUENTS OF SOILS.

It has been shown that the young plant subsists on the store of starch and gluten that is laid up in the parent grain, but this is of course soon exhausted, and then the roots have to make their own living. The plant finds itself in a soil variously composed of clay, with its numerous compounds, silica, alumina, soda, potash, magnesia, lime, etc., and humus, or vegetable mould, decayed vegetation, and possibly the prudent farmer has added to it his store of manure. But if nothing but organic substances entered into the composition of the plant, it would yield few or no ashes on being burned. We have shown in a former chapter that ashes remain, and therefore we know inorganic substances aid in building up this wonderful superstructure of straw, heads, chaff and wheat grains.

This brings us to a question that only the researches of geologists and chemists enable us to answer. In order to answer it properly we must first determine the elements of which clay is composed. That clay alone can sustain vegetable life has been fully demonstrated.

The continued decay of vegetables for unnumbered ages is sufficient to deposit a layer of humus, giving the top soil its dark color. How or where does clay originate? It is, as all know, the detritus of rocks rubbing together by the action of water, which would necessarily produce fine particles, just as dust is made on turnpikes, only here it is the friction

of travel, there it is the friction of water, the crumbling of frosts, etc.

Granite, the oldest rock, is composed of quartz, feldspar, and mica, and sometimes hornblende.

Feldspar is composed—

Silica.....	64.50
Alumina	19.75
Potassa.....	11.50
Oxide Iron.....	1.75
Water.....	0.75
Lime	a trace.

Here we have several of the inorganic elements necessary to the growth of vegetation.

Quartz is the most abundant of all rock substances, and enters more largely into all vegetation than other minerals. It is silica and oxygen, or silicic acid. All pure white sand and flint and crystal is silica. It composes for the most part sandstone rock, in fact nearly all rocks are composed largely of this base. But these silicates are all insoluble in water, unless by the action of an alkali. Such as potash, soda, etc., and these are nearly always found in sufficient quantity in the soil to answer. Without silica, no cereal could stand up; it enters into the composition of all cereals. Alumina, which is pure clay, is found everywhere, though not in a pure form. Kaolin, or the clay from which china-ware is made is the purest form of it. It is formed from the disintegration of feldspars, slates or shales. It is composed of oxygen and aluminum, a shining metal, that never occurs in nature. Without the presence of alumina in clay, it would lose its plasticity, and could not be moulded into queensware, earthenware or bricks.

Potassium, a bluish white metal, is the base of potash. It has such an affinity for oxygen that, thrown upon water, it will burn spontaneously. In consequence of its great affinity for oxygen, if brought into contact with alumi-

na or silica, it decomposes it, and renders it soluble. Saltpetre is a nitrate of potassium.

Iron, also, has a great affinity for oxygen, and forms oxide of iron, or iron rust. It is so generally distributed in nature that few minerals are without some of its combinations.

Chalybeate waters are so called because carbonate of iron is mixed with them.

Mica, another ingredient of granite, is found in a confused mass in granite, limestone, and in large plates in porphyry.

The following is its composition :

Alumina.....	20.00
Silica	47.00
Oxide of Iron	15.50
Oxide of Manganese.....	1.75
Potassa.....	14.50

This does not differ materially from the others except the presence of manganese, and this is a rare ingredient in soils. It is used in its compound forms quite extensively in the arts, but not in agriculture.

Hornblende is very common, and occurs according to its combinations in many different forms. It is called greenstone, and was a favorite mineral used by the aborigines to make pipes, axes, tomahawks, etc. It is asbestos, which is used as a roofing material, being incombustible, and some kinds of asbestos is woven into fabrics, and used by firemen as a covering. The Californians, in the early days of mining, made it into table-cloths, pants, etc., and when they wished to wash them, they burnt them clean. Its composition is as follows :

Silica	42.00
Alumina	12.00
Lime.....	11.00
Magnesia.....	2.25
Oxide of Iron.....	50.00
Ferruginous Manganese.....	0.25

Lime is the carbonate of calcium, and in this form it

enters largely in the composition of rocks, shells, etc. Marble, limestone, chalk and oyster and mussel shells, are composed of carbonate of lime.

When these substances are burned, carbonic acid is expelled, and quick-lime is the result. This has such an affinity for water that one ton of it will absorb 500 pounds of water, and then it is slacked lime. The water then becomes part and parcel of the mineral. This affinity for water is so great, that by its powerful action, if water is applied, it will produce a great amount of heat. If lime contains as much clay as 10 or 12 per cent, it makes hydraulic cement, and the more clay the better, up to 40 per cent. It is supposed that lime applied to the soil hastens the assimilation of vegetable or organic matters in it. It also forms part of the plants themselves though in a small degree.

Sulphate of lime, gypsum, plaster of Paris, alabaster, different names for the same substance, is of great importance to plants, nearly all showing its existence in their ashes.

Phosphate of lime, found in all animals and vegetables, is found abundantly in a state of nature.

Magnesia, an oxide of magnesium, also enters into many things; sulphate of magnesia is Epsom-salts; carbonate of magnesia is sold in white cakes as a medicine, and enters into the ashes of many plants.

All these ingredients result from the disintegration of granite, and they form the chief sources of the soil.

Granite is supposed to be the primitive rock, and has lost its constituents during untold ages, by the slow action of water and air. Upheavals also contribute their share towards this result. The destruction of granite leaves quartz, feldspar, mica, etc. These in turn are decomposed, and various compounds come from them. Water, by rolling and rubbing, makes a part, and this is added to, by frosts, rains and the action of the most powerful acids, and yet

what carbonic acid is caught in descending rains is sufficient to decompose the silica that is in feldspar, thus freeing the alumina from its combination, and that which is released goes into the soil.

In addition to these mineral earths there is sodium, the base of salt, and borax and washing soda, and a great many other compounds. It aids materially in the preparation of many ingredients of the soil for nutrition.

Phosphoric acid is found in all rocks of primitive origin. It enters more into the composition of plants than any other mineral, and is a large ingredient of the cereals, it forming about fifty per cent. of the ashes of buckwheat.

Sulphur, in the form of sulphuric acid, is also important in agricultural chemistry, and serves as a solvent of some of the mineral earths.

These are all the ponderable bodies that go to the make-up of the plant, but there are others imponderable that is lighter than water, and gaseous in form, that contribute as much as the others. In fact, without the one the others would be useless. Both are essential to the growth and maturity of the plant. These are carbon, oxygen, nitrogen, and hydrogen. Carbon is the most generally diffused of all substances in vegetation, at least one-half of all plants being composed of it. It constitutes the diamond, charcoal, graphite or "black lead," and forms the greater part of stone coal, petroleum, naphtha, etc., etc. In combination with oxygen, it forms carbonic acid gas, and in this form, being heavier than the air, it comes in contact with vegetation, and sinks into all depressions, and is then called "choke damp," "bad air," and certainly destroys the lives of those who incautiously venture into wells where it exists.

When carbon combines with hydrogen, it makes illuminating gas. This gas not only is formed in gas works of cities, but nature has a laboratory beside which that of man is Lilliputian in size. We mean the immense swamps and marshes that cover so much of the earth's surface. Vast

amounts of vegetable matter are here undergoing decomposition, and the gas arises therefrom in the form of bubbles; and if one should apply a lighted taper, it would explode.

Oxygen is another gas, and, though invisible, it goes further than all other substances toward the make-up of the earth. Nothing could exist without it, and yet it is the great destroyer. It is called oxygen, or "acid maker," because it was at one time supposed to have caused the formation of acids. It enters into all vegetables, all rocks and soils, composes one-fifth of the atmosphere, and eight-ninths of the water on the earth. It composes more of the earth than all other substances put together.

We have said it is a destroyer as well as a maker. It is the principle in the air that induces decay, but it loses its power without heat. It rusts iron, corrodes silver or copper, putrifies flesh, and causes the decomposition of all organic substances. Cut your finger, and it is very painful. It is the irritating effects of oxygen. Put a court-plaster over it, the pain ceases at once. That is because the oxygen of the air is cut off. During a great cataclysm of earlier ages, some mastodons became imbedded in the ice of Siberia. We have no conception of the length of time they have lain there, perhaps many thousands of years. Yet occasionally a carcass is discovered, and the animal is so well preserved the flesh is eaten by the Esquimaux. This marvelous preservation of animal matter is due to the inert condition of oxygen through the covering of the ice, and the presence of cold, for without heat oxygen is powerless. Fruit is preserved by excluding the air, and so the oxygen. With iron it makes rust, but with sulphur it is oil of vitrol. Hydrogen also enters sulphuric acid. Without oxygen no fires could burn, and besides no animal heat could exist. It enters the lungs, and finds in the system carbon and other principles; combustion, silent but sure, ensues throughout the system, and heat is generated.

"Oxygen is the factor which returns all substances to the earth, whence they are taken, and the process by which materials are returned, or converted, into their original elements is combustion."

Nitrogen is a negative gas, and simply acts as a diluent for oxygen in the air. It will not support life nor combustion. It will not support vegetation alone, yet it is a very important ingredient of all animal tissues, and enters the blood in vegetable matter. It only combines with other elements in the nascent state. With oxygen and hydrogen, it forms ammonia, and this will be found in manures. The smell is prominent in stables, and in the urine of stock. It is called hartshorn. Its great use is to neutralize acids, even the most powerful, and hence is of great use to the agriculturist. Sometimes a field is turned over with a mass of green weeds. The farmer is astonished that it does not manure the ground. It is because it is sour. If ammonia is spread over it, in the form of manure, marvellous effects are produced. It is then benefited by the weeds. For this reason manure should never be spread until the plow is ready to turn it under, for ammonia being exceeding volatile, it all evaporates, goes into the air, and leaves the manure without strength.

Hydrogen is the lightest thing in nature, being sixteen times lighter than air. Hence it never exists in a state of nature; if any forms, it rises at once. It forms 11 per cent. of water, and enters into the composition of all animal and vegetable substances. It is highly inflammable, and is used with carbon to light cities, raise balloons, etc.

Thus we have given a brief description of nearly all the elements that go to the building up and perfecting of the wheat plants. It is truly wonderful how plants will hunt out with unerring certainty through the soil for its nutritive wants, and assimilate them. It was at one time thought that plants took up these ingredients accidentally, but Liebig opened up a field of chemical research, followed by others,

until nearly all is known that can be. Some soils are rich in one element, and deficient in another; hence, one plant will flourish on this soil, and droop on that. Although lime is only detected in wheat as a trace, yet that trace is absolutely necessary to the perfect maturity of the plant. The vine will not flourish without lime, while wheat requires a soil rich in phosphorus or bone-dust. Tobacco and celery require large quantities of saltpetre or potash. Tea raised in Japan is not so good as the tea from China, because certain salts of iron are present in the soil; while cotton raised in China has the peculiar color that gives it the name of Nankeen, and derives that color from salts of iron. Seeds of this Nankeen cotton sowed in the United States is nothing more than ordinary cotton. In some experiments an excess of potash, or soda, was placed in reach of plants, but the analysis proved that not one particle more was taken up on this account.

It is a conceded fact that vegetation largely owes its sustenance to inorganic bodies. The lichen derives its sole nourishment from the rocks, as does the moss. It decomposes the rock, and in the course of ages this source adds no inconsiderable amount to the soil. However, the air also contributes largely to the sustenance of plants. De Saussure raised beans and peas in damp horse-hair and sand, but they soon drooped and died.

Much has been written as to the effect of humus on the growth of vegetable substances. The fact that much difference of opinion prevails, makes it probable that little is known concerning it. It is vegetable mould in a state of decay, such as weeds, roots, chips, etc. As humus, it adds nothing to plants, but in a state of moisture it extracts oxygen from the atmosphere, and forms, with its carbon, carbonic acid. When we loosen the soil around plants we favor the admission of air, and in this way carbonic acid is formed. From humus is obtained humic acid, which has a great tendency to absorb ammonia, and holds it very

firmly. The best chemists say, however, no humic acid is formed in the soil. The action of humis is, then, merely to furnish carbonic acid, and hasten the development of the plant. As it is a law in vegetable physiology that, when the food of the plant is more than its organs require for its own perfect development, the superfluous nutriment is employed in the formation of new organs—that is, new roots and fibres, new branches, leaves, etc. Hence, wheat tillers or stools most when sown in good soil.

CHAPTER XIII.

FAVORABLE CONDITION OF TENNESSEE FOR WHEAT SOWING—ROTATION AS AN IMPROVER OF SOILS—KINDS OF SOILS ADAPTED TO THE GROWTH OF WHEAT IN TENNESSEE.

Tennessee, as a wheat growing State, is increasing her reputation annually. Her wheat, in the first place, is of a very superior quality, far in advance of wheats grown further north. Besides, the climatic influences of Tennessee are very fortunate. The latitude of Tennessee is the same as Northern India, the place where wheat originated. Then the isothermal line of the northern shore of the Mediterranean passes through Tennessee. This Mediterranean country has long been celebrated as a wheat growing country, and has fed Europe for centuries with the surplus of her crops. Thus, if Tennessee is favorably situated as to latitude and heat, she is equally exempt from the chilling winds of the Western States that blow continuously through the winter and spring, stripping the soil from around the roots, leaving them bare and exposed to the biting frosts, and thus the wheat is winter-killed; or, if it escapes this, the roots being upheaved by the frosts and left bare, are exposed to the suns of summer, and what the frosts spare the heat destroys or vitiates. As I before stated, the wheat culture is not profitable when the summer heat is below 57° Fah. Tennessee is above that average, the mean heat during the year being about 59° and over. Now, if we have a better climate, more advantages of heat, it only rests to show the character of our soils to prove that Tennessee has more advantages as a wheat growing country than any other State in the Union. And yet by bad culture millions of dollars are lost in the attempt to grow wheat.

One of the best agricultural writers in England says "the soil prepared for wheat in England is a strong soil with a large proportion of clay." The clay plays two important parts here: it not only affords inorganic nourishment to the plants, but it has a mechanical effect in stiffening the soil, thereby holding it to the roots. The absence of this clay is all that prevents the prairie lands of the West from being the best wheat lands in the world. But they lack it and Tennessee has it.

As a matter of course the other ingredients, lime, sand and humus are indispensable. The wheat culture in California, that was considered the granary of the United States, has almost been a failure for the last two years, and unless a system of irrigation is devised less expensive than now known, wheat culture may be considered in many parts a dead industry. Ohio, with her sandy hills, can only be made profitable after incurring great expenses in hillside ditches and levelings, while Indiana, Illinois, Missouri and the Northwestern States—the prairie country—once the wonder of the world, where from 50 to 60 bushels per acre were common, are fast losing their popularity with farmers. The prairie sod is, when first broken up, very rich, but it is a friable mold, and when it once becomes pulverized it holds water. The winters come and the rains fall on it, and the wheat is heaved up by the cold and much of it is killed; then the March winds come and blow the loose dirt away from the roots, and what is spared to the farmer by winter is destroyed by the parching rays of a summer's sun. For these reasons the farmers of the Northwest have had to resort in a great measure to spring wheats, and they are so uncertain that they can hardly be relied on to add to the world's supply. South of parallel 30 no wheat need be expected. It is true some wheat is made, but cotton, tobacco, sugar and rice are the natural productions of that country, and what nature points out has to be followed. It is true under the impulse of newspapers many efforts have been

put forth to divert that country from its natural channel. But small returns will soon bring back the agriculture to its natural position. The Northern and New England States can raise and do raise much wheat, but it is late in the market, of an inferior grade compared with Tennessee wheat, and it is by much labor and great expense of manuring that it is effected.

For these reasons and many others we have come to consider that Tennessee occupies the point most favorable in the belt of ten or twelve degrees of latitude and 20° of longitude that is considered the wheat region of the United States. From latitude 32° to 43° is considered the favored locality. A portion of this lacking clay will not be suitable, or if used at all will soon wear out. A large portion is already worn out. Some can be reclaimed, other portion are irreclaimable, having been worn to the rocks. Under proper care the lands of England have improved with hundreds of years of cultivation, and now make an average yield of 36 bushels per acre. Of course this is not done without proper care and attention. Crops are rotated, fertilizing plants are cultivated, and fertilizers liberally used. All these things are attended to, and the result is instead of abandoning their lands and giving them over to briars and weeds for restoration, they are constantly improved by good tillage and judicious fertilizing, and although the climate is cold, wet and inhospitable, they are able to surpass our more highly favored and better situated fields.

How can we do this? The answer is simple. Rotation with corn, clover and peas. A field clovered two years put to wheat one year, corn one year and back to clover and wheat, will constantly improve in its capabilities. Sheep husbandry should always go with wheat. Peas, beans, turnips and other root crops make good rotation crops for wheat, and these all are fine food for sheep. It is better to sell the crops in the form of meats than in any other way, for then not only is a better price obtained for the produce

but the droppings of the stock are secured, which is no inconsiderable item in the balance sheet of a farmer.

A gentleman of this State fed sheep every winter on a turnip field, not patch, by the use of hurdles or movable fences, and the crops raised from the field the next year were simply enormous. With the hurdles he would fence, say an acre to the hundred sheep, and he would confine them there until they had eaten up every turnip. They would easily gnaw them out. By the time the turnips were exhausted, the surface would be black with their droppings.

But all the soils of Tennessee are not notably good wheat-producers. In the schedule of answers appended it will be seen in answers to the question, "what character of soils is most suitable for wheat," that the majority of answers prove the axiom at the beginning of this chapter, that strong soil mixed with clay, is given as the result of their experience. The mulatto lands of the State are the best. These lands are also called "red lands." They are yellow from the admixture of clay and iron. In defining what portions of the State succeed best, we can only state the character of soil best suited, and leave the balance to the judgment and experience of the owners of the farms.

A clay sub-soil will retain moisture, so that in times of deficient rains the plant does not wither and die with heat, besides furnishing to the roots of the plant that burrow to this sub-soil the inorganic substances essential to their proper development. There is in the valley of East Tennessee but little land but what produces wheat to advantage. The soils there possess naturally all the prerequisites of fertility, and all that is required of the farmer is a judicious rotation of crops, deep plowing, and proper additions to soils that have been exhausted by long culture. The valleys of that portion of the State are naturally fertilized by the constant decomposition of the rocks on the mountains, the detritus of which is carried to the valleys with the soluble humus, and keeps the soil in good condition for

wheat culture. Even on the slopes of the hills, when not too steep, the soils are rich in mineral matters. There is, as a general thing, a large admixture of chert or chalky gravel. This keeps the ground porous, and silica and lime enough are always extracted by the carbonic acid of the rains and dews, to keep them rich, and hence remunerative crops are the result. It requires much watchfulness on the part of the farmer to keep this soil from wasting and running off into the valleys, but his watchful care is amply repaid in the success of his efforts. The valley of East Tennessee has an elevation of 1,000 feet above the sea, and its area is 9,200 square miles.

Middle Tennessee is different from this in every respect. Here are two great divisions of soil. Of course there is much diversity locally; some counties combining both divisions, with a gradual intermediate gradation from one to the other. The Basin is Silurian limestone, and has an altitude of 700 feet above the sea, and an area of 5,450 square miles. It has a great abundance of clay for sub-soil, with a black or mulatto deposit above it. This black soil is the result of vegetable decomposition, and in proportion to its density is its fertility. The admixture of clay renders it more or less red soil. This mulatto soil has always been regarded as the best for small grains and clover. The Rim is different. The edges of the Rim show the Devonian age, and its general characteristic in its shale, or as it is generally called slate. These slopes are steep, and are of no agricultural importance, except for its timber. The plateaus that occur on some of the rimlands, however, are very extensive, and belong to the lower member of the Siliceous group. The soil is leachy and filled with chert. There is a great superabundance of silica but a lack of lime, and the subsoil is a pale yellow sandy or gravelly clay, very porous, and consequently, it will not retain moisture; manure it as you may, in a year or two it has all washed into the depths of the ground. Though the surface is covered with

timber and wild grasses, and thousands of cattle fatten on it every year, yet it does not produce cereals to a paying extent. It is true, that it would, by a proper rotation with clover, give good accounts in wheat, yet unless the country was more thickly settled than now, and transportation better, it would not pay to work it. Its capacity, however, as a tree-growing region, has been taken advantage of, and it has proved itself to be the finest fruit-growing region in Tennessee. The altitude of these plateaus are 1,000 feet above the sea, so that the thermal condition is highly favorable to the production of apples, grapes, pears, peaches and other fruits.

But the "Rim" is not uniform in this character. There are two principal kinds of soil, the upper and lower siliceous groups. The lower group represents the kind here mentioned, and is known by its plane-like surface, and is called "barrens." These lands, as before said, are leachy, and only suitable for oats, potatoes, fruits, etc. These plateaus of thin soils are principally found in the south-western parts of the rim, though here not universally. Parts of Coffee, Franklin, and nearly all of Lewis, much of Hickman, Humphreys, Wayne, and all that portion of Lawrence not included in the "prairies" or river basins, constitute the "barrens."

The upper siliceous group has a more rolling surface, with a red, tenaceous, unctious clay, with a greater or less covering of humus, and underneath is a cherty subsoil that gives it a sufficient porosity to furnish ample drainage. Such lands are found in Montgomery, Robertson, Stewart, part of Sumner, Warren, White, Putnam, Macon, Clay, one-half of Coffee and portions of Franklin. This soil is very productive, and gives some of the best wheat and clover lands in the State. The barrens are too leachy for wheat, quickly sifting down manures that are applied.

The lowlands or "bottoms" on the streams, however, in these barrens are well suited to the growth of all the cereals.

The accumulated humus of the hills, largely mixed with chert and sand renders it light, porous and exceedingly fertile: The area of the "Rim" is 9,300 square miles.

The Cumberland table-land rises 2,000 feet above the sea level. Agriculturally, this section is only noted for its fine swath of grass during the summer, for its excellent apple orchards and its capacity for the production of garden vegetables. It is not a wheat-growing section, however. Fine crops of corn and wheat have been grown on it by heavily manuring, but the cost of production would overgo the results obtained. It is flat, swampy in places, and siliceous or sandy. The same remarks that apply to the rim as to fruit is here more potent. Some of our best nurseries are located on the mountains. Its area is 5,100 square miles. Its mineral wealth is inexhaustible, and the abundance of coal and timber will always give this section a value independent of its agriculture. It has of late become the centre of gravitation for capitalists from the North and from Europe, and is destined soon to become in spite of its apparent poverty, the most important section of the State. It is well suited for potatoes, melons, peas, etc., and when thousands of miners congregate there, its agricultural capabilities will be tested to the full to feed its citizens.

Between the bottoms of the Tennessee and Mississippi rivers is a sloping plateau about 85 miles wide, and comprising an area of 8,850 square miles. The soils of the plateau are composed, for the most part, of a calcarco-siliceous soil, very uniform in the degree of their fertility, easy to work but tender and easy to wash. In the northern tier of counties where there is a predominance of clay, clover grows with a surprising luxuriance, and wheat makes an average yield greater than in any other division of the State. Henry, Weakley, Obion, Dyer, Lauderdale, Tipton, Gibson, Crocket and Carroll have soils wonderfully adapted to the production of this cereal. The counties south of these do not produce wheat in such quantities, but some fine

yields are reported. Continued cultivation in corn and cotton without rest or rotation, has greatly impaired the fertility of the farms, yet by the judicious rotation of the crops with peas, and where not too sandy, clover, treated with plaster of Paris, the soils may be reclaimed and made as productive as ever. Lake county is a bed of alluvium, probably the most fertile county in the State, but owing to the exuberant fertility of the soil wheat is apt to bed and rust. But for this, it would equal the valley of the Nile in the production of wheat. But this county does not belong to the plateau, and lies wholly with the Mississippi bottoms.

These bottoms, with those of the Tennessee river, are of surprising fertility, raising nearly all kinds of produce in the most luxuriant manner. Wheat, however, as has been said, lodges and rusts, there being too much rankness in its stem. In some parts of the "bottoms," where from overflows, sand has been deposited, it does extremely well, yielding large crops. As a rule, however, the bottoms are better suited to the cultivation of corn and cotton. The Tennessee "bottom" has an area of 1,200 miles, and an altitude of 350 feet above sea level, while the Mississippi "bottom" has an area of 900 miles, and an altitude of 295 feet above sea level.

The mean temperature of the valley of East Tennessee is 59° , of Middle Tennessee 60° , and of West Tennessee 61° . The average temperature is 58° and more. Mr. A. C. Ford, of the Signal Service, says: The mean temperature of Nashville, Tennessee, for 1873 is 59.5° ; 1874, 58.7° ; 1875, 58.5° ; 1876, 59.1° . The altitude of Nashville above sea level 504.2 feet; Memphis, 298.94; Knoxville, 993.02. Tennessee has every altitude possible between 200 and 4,000 feet.

The isothermals of Tennessee passes through the most delightful countries of Europe. Lying between latitudes 35° and $36^{\circ} 30'$, and longitude $81^{\circ} 37'$ and $90^{\circ} 28'$ west of

Greenwich, it has every variety of climate, from the cool, salubrious breezes of the mountains, to the warm, growing sun of Spain. Though its isothermal line passes through the countries bordering the Mediterranean, Turkey, the tea-growing districts of China, and the spicy fields of Japan, there is a marked difference in the climate of Tennessee and that of those countries just named. The range of the thermometer is greater in Tennessee, and consequently, the olive, fig, lemons and oranges, of those countries, cannot undergo its range. But for the cultivation of the cereals, we far surpass them. This is owing to the greater heat of our summers. West Tennessee having a mean summer heat of about one degree more than Middle Tennessee, makes cotton and tobacco the staple crops, this small amount of heat being sufficient to mature the cotton crop, and ripen all its bolls. East Tennessee is about 2° colder than Middle Tennessee and the table-lands of the Cumberland and its outlying terraces are 5° to 6° colder than Nashville. On this account these elevated points are becoming a great resort to the sick during the debilitating heats of summer.

The average length of the growing season in Tennessee is 189 days. In the southern border it is ten or twelve days longer. By this is meant the time between late and early frosts. The latest frost for any autumn for twenty-two years, was November 8, and this season extended 228 days, the early frost occurring March 23.

CHAPTER XIV.

SOILS OF TENNESSEE.

To any one who lives in one portion of the State, and who has not left his locality, it may seem that all soils are like that with which he is acquainted. Should several travelers, however, leave Kentucky at eight different points, pass through Tennessee and meet in Alabama, each one would come to a different conclusion as to the soils of Tennessee. This difference of opinion would naturally enough ensue from the character of the eight divisions of the State. We reproduce here what I have heretofore said of the soils of Tennessee. Every variety of soil may be found within the limits of the State. On the Unakas are found soils from the disintegration of granite which are sandy, micaceous and mellow. These granitic soils are confined exclusively to the counties bordering the eastern end of the State. Owing to the uneven surface of this portion of the State, the capacity of these soils has been tested to a very small extent. Wild grasses grow upon the tops of the mountains with great luxuriance, and afford fine pasturage for stock herders. The soil upon some of the "*balds*" is black and prairie like. Buckwheat grows with great rankness, and yields with remarkable fecundity, and in a few localities, 3,000 feet above the sea, good wheat has been grown.

On the Cumberland table-lands sandstone soils prevail, as well as on some of the ridges of the valley of East Tennessee. This class of soils may be divided into five kinds, more or less distinct. These are "*Chilhowee Sandstone*," "*Knox Sandstone*," "*Clinch Mountain Sandstone*," "*White Oak Mountain*," and "*Dyestone*" and "*Cumberland Mountain Sandstone*."

1. *Chilhowee Sandstone Soil* is confined to the Chilhowee ridges and is very limited in extent. Some few areas are found that will repay the labors of the husbandman in the cultivation of potatoes, buckwheat, and garden vegetables. The Chilhowee mountains, which pass through Blount county and a portion of Sevier, are sparsely settled and but a small proportion of the soil has ever been cultivated. But it is much used as a common pasture ground, blue grass growing on some of the ridges in the counties of Johnson and Carter. This soil prevails also upon the northwestwardly interrupted range of the Unakas. It may be well to observe that the Unakas are a double range of mountains, that on the southeast side being continuous and the range on the northwestern side being broken or interrupted.

2. The *Knox Sandstone* soil is unimportant, being confined to long, narrow, sharp ridges, which are often called *Piney* or *Comby Ridges*. This soil is confined to the valley of East Tennessee and is very little cultivated. It produces timber in limited qualities, but not much grass, and is not so valuable for pasture ground as the preceding.

3. *Clinch Mountain Sandstone* soil occurs mostly on the southeast side of Clinch mountain, which traverses Grainger, Hancock and Hawkins counties; on Powell's mountain, which lies in Claiborne and Hancock counties; on Lone mountain, a continuation of the latter, in the counties of Anderson and Union, and on some of the ridges of the Bay's mountain group, which lies mostly in Hawkins county. It is thin, sandy and poor, sparsely timbered, and has immediately underlying it large sheets of sandstone. It has a pale yellowish color, and when the depth of the soil is sufficient will yield Irish potatoes and garden vegetables. It may be mentioned that the northwest side of these mountains has a very fertile and calcareous soil, highly productive, the fields in many cases reaching the crests of the mountains. It is curious to observe the exuberance of the

vegetable growth on the one side and the poverty on the other. Stately trees with leafy tops covered with vines and creepers, making an impenetrable thicket, characterizes the one side in its wild state, while the other, covered with an impenetrable shield of sandstone, has here and there a very few scanty shrubs and starveling trees, typifying the indiscribable sterility and scantiness of the soil.

4. The *White Oak Mountain* and *Dyestone* soil occurs on the southeast side of White Oak mountain in James and Bradley counties and on the slopes of the smaller Dyestone ridges. These ridges are so called from the occurrence of red and stratified iron ore. The rocks underlying this variety of sandstone soils are more varied in chemical composition and give more vitality and fertility to the soil, which are manifested in a better growth of timber, though but small areas of this variety have been brought into cultivation, owing to the ruggedness of the country in which it prevails. It may be added that the aggregate extent of this soil is very limited, and can be represented by mere lines on the map. The White Oak mountain and the ridges mentioned are interesting mainly on account of the abundance of iron ore.

5. The *Cumberland Mountain* soil is the most important of this group, inasmuch as it extends over an area of over 5,000 square miles, covering nearly the whole surface on the top of the Cumberland tablelands. This soil is sandy and thin, the sand being coarse and angular. Nevertheless, at the foot of some of the knobs and ridges that rise above the general level of the table land, there are areas of moderate fertility. The valleys too, upon the top of the plateau and upon the north hill sides, are much above the average fertility. This region is almost totally destitute of lime, extremely porous and difficult to improve.

There are so many contradictory statements in regard to the fruitfulness of the soil that it is hard to give an opinion that will be concurred in by every one. There are two

leading classes of soil on the table land, the most valuable of which has a yellowish red sub-soil with a thin coating of humus on the surface. This character of land can be improved and rendered highly productive, but continual vigilance and care are required to prevent the escape of the elements of fertility. This may be effected by seeding to clover, which should be treated to frequent and liberal dressings of plaster of Paris. The soil is extremely tender and constant care is required to prevent washing. For the production of all kinds of fruits, including grasses, root crops and garden vegetables, this land is scarcely surpassed. The finest Irish potatoes grown in the South are raised on this table land. Apples are very prolific, and the trees are thrifty and long lived. It is the orchard land of the State, and millions of barrels of the very best apples may be raised annually at a small cost. The dry atmosphere prevents premature decay. For the growing of fruits and potatoes, no land is superior to it, but for the cereals it is uncertain and unproductive. Nevertheless some excellent crops have been made, and the Swiss who have settled on this mountain land are growing clover and the grasses with some degree of success. The lands are cheap, the climate healthy and the timber and water abundant and the high-way pasturage excellent.

The second class of these soils has a light yellow whitish and sometimes bluish sub-soil with little or no humus. It is extremely porous, leaky, and, when wet, is often inclined to be miry. In its native state it produces nothing but shrubby trees and a scanty growth of hardy weeds and coarse grass. Most of the surface is covered with lichens and sometimes with mosses. Manure applied to these lands soon disappears, leaving scarcely a trace after the second season. It is a serious question to determine the best uses of which these lands are capable. For grains they are useless, and scarcely better for fruit and cultivated grasses. The native grasses and herbs, with such of the hardy cultivated

kinds that might be induced to grow upon them, would afford pasturage sufficient during the summer for sheep and goats—perhaps for cattle. Besides these two leading classes of soils pertaining to the table lands, there is another, more limited in extent, but possessing peculiar characteristics which entitle it to special consideration.

This class comprehends the glades and wet lands along the streams. The soil, when wet, is of a dark blue color, sometimes nearly black, but when dry it is ash colored. Blue clay is generally found in connection with it as a substratum. These soils are often entirely destitute of timber and covered with rank coarse grass and spotted with beds of fern, the tussocks of which form a close mat over the surface. The absence of timber is owing to the superabundance of water with which the ground is saturated throughout the greater part of the year. These lands present another problem, but we are more hopeful of them than of those we last described. It is true that many efforts to reclaim them have failed, but this is owing to a failure to understand their peculiar character. It is not enough to drain off the water: they contain large quantities of half decomposed vegetable matter which imparts to them a high degree of acidity, and this must be corrected by a liberal use of alkali, and for this purpose either ashes or lime may be used. When thus treated they are nearly equal to alluvial soils in fertility, and are especially valuable for meadows.

On all the soils so far enumerated wheat does not repay the cost of cultivation. From three to four bushels is the average yield, and the amount sown is so inconsiderable as hardly to deserve notice.

In another chapter we have spoken of the porous, leachy soils of the barrens, which may be called the flinty or siliceous soils. Oats grow well on this class of soils, but wheat rarely does well. Associated with this flinty soil is oftentimes a chocolate-colored soil, which is equal in wheat pro-

ducing to any soils in the State. Large portions of Stewart, Montgomery, Robertson, Macon, Clay, Overton, Putnam, White, Warren, Dickson, Humphreys, and Hickman are occupied by this soil. On this character of soil, with good tillage, from ten to twenty bushels of wheat may be grown.

Sandy Soils.—Under this head are included the varieties of mellow upland and highland soils to be met with in West Tennessee. They are based not on solid rocks, but upon unconsolidated strata, mainly sandy. The resulting soils are of the same character. They are called sandy, or arenaceous, because this mineral feature preponderates, and are generally red or yellow, from the presence of a notable quantity of ferric oxide and silicate. It does not follow that because a soil is sandy it is therefore poor. The clay and calcareous matter that some contain give them a degree of body and vitality that render them for many crops highly valuable lands. The way they lie, too, is an important consideration. If high, plateau-like, or gently rolling and well drained, such lands are often highly esteemed by the farmer, when, if steep or very hilly, they are not prized. In the latter case the soils have the same components, but under tillage are easily washed away, and made comparatively worthless. Many of these sandy soils are fine wheat producers.

The *calcareo-siliceous* soil occupies the eastern parts of the counties of Obion, Dyer, Lauderdale, Tipton, and Shelby. It presents an ashen aspect as to color and consistence, but sometimes it is of a reddish cast, occasionally black, and oftentimes mulatto in color. It contains more calcareous matter than the other unconsolidated formations of West Tennessee, with the single exception of the green sand, or rotten limestone. It is not unusual to meet in it concretions of carbonate of lime. At some points they may be gathered by the bushel. The soil is similar in character to the formation, calcareous, siliceous, fine-grained, ashen, and sometimes slightly reddish and black earth. Its lands

are among the most fertile in the State. The soil owes its good qualities not to its chemical composition alone, but to its finely pulverulent mechanical condition. Tobacco, cotton, wheat, corn, potatoes, oats, clover, and the grasses, grow luxuriantly upon it, while the native growth, especially in Obion and Dyer, is of marvelous luxuriance.

Calcareous Soils.—These rest upon the different varieties of limestone found in the State, and differ mainly in having a greater or less quantity of siliceous material, or clay, in their composition, making them friable, or stiff, as one or the other material preponderates. In durability, extent and productiveness, they surpass all other soils in the State, except the alluvial. They constitute the wheat, tobacco, cotton, and blue grass region of the State, and are found in all the minor valleys of the Valley of East Tennessee, in the Central Basin, and on much of the Highland Rim and in the Western Valley. But few of these soils are found in West Tennessee, they being confined to a small strip west of Tennessee River. These soils are classified according to the prevailing limestone, and form the best farming areas within the State. They cover in the aggregate one-fourth of the surface of the State.

Green Sand Soil.—This soil is a kind of siliceous loam, resting upon an interesting formation in West Tennessee, which is, in the main, sand and clay intermixed, having as characteristic ingredients a considerable amount of carbonate of lime and numerous green grains (glauconite), resembling in consistence particles of gunpowder, which give the mass a light green color. It must be mentioned that the formation from which this soil is derived is mixed with shells, so much so that they furnish materials for burning lime. This greatly influences the character of the soil, supplying it with fertile ingredients, and making it friable and fertile. It is well adapted to the growth of cotton and corn, and some portions to the growth of wheat. The land where this soil prevails is by far the most rugged portion of West

Tennessee, and many glady spots occur, especially upon the Tennessee Ridge west, and its various spurs. This soil is confined almost entirely to the eastern part of McNairy and Henderson counties.

Shaly Soils.—Shales are common in many parts of the State. The black shale underlies the lands of the "Rim," sometimes however, cropping out; other shales are found in great abundance associated with the coal strata in the Cumberland Table-land, but as a top formation shale is rare. In a few of the narrow valleys of East Tennessee the black shale forms the basis of the soil. This soil is cold, clayey, unproductive and unimportant, except for grasses. In extent it is very limited, and it may be improved by utilizing the accompanying beds of calcareous nodules, some of which are nearly pure phosphates.

Alluvial Soil.—This occupies in the aggregate a larger area than any other in the State; for to the nine hundred square miles embraced by the great Mississippi bottoms there must be added the lowlands of the Tennessee and Cumberland rivers, and that of all their tributaries.

Alluvial soils prevail also in the valleys of East Tennessee. The whole state is furrowed by rivers, creeks, and rills, each of which has lying on its margin more or less alluvial soil. Some of the highland counties are alternate ridges and valleys, such as Perry. The alluvial soils differ greatly in character, aptitudes, and productive capacity, depending in great degree upon the formation of the surrounding uplands and the frequency or infrequency of overflows. Where the waters flow through or over limestone, the deposit is highly calcareous. This deposit makes a good wheat soil. When the streams gather their waters from sandstone-hills, or gravelly ridges, the soil is not so productive, being more deficient in carbonate of lime. The character of the alluvial soil is determined by the region through which the stream flows. On many of the streams are terraces, elevated high

above the stream-beds, and not subject to overflow, which have all the characteristic features of the low alluvial soils. These fluviatile deposits are exceedingly rich in plant food, and make our most generous soils. Their perfect drainage and freedom from overflows make them very valuable and desirable. For the growth of wheat they are especially desirable. We have seen forty bushels of this cereal raised per acre on this elevated alluvial soil.

The streams of the Highland Rim have their lowlands highly charged with flinty material. The soil is free and comparatively light, being formed for the most part of the silt deposited by the water, intermingled with chert and fragments of shivered limestone. Upon this character of soil are grown great abundance of peanuts, corn, and potatoes. It never compacts, but remains friable and loose throughout the growing season. Though not so productive of timothy as the more clayey bottoms, this rocky alluvium is more highly esteemed for all the crops that require cultivation.

There are almost an endless variety and modification of these classes, making warm and cold, light and heavy, low, loamy, hungry, marly, leachy, limey, sweet, sour, sandy, clayey, marshy, compact, tenaceous, fine, coarse, gravelly, rocky, and crawfishy; but all may be embraced in the classification above given. The productiveness of soils does not depend on the amount of the constituent elements altogether, such as lime, potash, soda, phosphoric and sulphuric acids, and vegetable matter, but upon climatic influences, surface exposure, subsoil, drainage, degree of pulverization and culture. Drainage is especially important. Standing water is destructive of our field-crops. On the other hand, the soil must not be so porous as to permit the fertilizers to filter to a depth beyond the reach of plants. For the purpose of production, the best condition of a soil is to be thoroughly pulverized and well drained of its surplus water, yet with an under-clay that will catch and hold all fertilizing ingredients.

The usual quantity of wheat raised in the State varies from 5,000,000 to 13,000,000 bushels, grown upon a surface varying from 1,000,000 to 1,500,000 acres, with an average of seven to nine bushels per acre. To sum up: the best wheat-growing regions of the State are the Central Basin, the valleys of East Tennessee, and the counties lying on the northern border of Middle and West Tennessee. The average in these regions is about fifteen bushels on the best soils. It could be raised to twenty or twenty-five bushels by intelligent labor on the farm. Though the average yield of wheat is far from being what a thorough preparation of the land and early seeding could make it, yet the excellence of the berry compensates in some degree for the scantiness of the yield. The flour made from Tennessee wheat commands in every market a superior price. This fact and its cause is clearly stated by Henry C. Carey, the distinguished political economist:

“Even before the war a great change had commenced in regard to the sources from which Northern supplies of cereals were to come, Tennessee and North Carolina furnishing large supplies of wheat, greatly superior in quality to that grown on Northern lands, and commanding higher prices in all our markets. The daily quotations show that Southern flour, raised in Tennessee, Missouri, and Virginia, brings from three to five dollars per barrel more than the best New York Genessee flour; that of Louisiana and Texas is far superior to the former, and does not ferment so easily. Southern flour makes better dough and maccaroni than Western flour; it is better adapted to transportation over the sea, and keeps better in the tropics. It is therefore the flour sought after for Brazil, Central America, Mexico, and the West India markets, which are at our doors. A barrel of strictly Southern flour will make twenty pounds more bread than Illinois flour, because, being so much dryer, it takes up more water in making it.”

Add to this the fact that the Tennessee harvest precedes

that of New York and the North-western States by nearly a month, and the wheat crop comes in upon a bare market, and it becomes evident that so far as quality and time of selling go, our statement of the superiority of Tennessee as a wheat section is borne out.

For these and many other considerations mentioned in the course of this article, we do not believe the farmers of Tennessee, especially those living in the favored sections, can do better than turn their attention particularly to raising wheat. The present supply of labor renders it imperative for the adoption of a system of agriculture that will render it practicable to cultivate a large breadth of land with the employment of few hands. The cultivation of wheat to a large extent will enable the farmer to do this, for, by the introduction of machinery, and by the employment of some extra hands at harvest and at threshing-time, a large crop may be gathered at a comparative small cost. Let farmers sow more clover and grow more wheat, as well by increasing the yield as by increasing the acreage, and a healthy independence will be secured.

CHAPTER XV.

PREPARATION OF SOIL.—TIME AND MANNER OF SOWING.—
LETTERS FROM FARMERS.

The subject of this chapter is one which can be supplied by every farmer in the State, and in all probability better than is here given. Should any one else be called upon to write this chapter, he would in the first place give his own personal experience, together with observation on his neighbors habits, and rest upon that. This shall be the rule, only in addition to that we shall give such rules as can be deduced from the schedule of letters at the end of the work.

Let it be assumed, in the first place, that the farmer has selected a good, suitable piece of land. Knowing what wheat requires he has most probably selected a clover lot, meadow sward, oat field, or fallow land. At the time when the spontaneous growth is at its height, for instance, when the weeds are between the flower and the seed, in July, or latest in August, he will break up his land thoroughly with large plows and good teams, ox, mule or horse. There must be a watchfulness on the part of the farmer at this time, for on the work done before sowing depends the success of the wheat. Land badly prepared, broken up too wet, or "cut and covered," will not perform its work properly. *Poor land well pulverised will make more wheat than rich, cloddy land.* Remember this, and if it is necessary to hurry at sowing time, know that to a farmer, great hurry is poor speed. Turn over the growth well, be it weeds, grass or clover. Let it rot, and then, when everything is ready to sow, the land will be found mellow, rich and well pulverised.

It is of no use to say, break any number of times, harrow or roll any number of times. There is but one question to be fulfilled, and that is to have the ground thoroughly crumbled. It will require work, breaking up, harrowing, rolling; let it be done. When ground is well prepared, and the seed selected, it will then be ready to sow.

There is such a thing as sowing too early. It looks very charming to have a field of wheat looking fresh and green throughout the winter. It will charm the eye and delight all beholders, but when harvest arrives there will be a terrible disappointment to find that the "sweet field arrayed in living green" had been for all winter a city of refuge for all insects. That, in other words, the wheat having come up and formed a "boot" before frosts had killed the Hessian flies, they had gladly availed themselves of the hiding place, had deposited their eggs in the boot, which had safely protected them through the winter, and in the spring had hatched, and then the young stalk, instead of sending forth strong, healthy tillers, each loaded with golden grain, had put forth some abortion of stems, each sucked at its base by vile worms, until at last its vitality was so exhausted, it fell short of its destined fruitfulness.

Then, so time the sowing, as to meet this danger. Some may say, "we sowed last year the 15th September, and was not troubled with fly." So they did, and they may sow the same time next year and escape, for the fly does not devastate the whole country every year, but only now and then. It takes the country by sections; but if the wheat is not up when it comes, it will escape; if it is up, the whole crop may be destroyed. A prudent general should always be provided against surprises, and so should a prudent farmer. Therefore, never sow until the chance for the fly is over. In other words, so time the sowing as to let the wheat come up after the frosts have begun to fall.

This time will range from 1st to 20th October, according locality. In the schedule of answers, the majority of gen-

tllemen say from 15th September to 15th October. But it is safe to say not before 1st of October, nor later than the 1st of November. However, the nearer to the 10th of October the better. By this time the fly will be destroyed, and yet the wheat will have ample time to send out its roots, and accumulate a head for winter.

It is unnecessary to say but few words as to the quantity to sow, and the manner of doing so. Before the late war drills were unknown in Tennessee. Since their introduction, they have gained such headway that few can do without one, if the quantity sowed will justify them in the purchase. Sometimes several neighbors will club together and buy one, and it will suffice easily to sow 150 acres in full time, or possibly two hundred. The reasons for using a drill are few and simple. It deposits the seed at precisely the right depth, and all, or nearly all germinates. In stiff land this should be $1\frac{1}{2}$ inches, in friable land 2 inches.

It places the seed evenly, and requires less seed. In planting 100 acres it will save at least 40 or 50 bushels, for with a drill from one-half to three-quarters of a bushel is deemed amply sufficient, while by the hand it is customary to sow a bushel to a bushel and a half. In sowing 200 acres, it is claimed by the advocates of the drill that enough will be saved to pay for the drill.

The Agricultural Department, in 1873, issued circulars, and sent to all the States, making inquiries as to the relative use and benefits of drills and broadcast sowings. From the answers it appeared that from all sources only 47 per cent. of wheat was sown with drills. Many and urgent objections were made to the use of drills, and some good reasons given, which shows that under some circumstances wheat drilled did not do well. The cotton States, with the exception of Tennessee, did not know the use of drills at all, and there were but few in Texas. As a general thing, partisans of the drill method estimated the increase at 10 per cent., though some placed it as high as one hundred

per cent. Nine-tenths of the testimony adduced favors the drill. It must be preceded by thorough culture, and

FIG. 4.

where the surface is uneven, rocky or stumpy, the only plan to use is the broadcasting plan.—(Agricultural Report, 1873.)

Fig. 4, on page 122, faithfully depicts the effects of deep

and shallow sowing. In other words, drill and broadcast :
N o. 1 is wheat put in deep enough under the surface to in-
ure it in taking root. If too close to the surface it will

sprout. Should it become dry afterward it will die, or should early freeze ensue it would be destroyed. Then let it be assumed, $1\frac{1}{2}$ to 2 inches, is the proper depth to secure it against both freezes and droughts. When it is sown broadcast, some will be at a proper depth, some four inches, and some on the surface.

That plowed in deeply is represented in No. 2. It is a long distance for the young and delicate "*plumule*" to reach, and while pushing its way up, it has to receive sustenance entirely from the store of starch in the grain, and by the time it gets to the surface its vitality is well nigh exhausted, and it becomes a poor, sickly stem, only affording those faulty grains the miller has so much trouble to get clear of.

Not only is it weak and feeble in its growth, but there is another danger. Observe a long stem between the true roots and the surface roots it is fain to throw out in its struggle for life. During the winter, should a freeze affect only an inch or two inches, the frozen earth grasps the surface roots of the tender plant, the subsoil clings to the deep-seated roots, and the stem is severed.

It is then doubly injured, and barely makes a head without grains. No. 3 gives an idea of a properly drilled shoot properly stooling.

In Fig. 5, see the result of deep and shallow plowing. This is no exaggerated picture, but a true and faithful representation of the relative difference between deep and shallow sowing. Of course the same objections urged against plowing in deep would hold against surface sowing. It is true it will germinate, but between the sun and the birds, mice and insects, but little is left to gladden the heart of the farmer. Some land will not admit of the drill, either too rocky, or too steep, or filled with stumps of trees. In these cases the judgment of the farmer will indicate to him the only feasible method. When forced to plow in, after all the necessary preparation is made, it is best to use the

bull-tongue or double-shovel, run east and west if possible. It covers up, pulverises, and does not put it in too deep.

FIG. 5.

If it is intended to put the wheat in corn grounds, two methods present themselves, either to plow among the standing corn, or cut the corn, stack it, and break the ground. As in the former case, this has to rest upon certain contingencies, that can only be properly judged of in each particular case, and by the farmer himself. In the former case the farmer must content himself to use cradles in his harvest. In the latter, he can select either that or the reaper. But corn-land wheat rarely ever pays. Wheat as a rule should never follow corn.

A very general opinion sanctions the use of the roller or the harrow in the spring. Some say it adds one-tenth to the yield. When a method receives such a universal sanction from the public, the verdict may be safely accepted. In the spring, after the frosts are out, should the ground be very loose and friable, the young wheat standing tip-toe out

of the soil, a heavy roller will settle it in its place and greatly benefit it. On the other hand if, from early heavy rains the ground is hard-packed or baked, it will be equal to a cultivation, to run the harrow over it. It will loosen the surface, admit the air to the roots, so that the healthful functions of nature may be exerted. Besides, it destroys the crop of young grass and weeds that are just peeping up. It looks like rough handling for the wheat, but if a fine-tooth harrow is used it rarely tears up any. It also prepares the ground for the reception of clover or grass seed, should it be necessary to sow any.

A practice which is adopted by some of our most skillful farmers is to roll the land just before the drill. This solidifies the soil on top, but leaves it loose beneath. This greatly aids the wheat in the process of germination.

Winter killing is a great drawback in the North to the cultivation of wheat, but in this State it is a very rare occurrence that it is totally destroyed. The reason is the porosity of the soils, that permits the roots to thrust its spongioles far down in search of nourishment.

Should a field require it, it should be drained, as a matter of course, as that is the most fruitful source of winter killing. A light coat of manure is also a good preventive, as it stimulates the wheat to vigorous growth, before the severe cold comes on to kill it. As to the application of manures, every farmer is aware of the importance of giving the ground all it needs. It is beneficial to sow guano, plaster, manure from the compost heap, ashes, salt, or in fact anything that will invigorate the wheat.

As to the use of lime, it is good for the wheat beyond question, but it will surely exhaust the land if persevered in without rotation. Its action on the soil is to act as a solvent for the inorganic substances already composing it. As a matter of course, the more that is taken out the less remains. It is true, it stimulates the plant to draw from the atmosphere, and if the plant is plowed in, it will enrich

the soil by returning to it all it took out, besides what was taken from the air.

One error of some farmers is, that ammonia and carbonic acid, extracted from the air, are passed by means of the roots into the soil. By aid of the most powerful microscope, no one has been able to detect any circulation from the stem toward the roots, though the reverse is easily seen. Agricultural writers talk a great deal about manuring, but practice has yet to see a large field manured from the compost heap, or with any other fertilizer, except it be ashes, plaster, superphosphates, guano, or salt. It is utterly impracticable, except for a small experimental patch, and then, if too heavily put on, it will surely injure the wheat.

The great and only fertilizers practicable for wheat are clover and peas. Tons of the best manure are contained in the clover field, all spread to hand; and there is but one trouble — that is, to plow them in. Unlike other manures, clover pays for itself while being collected. It will fatten hogs, sheep, cattle, or horses. It will furnish the best of hay for winter store, and then it will sow itself so that, with ordinary attention as to plowing in the second crop of seed, it is easy to perpetuate the stand indefinitely. Should the ground become so filled with nitrogenous substances, and become deficient in silica or calcium, the wheat will not stand up by reason of rust. It can still be placed to any other crop, keep it so for years, and when again seeded, clover will still be on hand.

Tobacco extracts, as its principal support, saltpetre from the soil, and leaves the phosphorus untouched, so that it precedes wheat very well; but by alternating the wheat and tobacco, the soil would soon be impoverished. Witness the exhausted fields of Virginia and North Carolina as a result of such a ruinous system of agriculture. So with corn. But rotation with clover will absolutely prevent this.

A planter had two fields of twenty acres each, which he alternated with corn and wheat. This was kept up for fifteen or twenty years, and resulted in both fields being completely and effectually worn out. Wheat takes up certain principles in the soil, and so do corn and tobacco, and it is very unreasonable to expect the soil to furnish liberally of its riches every year, and last forever. It is like continually checking upon a bank deposit without ever adding to the account. At last the checks will be returned dishonored. The magnificent prairie lands of Illinois and Missouri, that once yielded forty and fifty bushels per acre, barely yield now from ten to twenty.

In regard to the culture of wheat, I have introduced letters from some of the best farmers in the State, who have spent a long life in the business, and know whereof they speak. But before giving these, it may be well to recur to the reasons given by some of our best farmers why they do not use the drill. It must be confessed that there is good ground for believing that the increased yield claimed by the drill is due, in part at least, to the more thorough preparation of the soil. Major C. K. Vanderford, of Rutherford county, one of the most successful wheat-raisers in the State, in a communication to the *Rural Sun*, dated September 17, 1877, in referring to a large yield of wheat grown by Byrd Douglas, says:

“The best and most important part of the work was in the management of the soil for two or more years before putting it under the plow for the wheat crop. Thorough plowing at the proper time and in the best manner, and all other subsequent processes, essential though they were, would not have guaranteed success, but for the forethought which had provided good ground upon which to sow good seed. The *drilling* did not make the large yield, no more than did the timely threshing. This drilling was only one of a series of well conceived and properly conducted processes. And it will be evident to any one, who will exam-

ine into the conditions of success in wheat-culture, that these conditions are not one or two, but many.

“Notwithstanding the fact that a large proportion of the winter wheat sown north of the Ohio is put in with the drill, it is by no means an acknowledged fact that the use of this implement is to be credited with increased product per acre. Whoever intends to drill in wheat must of necessity put the ground in good condition. I have before me the ‘warranty’ of one of the most popular grain drills in use: ‘To sow wheat, rye, etc., regularly and evenly, also to cover well, provided always that the drill is properly used, and under ordinary favorable circumstances.’ On receiving notice of any failure to perform well, the manufacturer or his agent will go to remedy the trouble; but ‘when on examination the difficulty is found to be *in the ground*, seed, or manner of using the drill, the person who ordered the machine shall pay the expense of this visit, and the warranty shall cease.’ Now, this is all fair enough. I quote it only to call attention to the fact that the *proper condition of the ground* is an absolute prerequisite to the use of the machine. Now, we learn from the very highest authority that the improvement by drilling is made to average ten per cent. (Report of Commissioner of Agriculture for 1875, page 42.) How much or how little of this improvement is really due to the better preparation of the soil, and how much or how little to the use of the drill, is problematical.

“This question of drilling *versus* broadcasting has been recently made the subject of experiment by several of the better classes of agricultural colleges, by experimental farms in several States, and by a number of intelligent farmers. I have watched carefully for the result. So far, the weight of testimony is in favor of broadcasting—the preparation of the soil being alike for both methods of seeding.

“When we put in wheat with an eight-inch drill, using four pecks of seed per acre, there will be about nine grains of wheat to the lineal foot of drill—fourteen to each square

foot of surface; and if every seed grows the plants will stand one and one-quarter inches apart in the drill. If we use three pecks of seed, the plants will be not quite two inches apart—in both cases much too crowded for thriftiest growth. If we broadcast one bushel per acre there will be fourteen plants to the square foot, but distributed more or less evenly over the whole space. The few pieces of drilled wheat which I have seen were full of weeds, which had opportunity to grow in the open spaces, while upon similar soils in broadcast fields near by, few or no weeds could be seen. Drilling or “dibbling” wheat has long been practiced in England. Hoeing and weeding wheat by hand and by machinery is a necessary practice there; and it is noteworthy that the grain-fields of the mother country are more and more infested with weeds every year.

CHAPTER XVI.

LETTERS FROM SUCCESSFUL WHEAT RAISERS AS TO CULTURE, EXPENSE, AND MANAGEMENT OF THE CROP.

I know of no way better calculated to instruct our farmers in successful wheat culture than by collecting and publishing the detailed operations of those who have been most successful in the production of wheat. For this reason I addressed, or caused to be addressed letters to a considerable number of eminent wheat-raisers in the State, asking for a detailed account of their experience in wheat growing. Many responded, but several from whom I expected the best accounts failed to respond, much to my regret, and to the regret, doubtless, of my readers.

The first letter is from Jno. B. McEwen, of Williamson county, who is known to be one of the most energetic and successful wheat growers in the State. His letter is full and to the point.

FRANKLIN, TENN., July 24, 1877.

J. B. Killebrew, Esq.:

DEAR SIR:—At your request I address you a few lines upon the culture of wheat, and the varieties adapted to this locality. Middle Tennessee is naturally a wheat country, and when the proper attention is given no section of the United States can excel Middle Tennessee, either in yield or quality of grain, and I am fully of the opinion that the lands of Middle Tennessee will yield in proportion to the attention given to the crop. Such a thing as manuring land for wheat is unknown. In the past, as a general rule, the lands have been too rich for wheat, and it would run too much to straw. Now, as a general thing, the lands are too poor, and will not make straw enough. We must therefore temper up the lands to make the wheat crop remunerative, and according to my experience nothing answers the purpose so well as clovering the lands. I have been told by a large thresher man, that in threshing nearly 100,000 bushels this season he never struck a clover sod field, which did not yield more than 20 bushels per acre. On the contrary, equally as good land, where the wheat followed corn, the yield rarely went up to ten bushels per acre. Wheat after wheat on a clover soil does as well for three successive crops as

at first. Wheat after wheat on corn-stalk land will yield better after the first crop for five years, but will rarely even come up to the succession of crops following clover. Wheat does well after tobacco, cotton and potatoes, but not so well either in yield or quality as after clover.

The next thing after getting a clover sod is to break the land deep and subsoil it, re-break, harrow and drill the seed. By this mode I have succeeded in making a yield of from 40 to 50 bushels to the acre, an average of $44\frac{1}{2}$ bushels to the acre. The time for breaking is August, when the green grass and weeds can all be turned under green, the green weeds and grass being equal to a general cast of light manure. The time for seeding is from the 1st to the 20th of October, neither sooner nor later; if sooner you encounter the fly; if later, the fall drouth.

The same amount of labor and manure put upon land here, as upon lands in Pennsylvania, New York, Maryland or Virginia, would bring forth a yield double to treble, and an article far superior in quality to any of these States. Such a thing as clearing our lands of stumps and loose stones is unknown here, but is the first consideration in the States named, and should be here. Our lands are very kind here, and will make some wheat if the seed are scattered over it with or without manure or plowing, and at any time from the middle of September to the first of January.

I have been a wheat-raiser during the past twenty-five years, and tried every variety, and tried it upon all kinds of land, and cultivated it in every mode, from the best to the meanest, and the results varied accordingly, and I am now satisfied that the land will produce just in proportion to the labor and skill bestowed upon it. Another suggestion: always plow your land when it is dry, never when wet. If you do plow the land too wet, your crop will surely be a failure on your best land.

The wheat crop is subject to many ills in Middle Tennessee, and the greatest of them all is the rust. To avoid that is to sow wheat which will ripen earliest, and sow it by the 10th of October. There are several varieties which will ripen from the 1st to the 7th of June. These varieties will rarely rust. Some varieties will succeed finely in some localities, and be total failures in others, hence you must study your locality.

The next ill we are subject to is the grasshopper and fly which, combined, very often blasts your prospect for a crop. To avoid these, do not sow before the 10th of October, and you will escape both, nine times out of ten.

The next is smut. No man need ever have a single grain of smut. It has been fully ascertained that bluestone is a certain remedy against smut. I have tried it for years, and never had a grain of smut in my crop when the remedy is applied. The mode of applying is not soaking, but it is to take one pound of bluestone and thoroughly dissolve it in boiling water, and when cooled down, have ten bushels of wheat cleaned ready, and in a pile. Sprinkle the bluestone water slowly over the pile and stir it thorough-

ly until the two gallons of mixture is all taken up by the wheat. The wheat is then ready for sowing, not wet and sticky, and scarcely shows that it has been dampened. This is my practice and that of others, and when attended to, you cannot find a grain of smut, and you may be sure when you find smut, this remedy has been neglected. The application seldom costs exceeding two cents per bushel, surely a small sum to insure against smut. You often hear men say they never have smut on their land, and they do not trouble themselves to use the remedy against it.

Perhaps they get the experience the next year of losing half the value of their crop. These ills, with that of laziness, constitute the main force with which we have to contend. Cockle, rye, chess and such things, are the result simply of laziness and carelessness.

Wheat culture heretofore in Middle Tennessee has been greatly neglected. Attention is now being turned towards its culture, and great strides are making in the right direction, and soon it will become the staple money-making crop. Transportation in the past has been the principal cause of its neglect.

I had eleven varieties of wheat this year, making a succession to meet the convenience of harvesting, but one half of them I would pronounce worthless for this locality? The varieties have selected for seed—are the Yellow Lamas, being the earliest to ripen; the next the Boughton, for its hardy and freedom from rust; the next, the Fultz and Walker—the two latter varieties being very prolific and very hardy, and all fine wheat. The others I discard. I have now said as much as needs be said upon the subject.

Yours, very respectfully,

J. B. McEWEN.

The following letter from one of the most successful wheat-growers in the State, will be read with interest. The soil on Mr. Matlock's farm is a stiff clay loam, resulting from the disintegration of the Knox dolomite. It is deeply stained with ferric oxide, and is capable of indefinite improvement:

OCTOBER 12, 1877.

J. B. Killebrew, Commissioner:

You ask me to give you the best time and method of preparing land for wheat, also what time it ought to be sown.

I prefer a clover sod plowed early in July and turned deep and well under. This should be kept harrowed so as to prevent the growth of grass and weeds. Manure should be liberally scattered upon the thin places. Roll well and drill in the wheat about the 10th of October. If I could sow all my wheat in one day it would be the 10th of October. I

always want about three inches of the top soil well packed, and under this I want it loose and mellow. The seed comes up better in land so prepared, and if the winter should be wet, the loose soil underneath supplies a good drainage, so that there will be but little danger of freezing out. Should the weather be dry the closely compacted stratum on top will keep moisture enough to hasten the process of germination. I have raised on land thus prepared 44 bushels of wheat per acre.

As to the quantity of seed to use I state that upon one occasion, through mistake, I put in seven acres with only three-quarters of a bushel per acre. From that piece of seven acres I got 37 bushels per acre. I prefer one season with another, to begin with seven-eighths of a bushel to the acre, and later in the sowing season one bushel, and I do not care ever to have a greater quantity, unless the soil is very thin, and it is very late in the season. Thin soils require more seed than rich ones, as the stand is never so good, nor does it tiller so well on thin soils.

On such soils I prefer peas to clover as a crop to precede wheat. Sow the peas at the rate of three or four bushels to the acre. Treat them with plaster as you would clover, and before the leaves begin to turn yellow plow them well under. I never found so much advantage after the leaves begin to turn yellow and fall off. By the judicious and persistent use of peas almost any field can be made to bring a fair crop of wheat and clover.

Respectfully,

H. H. MATLOCK.

Here follows a letter from Mr. Campbell :

VINE COTTAGE, FRANKLIN, TENN., }
July 20, 1877. }

J. B. Killebrew, Esq.:

In answer to your note received to-day, I would inform you that my field of nine acres and 65-100, which you allude to was plowed about the 15th of August last, with the Oliver chilled plow, turning under a crop of red clover and rag-weed. Early in September I broke it again with sub-soil plows, tearing the sod well to pieces, then harrowed twice, and with what I call a drag, went over again, mashing clods and smoothing it very nicely; then, with my neighbor Daniels' drill I put a little over three pecks of Boughton wheat to the acre. I should have preferred drilling a half bushel to the acre, but could not regulate the drill so as to put that amount on. If the drill could have been made to put a peck to the acre, I would have put that amount one way and crossed with a peck the other way, which I think would have made a better yield, leaving the seed more evenly distributed over the ground. When the seed was well up, and before it began to branch or tiller, I sowed about eight bushels of gypsum and thirty-five bushels of leached and unleached ashes to the

field. I have threshed out thirty bushels to the acre, and have got yet to thresh my gleanings, which will make the yield 32 or 33 bushels to the acre. I will state to you the fact that you and my neighbors all know that the crop was materially injured by storms in April and June. Now let me foot up the cost and profit of the crop, calculating the field at $9\frac{1}{2}$ acres to save fractions:

Cost of plowing at \$1.50 per acre.....	\$ 14 25
Cost of subsoiling at \$1.50 per acre.....	14 25
Cost of harrowing once, at 25 per acre.....	2 37
Cost of harrowing second time.....	2 38
Cost of dragging once.....	2 27
7 bushel seed wheat at \$1.25.....	8 75
Cost of drilling at 50c per acre.....	4 75
8 bushels gypsum.....	8 00
35 bushels ashes at $7\frac{1}{2}$ c.....	2 63
Sowing fertilizers.....	1 00
Rent of land, 10 per cent. on \$50.....	47 50
Cost of cutting at \$1 per acre.....	9 50
Binding and shocking by 9 men, 3 girls and 2 boys.....	20 62
Board of hands at 25c.....	5 25
7 hands in threshing $1\frac{1}{2}$ days at \$1.....	10 50
3 wagons and teams $1\frac{1}{2}$ days at \$2 50.....	11 25
1 wagon and team $\frac{1}{2}$ day saving straw.....	1 25
Board of 17 hands hauling, threshing and stacking straw $1\frac{1}{2}$ days each.....	6 38
Corn and barley for 17 horses.....	2 00
3 pints whisky.....	90
Total	\$175 90

By 258 51-100 bushels wheat, deducting toll at 10 per ct.. \$322 96

By straw.....	10 00	
		<u>\$332 96</u>

Clear profit.....	\$157 06
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or about \$17.50 per acre.

Now for the field of eight acres, rented of Mrs. Harriet Baugh:

To rent of same at \$4 per acre.....	\$ 32 00
Cost of one plowing at \$1.50 per acre.....	12 00
Cost of one harrowing.....	2 00
Cost of one drilling.....	4 00
Cost of 10 bushels seed wheat at \$1.25.....	12 50
Cost of 4 bushels gypsum.....	4 00
Cost of 24 bushels ashes.....	1 80
Cost of sowing do.....	1 00
Cost cutting 8 acres.....	8 00

Cost binding and shocking.....	3 50
Cost of board 7 hands $\frac{1}{2}$ day.....	1 10
Cost hiring 7 hands $\frac{1}{2}$ day, threshing and straw.....	3 50
4 wagons and teams $\frac{1}{2}$ day.....	5 00
Board of 7 hands binding and shocking.....	87
Board 17 hands hauling, threshing and stacking straw.....	2 13
Corn and barley for 17 horses $\frac{1}{2}$ day.....	50
One pint whisky.....	37
Total.....	<hr/> \$ 94 27
By 59 45-100 bushels wheat, after paying toll, 1-10, at \$1.2	\$ 74 31
By straw.....	2 00
	<hr/> \$ 76 31
Net loss.....	<hr/> \$ 17 96

or loss per acre \$2.24 $\frac{1}{2}$.

So you see the more of such land we farmers cultivate the greater the loss. This field was in sweet potatoes last year. If the land had been given to me free of rent, I would, after getting a low price for labor, have got \$1.75 per acre. We must quit this system of farming, and improve our land by system of grazing stock, especially sheep and cattle and a free use of clover with land plaster and ashes, and using all the manure we can make from the stock. If in the above two statements I have committed an error, it is unintentional, and I would like for you to point it out to me. I have not yet threshed out any gleanings, but will report the same to you when I do.

Yours, with respect,

WM. P. CAMPBELL.

JUDGE HURT'S EXPERIENCE.

Judge W. J. Hurt, of Como, Henry county, Tennessee, sowed Tappahannock on a piece of dark chocolate colored land with red, porous sub-soil, whose original growth was hickory, pawpaw and poplar, and has been cultivated forty years in corn, cotton and tobacco without rest or clover: lies high and level. Sowed from first to fifteenth of October, one bushel of seed to the acre. Sowed it broad-cast. It ripened about the first week in June. Broke up in September with a one-horse Brinley plow drawn by two mules. Seed harrowed and brushed in. Yield: 3,000 bushels on one hundred acres. In 1874 sowed wheat on clover land

and raised forty bushels per acre. Clover sod turned under in July. Did not graze nor ever does. Quality of wheat is improved by letting it become thoroughly ripe before cutting. Soaks his wheat in bluestone, one pound to eight bushels, for twenty-four hours.

Jno. H. Harrison broke up a meadow of five years' standing with three horses in July. He broke first of October and sowed three-fourth of a bushel Boughton wheat per acre one way with drill and crossed with one-half bushel per acre the other way. Drought killed out a good deal. Harrowed before sowing. Result: 17 acres made 35 bushels per acre, 10 acres made 40 bushels per acre, and 4 acres made 50 per acre. Several gentlemem made from 25 to 45 bushels per acre, and it is a notable fact that all the large yields were from clover land broke up in July or August.

A remarkable instance of the result of good farming took place at State Lunatic Asylum. The land is a white oak ridge, known as Nubbin Ridge, from the size of the corn grown on it. When purchased by the State it was literally exhausted—worn out. Last year it was in clover, was broken up in September and Fultz wheat sowed, after being rolled and harrowed. It was sown broad-cast and bull-tongued in. It was rolled in the spring. The yield of the field of 28 acres was 981 bushels by weight, or 35 1-28 bushels per acre.

Letter from Mr Sanders, of Rutherford county:

MURFREESBORO, TENN., July 11, 1877.

J. B. Killebrew, Esq.—Dear Sir: I have been requested to send you a statement of my wheat, manner of putting in, time of sowing, etc. My land was all turned under with a three-horse plow in August and September, and was let lie until the 1st of October, when it was thoroughly harrowed with a three-horse harrow and then seeded as follows: The first three pieces were Fultz, and turned out as below. The first on clover, three-fourths of a bushel per acre sown October 5th, rusted badly, fell down, and got 20 bushels per acre.

Second piece after oats. Seeded three-fourths of a bushel per acre, October 5th, rusted slightly; yield 15 bushels per acre.

Third piece, three-fourths of a bushel per acre, after wheat; land thin, no rust, yield $12\frac{1}{2}$ bushels per acre. Sowed October 28.

Fourth piece after wheat, five-eighths of a bushel per acre, bright amber, land thin, October 25, yield $16\frac{1}{2}$ bushels per acre.

Fifth piece after clover, three-fourths of a bushel per acre, bright amber, sowed October 17, yield $25\frac{1}{8}$ bushels per acre.

You will observe from the above that my average yield per acre was 18 bushels, or $26\frac{1}{4}$ bushels to one sown. All the above plats were treated in the same way, being thoroughly harrowed, sown and harrowed in. My crop of 22 bushels of seed on $32\frac{1}{2}$ acres of land yielded 578 bushels of choice wheat.

Respectfully,

S. K. SANDERS.

A gentleman in Bedford county bought a worn-out place and sowed a forty acre field in wheat and clover. The first year he got 160 bushels of inferior wheat, or four bushels per acre. The next year he got by plastering his clover a large lot of valuable hay, and in August he saved and sold \$600 worth of clover seed, and then broke it up and sowed in wheat. The next year, being the third year from the purchase, he saved 1,200 bushels of good wheat, and it has, by alternating with clover, got to be one of the best wheat farms in Bedford county.

A Mr. Daniels. came from Indiana a few years ago and bought a portion of an old place that had been worn out in cotton culture. He plowed it across gullies, making his horses jump, and sowed in wheat and clover. This year he made 30 bushels per acre on the whole place. When he bought it, from five to seven bushels was the average.

There is a great diversity among farmers as to the crop that precedes wheat. Unfortunately it often happens that no regular system at all is observed, but he merely sows certain pieces of ground because it is convenient. These farmers help to reduce the average per acre in the county or State. It is not always practicable for a farmer to sow clover, in fact some land does not produce it successfully. Then peas would precede it with fine effect. A pea crop turned under has been known to add five bushels per acre, and this cer-

tainly will remunerate the farmer. The proper plan will be to sow peas broad-cast on the ground, it being properly prepared to receive them, and then in August, either pasturing with hogs or without, plow in the vines, and treating afterwards as any fallow land. Next to clover this crop is the best to precede wheat.

Mr. Lovelace, of Henry county, has made some interesting experiments in wheat growing by preceding his wheat crop with peas. From three pecks to a bushel of stock peas were sown per acre in May, 1873, upon a field almost totally exhausted, the last crop of wheat from which, though a good season, yielding only five bushels per acre. The pea vines were turned under in August following, and the field sown in wheat in October. The following year ten bushels of wheat per acre were harvested. The field was put in peas as soon as the wheat was cut, the vines turned under in August and wheat sown. The yield the following summer was fifteen bushels, showing a regular increase of five bushels each year, though the land was in cultivation every year. In 1873 the soil was so poor it would not grow clover. In 1876 there was a magnificent stand of clover on it, and the land was rich enough to bring a crop of tobacco. If our farmers generally would adopt this simple plan to fertilize their lands fewer complaints would be heard of the unprofitableness of farming.

Rotation of crops should always be observed. A farmer who will persistently cultivate in the cereals, cotton and tobacco, cannot expect long to enjoy prosperity, but if he will alternate with clover every two, three or even four years, his land can be kept good a long time. Prof. Voeleker, reporting experiments to the Royal Agricultural Society of England, says :

“The heaviest crops of clover removed from the soil appear to render it more capable of yielding a good crop of wheat. The addition of even powerful saline manures (super-phosphate of lime, mixed alkalis, etc.,) seems hardly

to improve the subsequent wheat crop. Clover mowed twice leaves the land in a better condition, as regarding its wheat producing qualities, than when mowed once only for hay, and the second crop fed off the land by sheep." "Clover not only provides," says he, "abundance of nitrogenous food, but delivers this food in a readily available form, as nitrates, more gradually and continuously, and consequently with more certainty of a good result than such food can be applied to the land in the shape of nitrogenous spring top dressings."

The removal of the clover crop does not always benefit the succeeding wheat crop. An interesting experiment was made a year or two since in Maury county, one half of the field being mowed and the clover hay taken off, while on the other half the clover was allowed to fall down and was subsequently turned under. The latter half made five bushels of wheat per acre more than that portion from which the clover crop was taken off. Whether the clover should or should not be taken off depends greatly upon the time of plowing. If this be done in June or July a heavy growth of clover would doubtless be an advantage to the succeeding wheat crop, but if the plowing is postponed until August the cleaner the land is the better. The decay of the green crop should be perfect before the wheat is sown, and to hasten this a liberal dressing of lime would not be out of place. This practice accords with my own experience of twenty years in the raising of wheat.

Mr. Joseph Wright, on land which had been two years in clover, hauled out manure in the winter, spread and plowed in early in the spring, turning the soil to cover the manure, and then as early as possible planted it in corn. As soon as the corn was in condition he cut and shocked it, plowed the land, giving it a thorough pulverization, and sowed wheat by October 10th. He raised on this corn land the past season $45\frac{1}{2}$ bushels per acre. After the fall sowing of wheat he seeded it with clover in the spring

with a small quantity of timothy seed to hold up the clover. His crop of corn yielded him 80 bushels per acre.

By reference to the schedule at the end of this work it will be observed that a great discrepancy exists as to the proper time of cutting. When seed is required it is the general belief that the wheat should be thoroughly ripe. For flour the proper time is thought to be just as the wheat passes out of the dough state. Millers prefer it thoroughly ripe, and when we consider that seed wheat is taken out of the general store, it is best to let it all get ripe alike. It has never been tried, but it certainly would be but little trouble for an experiment to be made in cultivating wheat seed as we do millet seed. An easy plan would be to double the distance of a drill, or rather stop every other tube so as to double the width of the rows, then in the early spring either cultivate with the same drill, or use a sub-soiler with an iron bar helve so as not to cover with soil. It would be interesting to know what would be the result of a few consecutive years of such cultivation on any given species of wheat.

We have said but little as to the pasturage of wheat but refer the reader to the schedule of answers. It sometimes may not show injury, but the cropping off the leaves given by nature for its sustenance does not seem at all beneficial. If very rank it may not hurt it, but it is yet to be proved that it benefits it.

WHEAT CULTURE.

The following letter is written by a citizen of Bradley county, who has made a great success in wheat culture :

Wheat is, perhaps, the most peculiar of all the grasses. It certainly is the most valuable, and admits of greater improvement and is subject to more accidents, diseases and attacks from parasites than any other cereal. To adapt its peculiarities to different soils and climates; to feed the plant with food that promotes the stalk and grain equally; to discover the cause and cure of the many diseases that prey upon it; to prevent the attacks of insects and accidents that come upon it; in fine, to manage the whole *to make it pay*, are questions not yet satisfactorily answered. He who has genuine

wheat land does not always make a crop remunerative, nor is he left out in the catalogue of failures. There is a culture, and that culture will be discovered sooner or later, that will obtain, and make wheat as much a success as it is now a failure. Science alone will develop the method of adapting the plant to soils and climates, so that almost every season it will produce a remunerative crop. So far as experience in wheat culture is concerned, it is quite limited. My partial success in producing fine grain is due entirely to a careful study of wants and demands of the plant, and persistent labor (carried out on the simple natural laws that govern each) in selecting and saving the seed.

Genuine wheat soil is the first requisite. Good seed the second. Ten dollars per acre, no less, will just about cover the expenses of preparing the land, sowing, reaping and threshing. Some farmers (?) think this exorbitant. Those who think so do not make their average reach ten bushels.

The soil first. Before turning under the green growing crop of weeds or clover, sow ten to thirty bushels of caustic lime per acre, or cut them low and after a few days drying, scatter straw and burn off clean. The lime prevents the weeds from souring the soil, assists decomposition, and the soil packs more rapidly. The ashes promote the growth and health of both plant and grain, and partially prevent rust. Light soils require less lime and much more care in the preparation. In applying manures from stables or cow stalls, they should never be scattered in the fresh or green state. The farmer loses too much. One load of manure taken as the base, will make from ten to fifteen of the most excellent compost, and will go at least as much further in producing good crops. This compost can be made up of elements found on every farm. One day each week, with a team and two hands, should be spent at the compost heap. It is the farmer's bank—his money is in it. At the rate of twenty loads of this should be scattered upon the land four or five months before the wheat is sown. After plowing, immediately harrow both ways and roll, and let the land rest until sowing, at which time harrow again and roll, then drill. In the short dry spell in February or March, when the dew is off, sow salt and ashes or salt and lime, harrow and roll again. This constitutes putting in wheat tolerably well.

The seed. It should never be taken from the bin. Seeds of all kinds *must be selected in the field*. The farmer can then select his best. Take that which is last, best and earliest ripe. For any choice seed pick by hand a bushel or two of center heads, and drill by hand on some fine spot of ground and take its product for your seed the next year. Hand-pick every year to relieve your crop of cockle, cheat and unhealthy grain. There is more money, and infinitely more satisfaction to the scientific farmer in this method of treating his seed, than any other he can possibly invent. Good seed sown properly in good soil, and well prepared, will make re-

munerative crops nine years out of every ten. It requires clean land to prevent the ravages of the fly; it requires early sowing to insure a good stand; it requires potash in some of its forms to prevent rust, even on elevated lands; it requires salt to stiffen the stalk and make the grain, and it requires a well-balanced head to make a wheat crop pay.

The varieties of wheat are quite numerous. Almost every one has its drawbacks. It may be more in the management of soil and seed than in the variety. I have for several years experimented with as many as 38 different varieties, giving each three years trial. None have I found to excel the Golden Straw—a beautiful, white, smooth variety, and much called for by the mills. It yields more under the same treatment, makes more flour, and ripens from four to ten days earlier than all others. I have certificates from thresher-men and millers, that its yield has reached this year as high as $67\frac{1}{4}$ and $68\frac{1}{4}$ bushels per acre, and that it produces as high as 48 pounds of flour in every 60. The weight of a struck bushel is $65\frac{1}{4}$ pounds. I have in this, given a very imperfect outline of my mode of wheat culture, which may be of some benefit to farmers.

A. E. BLUNT.

CLEVELAND, TENNESSEE.

Professor Nicholson, of the East Tennessee University, sends the following:

E. T. U. KNOXVILLE, TENN., COLLEGE OF AGRICULTURE, }
September 16, 1877. }

J. B. Killebrew, Commissioner of Agriculture, etc.:

DEAR SIR—I take the first opportunity to comply with my promise to write you concerning clover as a preparation for wheat. Observant farmers, in all parts of the world, where wheat and clover are grown, long since noted the fact that a clover sod was the best natural preparation for a good wheat crop. It has also been often noted that the yield of wheat was better when the clover crop had been grown for seed, than when the second crop was either turned under green or depastured by cattle. This fact is an exception to the general law that crops allowed to go to seed exhaust the land far more than they do when they are cut or removed at an earlier stage. I do not doubt that a comparison of the histories of the best wheat crops reported to you will confirm these observations.

The only attempt to explain the causes of the superiority of clover as a preparatory crop for wheat, with which I am acquainted, was made by Dr. Augustus Voelcker, chemist to the Royal Agricultural Society of England. The results of a long series of experiments were published in the journal of that Society for 1868. The report of Dr. Voelcker is long and elaborate, and would occupy probably more space than you would care to allow.

I therefore venture to summarize his conclusions, leaving out the chemical tests and experiments by which they were reached.

I assume, as proved by the elaborate, long-continued and oft-repeated experiment of Dawes & Gilbert, and others, that the wheat-producing capacity of a soil depends upon the amount of available nitrogenous matter that it contains.

By analyzing the soil from which the heaviest crops of clover have been taken, it is established :

1. That in the growth of clover a large amount of nitrogenous matter accumulates in the soil.

2. This accumulation is greatest in the surface soil, and is derived from decaying leaves, dropped during the growth of the clover, and from the great mass of root, containing when dry from $1\frac{1}{2}$ to 2 per cent. of nitrogen.

3. There are more and larger roots and more fallen leaves when the crop is allowed to go to seed than when it is cut for hay or pastured—in consequence, more nitrogen accumulates in a seed crop than in a hay crop.

4. When clover is pastured the young plants are checked in growth, less roots are formed, and less leaves fall than when the crop is allowed to grow for hay, hence the smaller amount of nitrogen left in pastured sod than in a mown sod, and as a consequence, the smaller yield of wheat.

5. It is highly probable that the rains wash from the air sufficient nitrogen to satisfy the requirements of an ordinary clover crop. The nitrogen of the clover crop left in the soil, is gradually converted into nitrates, which is the most available form for the use of the wheat plant.

I quote the practical conclusion of the report: "Indeed, no kind of manure can be compared in point of efficacy for wheat, to the manuring which the land gets in a really good crop of clover. The farmer who wishes to derive the full benefit from his clover lay, should plow it up for wheat as soon as possible in the autumn, and leave it in a rough state as long as it is admissable, in order that the air may find free access into the land, and the organic remains left in so much abundance in a good clover crop be changed into plant-food ; more especially, in other words, in order that the crude nitrogenous organic matter in the clover roots and decaying leaves may have time to become transformed into ammoniacal compounds, and these in the course of time into nitrates, which I am strongly inclined to think is the form in which nitrogen is assimilated, par excellence, by cereal crops, and in which, at all events, it is more efficacious than in any other state of combination wherein it may be used as a fertilizer."

"When the clover lay is plowed up early, the decay of the clover is sufficiently advanced by the time the young wheat plant stands in need of ready available nitrogenous food, and this being uniformly distributed

through the whole of the cultivated soil, is ready to benefit every single plant."

Dr. Voelcker, you know, stands at the very head of his profession, and there is no higher authority known in agricultural chemistry.

Very respectfully,

HUNTER NICHOLSON.

We might multiply instances of this kind for a hundred pages, but we have said enough to convince every one that on suitable land, with proper care, wheat raising will pay, and on poor land it will prove a disappointment to any one who attempts it.

CHAPTER XVII.

PEAS AS A RENOVATOR OF THE SOIL AND AS A FORE-RUNNER OF WHEAT.

It is well known that many green crops when turned under adds greatly to the fertility of the soil. Some green crops, however, seem especially adapted to prepare the soil for wheat. Among them we may mention red clover and peas. It is well known that wheat always grows kindly and yields profusely upon a clover lay. An ordinary clover crop upon an acre will contain, after drying :

Ammonia.....	52.00
Phosphoric acid.....	19.76
Sulphuric acid.....	7.50
Silica	18.65
Lime.	75.00
Magnesia.....	21.00
Potash	80.69

This turned under will supply plant food enough to grow a very heavy crop of wheat. Twenty-five bushels of wheat will weigh 1,500 pounds; the straw will weigh 3,000 pounds. The straw and wheat will abstract the following elements, supposing it to have been grown upon an acre :

	Grain.	Straw.	Total.
Ammonia	41.71	10 18	51.89
Phosphoric acid.....	15.00	11.10	26.10
Sulphuric acid.....	1.80	5.10	6.90
Silica	1.05	143.10	144.15
Lime	1 35	12.00	13.35
Magnesia.....	4.65	5.10	9.75
Potash	12.00	23.70	35.70

It will be observed by a comparison of the two tables that there is great similarity between the composition of the

ashes of wheat and clover, that every element necessary to the production of wheat is found developed profusely in the clover hay, to say nothing of the clover roots, which abound in the same substances. Two elements only are found in greater quantity in the wheat than in the clover hay, viz: silica and phosphoric acid. The first is nearly always found in excess in our soil, and the apparent deficiency of phosphoric acid is more than made up by the roots of the clover.

Clover restores fertility to exhausted soils by taking carbon from the atmosphere and causing elements in the soils to assume organic forms, thus rendering them available as plant food. The practice, however, of cutting and selling the clover hay before plowing up the land for wheat cannot be too strongly condemned. Clover, to do any good, must either be plowed under or fed out on the farm and the manure carefully saved and returned to the land. Frequent experiments have been made in the same field by taking the clover hay from a part and leaving it on the remainder. It almost always happens that the yield of wheat is greatest on the portion of the field where the clover was plowed under. And when it is otherwise it is due to the delay in turning over the clover sufficiently early to allow it to pass through the process of fermentation and decay before the sowing of the wheat.

A volume could be written on the benefits to be derived from the sowing of clover. It is enough for our present purpose to know that it unlocks the fertility of our soils, keeps them in good physical condition and greatly increases the yield of wheat.

Next to clover as a forerunner of wheat we may put peas. Sown broad-cast and turned under when in flower, they have been known to increase the yield of wheat from four to six bushels per acre. The following letter from the Hon. H. M. Polk is conclusive as to the value of this crop as a fertilizer, and no better service could be done to the agricul-

ture of Tennessee than to induce our farmers to sow largely of this crop. In addition to the manurial value of peas, they contain a large amount of flesh-forming principles. Analysis shows 22.4 parts of albuminoids and 53.3 of carbo-hydrates in 100. Hogs can be fattened upon them, and cattle can subsist upon the hardier varieties, sown in the corn fields at the last plowing, almost during the entire winter. But to the letter of Mr. Polk :

BOLIVAR, TENN., Aug., 1877.

Col. J. B. Killebrew:

DEAR SIR—I am in receipt of your request, communicated through our mutual friend, Col. M. T. Polk, to write an article on “the field pea, its manurial qualities, and its capacity as a permanent renovator of the soil.” This is intended to accompany, simply as an addendum, a treatise upon “Wheat Culture in Tennessee.”

The importance of the field pea as a collector and depositor of plant food in the surface soil, to meet the future wants of a heavy wheat (or other cereal) crop, has never been fully appreciated even by our most thoughtful planters. And, although the pea cannot perform miracles, in the common acceptance of the term, yet it can, on most soils, assure a heavy wheat crop *annually* from the same ground, and at the same time improve the soil. This, at least, is practicable whenever wheat is made to follow oats, wheat or rye; for in this case, time sufficient is allowed, from the removing the small grain crop in June, to that of sowing wheat (from the middle of October to the first of November), to intervene with a renovating crop of peas.

A good lay of pea vines (grown upon the spring stubble) plowed under from the first to the tenth of October, will not only restore the elements of fertility abstracted from the soil by the preceding crop in the spring, but will collect and deposit therein more than a sufficient amount of plant food necessary for the demands of the succeeding wheat crop. It may be contended this too persistent call for the same elements, in the same soil, *annually*, cannot but eventually result in injury to the soil. Under our ordinary tillage, (which ignores feeding the soil), this would be true; but where an intervening crop of peas returns the plant food abstracted by the previous crop, and in addition thereto stores away the pabulum required by the succeeding crop, we cannot preceive the dangers to be feared from such a practice. The various elements necessary to a vigorous and healthy growth of wheat, are, through the pea lay, in the incredibly short period of seventy-five days, restored to and husbanded in the soil for a generous yield of the incoming crop. Not even soluble siliceous matter is overlooked in this statement, as we may rely upon the small amount returned in the pea

vine, a portion also given back in the small grain stubble plowed under when the peas were sown, and super added thereto, the abundance of this particular substance ever present in our silicious soil.

I said the field pea could not perform miracles. It is not a panacea for all the evils resulting from defective tillage, neither can it claim to introduce into a soil, defective in a particular element, that which the pea itself does not possess. For such an impossible requirement no one vegetable or animal manure is competent. The intelligent farmer must find out what is wanting, and apply the particular manure calculated to remedy the defect.

Husbandry also should be made to repair many of the evils resulting from defective tillage. Chief among these, (and far surpassing them all in magnitude), is the annual leaching out the fertilizing elements through the shallow culture so universally practiced. But I can neither discuss this nor such other calamities as must result from a total neglect to return one generous shovelful of manure to land from which the elements of fertility have been annually abstracted; nor the fact that a rational rotation is altogether ignored; nor the unwisdom of relying on one crop alone, thereby taking year after year the same elements from the same soil, until it is made deficient in some one or more of the many substances necessary to healthy and vigorous plant life. I must not turn aside to discuss these evils, but shall confine my remarks to the pea in connection with wheat culture, and as a renovator of our worn lands. We have shown that the pea, as an intervening crop with small grain in the spring and wheat in the fall, can and does restore to the land a liberal supply of plant food for the following wheat crop. But on other parts of the farm occupied by cotton, corn, tobacco, etc., (which require the better part of the year to mature), peas *cannot* be made an annual intervening crop. This, then, brings us squarely up to the *first great principle* in farming—*rotation of crops with the purpose of feeding the soil.*

In a three years rotation of cotton and corn with peas and oats, or other crop, it is asserted by many farmers that the peas sown with the corn will restore to the earth in one year an equivalent for the plant food abstracted by the other two crops. But when the object is to feed the soil abundantly for renovation, at the same time that we expect to secure heavy yields of the cereals, it is necessary to adopt at least a five years rotation, in two years of which more plant food shall be put back into the soil than will be abstracted by the other three (so-called) money crops. Here is the whole secret of successful farming in a nutshell.

England not only rotates and feeds her soil, but *imports* plant food. We extract and impoverish and *export* plant food. How does our soil of eighty years culture compare with her soil, cropped about one thousand years? Peas and clover, aided by what manure we can manufacture, are the great agents to recuperate and build up our soil, that it may be able to

supply in future the heavy demands of a population as dense as that of the European States. Let us illustrate the exhausting process:

The earth is the farmer's bank. If he has \$10,000 in it, represented by the natural fertility of the soil, and should draw therefrom \$1,000 annually, at the same time refusing to replenish the original capital, how long will it be before the bank will dishonor his drafts? The sum is too simple to require a demonstration. The farmer appears to be, however, obstinately bent on trying to convince himself that even under this senseless practice his drafts will continue to be honored forever. He is absolutely sublime on the *annual draw*. It would seem that experience might have taught him that his exhaustive practice would eventually close the doors against him; that his capital must soon be all used up, and that want even now threatens him from a quarter where plenty and prosperity could easily have been assured. He seems to be desirous of emulating the profound wisdom of the fellow (he must have been a Southern farmer) who killed the goose for the golden eggs. Were it not for the disastrous effects such practice must have upon the interests of posterity and the future welfare of our State, we might with more patience await the working out *upon this line* the problem in its bearing upon the material prosperity of the men of the present generation.

If we cannot induce our neighbors to adopt a judicious system of rotation, let us at least urge them to avail themselves as far as possible of the pea and clover as renovating crops. We have not the tithe of the stock in our portion of the State necessary to keep our arable lands in good heart by animal manure alone; nor are we prepared, under our present mode of farming, (in which husbandry has but little part), to subsist that amount of stock through one winter.

For the renovation of our broad acres then, we must look to green crop turned under. The size of our farms forbids us to hope to accomplish this with animal manure. We have to our hand the very best of agents to accomplish this great work. The farmers in the wheat region northwest of the Ohio river can avail themselves of clover only as a renovating crop. They are denied the benefits springing from the field pea. This is a child of the South. Its value to us is beyond estimate. Questions of tariff, internal improvements, contraction or expansion of the currency, demonetization of silver, all sink into insignificance when contrasted with the results flowing from the utilization or neglect of the field pea in agriculture, as an agent bearing upon the future prosperity and happiness of the people of the South.

In our latitude the pea goes hand-in-hand with clover. South of us it stands alone, and is destined to have the all honor of rebuilding that section of the country, if its prosperity is ever restored. There is no portion of the world so favored with such rich vegetable substances to renovate its arable lands as the particular latitude of our own State. And, shall we

confess it? No portion of the civilized world (except the cotton accursed region south of us), where farmers have so little availed themselves of the means at hand to keep in good heart, and to enrich their soils.

Deterioration is the curse stealing over our soils, abroad as well as at home. Even the deep, rich soils of Illinois, Ohio, and the other great wheat-producing States of the northwest are manifesting this lamentable truth. And it is now accepted as a fact, that, in this region the wheat-producer is annually becoming poorer, while the stock-raiser (and his land) are yearly growing richer. True, they are deprived of the best of all preparations for a wheat crop, the field pea, but they have clover. And in ratio to the decrease in the number of acres annually given to this crop, may be measured with infallible certainty, the decrease in yield of their wheat crop per acre. And what is much worse, the waning capacity of their lands for the production of future heavy crops.

We cannot, with impunity, long ignore in practice the fundamental truth in agriculture, that *the earth must be fed* to continue to give us bounteous harvests. It cannot be too often repeated, that rotation with the purpose of feeding the land, gives plenteousness; annual abstractions, with no equivalent return, brings ruin.

The farmer has been calling inexorably for the same elements of fertility in the same soil, with the same unvarying crop, never replenishing the soil until his famished ground has failed to "give up her increase," and the bankrupt landowner finds, too late, that he has really been living on his capital, instead of its interest, as he supposed. In short, he has entirely exhausted his soil. This he cannot understand. Of course the fault does not lie at his door; no, he is a hard-working man, and as everybody knows, gets all out of the earth which he is able to extract. He could not, for the life of him, tell who hit Billy Patterson. Not he! This man has never even risen to the intellectual level of the astonished Dutchman, who, with elevated hands and with uncertainty, doubt and wonder faintly expressed upon his stolid countenance, he exclaimed, "mein Gott! I drive dis wagon two thousand mile, and he never broke down before!" Why a wagon that has accomplished so much, and was thereby fitting itself daily to perform *more and greater work*, should not drive on to all eternity, was what our astonished Teuton could not understand. "And that's what's the matter with Hannah," generally in agriculture. We are all of us blind, and when we attempt to lead each other, we generally tumble "into the ditch." I feel that I am never out of the slough of despond. It is absolutely startling to think that agriculture, the great wealth producing agent of the State—the art of arts—the mainspring of civilization, refinement and progress, should be engineered by a reckless indifference which would disgrace any other calling whereby men are named or known. It amounts to an astonishingly stupendous evil, with results as wide-spreading as our loved south-land, and as far-reaching in its desolating effects as the interests of our remotest posterity.

Some of the great advantages possessed by the pea as a renovator, are:

1. Its mechanical effect upon the soils.
2. The very short time in which it perfects a heavy lay of vines for being turned under.
3. (Resulting from the above fact) its capacity for being made an intervening feeder following oats, rye, barley, with most of the root crops preceding a crop of wheat in the fall.
4. The great richness of the pea in the very manures required by wheat and other cereal crops.
5. Its capacity for growing upon land too poor to subsist clover.
6. Its capacity to put more plant-food in the earth, (and at the same time produce more animal food,) than any vegetable substance known, not excepting clover, (allowing two years to one crop of clover and four crops of peas.)
7. The large addition made to humus upon which the tilth, as well as the capacity of the soil for retaining moisture so greatly depends.

What pea is best to sow as a renovator of the soil? They are all equally rich in plant-food. For our purpose, we will distinguish between them as the bunch pea and rampant runners. The best variety to select is that which runs least. The common black pea, the clay pea and the cow pea, are immense runners. A heavy lay of these peas is difficult to plow under. A heavy roller passed over it when the pea is in the green state, followed by the best of our two horse plows, armed with a sharp rolling coulter (kept sharp) and set deep enough to sever the vines, would no doubt greatly facilitate the operation. This difficulty may be avoided by sowing the speckle pea known as the whippoorwill; a still better pea, perhaps, is the bunch black pea. Either of these will give a heavy lay of vines, which can be turned under very readily. They each further possess the additional value of maturing more rapidly than the rampant runners, and are, therefore, the sooner ready to be turned under when sown as a manuring crop between small grain removed in June, and a wheat crop in autumn.

A light application of caustic lime to the vines before plowing under, will promote decay in the covered up lay, and enable the soil to become sooner "firmed"—an important point before sowing wheat upon the same soil, and unless done by rain, should certainly be done by the roller, before, and after sowing.

The lime will further neutralize the superabundance of vegetable acid produced by fermentation of the vines, and *will also put a desirable mineral manure* in the soil. This last is certainly needed in our West Tennessee siliceous soils. A few practical facts showing the manurial capacity of the pea, preparatory to a wheat, cotton or other crop, will have more weight with farmers than anything in the way of argument, or deduction based upon known scientific facts.

The average yield of wheat upon our leached and impoverished soil in Hardeman county is about six bushels per acre. This year the yield is larger because but little of our wheat is on land which has been run a length of time in cotton. The yield per acre is greater than in Middle or East Tennessee, up to date of the present year, as shown by your report. Now, one crop of pea vines turned in upon our partially exhausted soils brings the yield up from 6 to 10 or 12 bushels per acre.

The wheat crops in this portion of West Tennessee are often nearly doubled by the additional supply of plant-food thus given. Now let two crops of pea vines be returned to the soil in one year, before sowing wheat upon the same, would it be expecting too much to look for a still further increase upon this land of 3 or 4 bushels more, bringing the yield up to 15 bushels per acre? A sufficiency of plant-food has certainly been put into the soil to justify this expectation. And as sure as the capacity to produce crops, is measured by the quantity of plant food put into the soil, (contingent, to some extent, upon propitious or unpropitious seasons) just so certain, and so proportioned, will be the return of grain gathered by the husbandman from the ground.

Take one step farther in manuring, and add to this double pea lay a light application of cotton seed, superphosphate and salt, and there is no reason to doubt that, with this adjunct, the yield would be brought up to 25 or 30 bushels per acre. Will not this increase of grain pay largely upon the trifling cost of these additional manures

Let me tell you of a crop of wheat near here, raised upon land in which there was probably not more than one element necessary to wheat wanting, in an otherwise rich soil. The wheat grew about four and a half feet high, stood well upon the ground, and apparently promised 30 bushels per acre. No rust, and the season favorable. From this ground 10 bushels only of indifferent wheat was harvested. This ground, thought to be rich, was undoubtedly deficient in phosphoric acid. A pea lay preceeding the wheat, or a small addition of superphosphate would have cured the evil and given probably 30 bushels of good wheat.

The corroboration of the following facts illustrating the manurial effect of the pea upon wheat and other crops, let me refer you to the Master of the County Grange of Hardeman county, Mr. Wm. A. Caruthers, one of our most intelligent farmers. The first is a widow's crop. From three acres of good land enriched by plowing under a heavy pea lay 107 bushels of wheat was gathered. Rate, 35 $\frac{2}{3}$ bushels per acre.

Mr. Caruthers' crops of wheat usually give him from 15 to 20 bushels upon medium land in which a pea lay has been plowed. Upon his worn broom-sedge land he plows up the sedge, sows peas, and here fattens his hogs, thus preparing the land for a future wheat crop.

Another intelligent planter of Hardeman County claims this year to have measured up 33 bushels of wheat per acre upon land given two

years to clover, and a good afterneath plowed under. Again, on 18 acres of ground near the town of Bolivar, an average of twenty bushels per acre was taken from the land. This crop was spotted, and good judges thought that portions of the field, where the green crop plowed under had been heaviest, yielded thirty-five bushels per acre. The ground had been two years in clover. The summer the third year it was taken by ragweed. This was so heavy upon certain portions of the ground that the plow could make no headway until a heavy log was drawn over it, attached to the wheels of a wagon. Where the clover and weed crop were heaviest the yield of wheat was largest.

The capacity of production being proportional to the amount of plant-food put into the earth is plainly illustrated by the difference in the yield from different acres on this field, all treated alike in the cultivation.

We could also refer to a very prosperous farmer near us whose success in farming is probably due more to the renovating quality of the pea than any superiority of judgment in tillage. Ten years ago his lands were thin and worn. They are now fifty per cent. better than when he purchased them. He has never sown any clover, but relies entirely on the pea; and where he has brought up the producing capacity of his land until it now conceded he makes better crops of wheat, cotton, corn and meat than any of his neighbors. In 1873 he sowed peas broadcast upon a field of fourteen acres planted in corn. 1874 this field was planted in cotton. He picked from these 14 acres ten bales of cotton averaging per bale $12\frac{1}{2}$ pounds of ginned cotton.

I could multiply instances to prove that the only farmers in this part of the State who are making any money, are those who have adopted a judicious system of rotation looking to feeding the soil.

A few facts connected with green crops as a renovator of the soil, from the highest agricultural authority, and eminently true, when considered in connection with the pea, will give ample reasons why a pea lay should never be divorced from its fitting connection with wheat culture.

"Peas contain a much larger proportion of alkali than wheat, and hence should be resorted to as a preparation for that crop." Again, "green crop requires but a small portion of the inorganic substances in the earth for its substance, and hence it leaves more of them for the succeeding crop."

"The additional amount of vegetable matter and manure which green crop introduces into the soil, and the large amount of inorganic matter brought up by deeply penetrating roots from below" are strong recommendations of clover and peas.

Again let me add: That the pea and clover excel all other green crops in fertilizing elements, these two trefoils far excel all other vegetable productions in capacity to seize and appropriate the valuable fertilizing gases the great manure depot above us—the atmosphere.

"When vegetable matter is allowed to decay in the open air, it is resolved more or less completely into carbonic acid, which escapes into the air and is so far lost. But when buried beneath the surface, this formation of carbonic acid proceeds less rapidly, and other compounds preparatory to the final resolution into carbonic acid and water are produced in greater quantity and linger in the soil."

We are told by Bousingault and other authorities, that the theoretical value of different vegetable substances "depend mainly upon the relative proportions of nitrogen they contain." The pea and cotton seed are rich in nitrogen, besides phosphoric acid, potash, and the elements of ammonia. It is useless to say more of the pea in connection with wheat culture. I will only add, that the value of vegetable substances as manures depend "not only upon the nitrogen mainly which they contain," but "the quantity and kind of inorganic matter they contain." Taking farm-yard manure (composed of droppings from stock and refuse litter) as a standard, Johnson arranges vegetable manures as follows:

Equal effects are produced by

Farm-yard manure.....	1,000 pounds
Potato and turnip tops.....	750 "
Carrot tops.....	470 "
Clover roots (peas as good).....	250 "

Inorganic manures,

Farm yard.....	1,000 "
Pea straw (English).....	220 "
Wheat straw.....	750 to 1,700 "
Oat straw.....	1,400 "
Wheat chaff.....	470 "

Tru'y your friend,

H. M. POLK.

CHAPTER XVIII.

COST OF CULTIVATING WHEAT—OLD METHOD OF HARVESTING.

It will be seen in the records of various correspondence there is a great difference in the estimate of cost of culture and garnering an acre of wheat. This discrepancy is due to several causes. In the first place, some farmers expend far more work in the preparation than others. While some are content to sow their wheat on the land broadcast, and plow it in, others will break it up and harrow it in, and still others will break up in July or August, and re-break in October, rolling and harrowing it until it is thoroughly pulverized, and a few, in addition to all this, will put several dollar's worth of manures on the field. All this involves variations in their estimates of expense, and it is a legitimate difference in opinion. We think the following a fair estimate of all the absolutely necessary expense to raise an acre of wheat, presuming that the land is clover or stubble. Before giving it, however, another consideration that will make the estimate look less formidable, is that the farmer receives all this outlay himself. If a man sets down to a calculation, and becomes frightened at a huge array of figures, and cannot see his profit beyond them, he will never achieve success as a farmer. He must work as cheaply as possible, save at every point, but not stint the land. It is a poor economy that will make a man put off work essential to the success of his crop, because he gets no immediate return. If justice is done to the soil, the soil will do justice to the farmer. Here is an estimate, exclusive of manures, as no fair consideration is made of the necessity for them, some land requiring them absolutely, others, from clover, peas, etc., being in a fair condition to do without their use. One more

thing. This estimate is made for the average limestone land. Now, some lands require much more work to put it in proper tilth than others. A stiff, unyielding clay, will have to be gone over oftener than a light, porous, silicious soil; one heavily clothed with weeds, than one closely cropped of all verdure. These considerations must enter into our calculations.

Breaking land in August, per acre.....	\$1 00
Re-breaking land in October, per acre.....	1 00
Harrowing thoroughly once.....	25
Drilling (supposing you have none).....	50
Seed, $\frac{3}{4}$ bushel per acre.....	1 00
Harvesting, per acre.....	1 00
Threshing, toll, etc.....	2 50
Feeding hands, etc.....	75
Rent of land at grain rates.....	2 00
Total expenses for one acre wheat.....	<u>\$10 00</u>

Now, for the balance to this expense there will be, in the first place, a fair price for the work in preparing the land. The farmer sells at his house food for man and horse, all of which goes into his own pocket. If he owns the drill, reaper and thresher, there is no outlay for those expenses; and, in fact, if he is a large farmer, his own hands will do all the work, and if they were not at this they would have to be paid. The farmer gets rent for his own land, and really the only thing he is obliged to absolutely lose is the seed, and the wear and tear of machines. But this estimate is made for all, and the small farmer has the expense of the machines to come out of his receipts, and rent of land to pay. With this preparation, however, he is almost sure of from twenty to thirty bushels of wheat, wherewith to pay his expenses. Taking into consideration the number of acres of land a farmer is able to cultivate, it will pay more in the aggregate than corn, oats, or, unless he understands it, and is prepared for its culture, tobacco. Besides, the land is not losing its vitality. Wheat after wheat can be raised without apparent injury to the land, provided it is

occasionally manured. Horace Greeley knew a field sowed in wheat consecutively sixty years, and the last crop raised on it was the best.

One word as to machines. We all remember the day when harvesting was looked forward to as a day of frolic. Each farmer cultivated just enough to do him, and sow, and barely that. A man who owned slaves would cut it himself, but in a neighborhood "where all did their own work," the farmers would club together and go from house to house, and with coats off and ponderous cradles on shoulder, march into the field, each cradler with his partner to tie behind him. Besides these, was an old man with two or three boys to "shock and bring water, etc." The wheat harvest was generally wound up with a dance. In a few days a circular space was cleaned off from grass, weeds, and loose soil, and swept clean. It would be like a circus-ring, and then hauling up his wheat, loosen the ties, and set the bundles on end, butt down, and leaving a small space in the center. This was the boy's time, and mounted on the heavy mares, with colts following, he would ride as proudly into the ring as ever belted knight couched lance at tournament. If there was on the place a colt to break, great contention was had as to who should ride him, for here was a chance to be thrown, and no injury to him who fell on this yielding bank of straw. Round and round they would go, only diversified by taking off, tossing up the straw, to separate the wheat, throwing off that which was free of grain, and putting on more. One stood in the open center to toss with a pitchfork that which was not being well tramped, and when it was finished, and all the straw cast off, a thick layer of wheat was left. This had to be fanned, and the old rattletraps of that day, home-made mostly, flapped, flapped away, at the rate of five bushels the hour, until the job was completed. This was stored in hogs-heads, or rather a hogshhead, for few had more than one.

After awhile threshers, located in a barn or outhouse, took the place of threshing-floors, just as threshing-floors

followed the flail. It was an easy jump from stationary to movable threshers, and the "ground-hog" was born. This was a great improvement, for these ground-hogs could, by being well driven, thresh out two hundred bushels a day. This increased work was followed by improvements in fans that could keep pace with the former, and then the happy thought occurred of combining the two. It was hard work for horses and men, in those hot, sultry days, to pull the power and turn the fan; and when steam was introduced, though it met with some opposition, it at once jumped into public favor. Of course, there are still some of the primitive threshers yet used, and most of the threshers are still driven by horses, but they are wearing out, and, with few exceptions, will never be renewed. Steam is tireless, and works well in hot or cold weather, and few farmers would prefer to feed fifteen or twenty horses to do what fire and water will do better.

The march from cradles to reapers has been slower, but none the less sure. Much of this is due to the expensiveness and frail make-up of the reapers. But the exorbitant demands of harvesters for labor has, within a few years, given a great impetus to the introduction of these labor-saving machines. And when, last year, we visited the field of a farmer, and saw a self-binding reaper doing the work of six men, and doing it better and more unerringly than any human being could, we became convinced the new birth of labor-saving machines had taken place. This reaper was followed by two men to shock, and that was all.

There are many reapers sent out by various factors, and each make has its adherents. The one a man uses is his favorite, which is conclusive of the general good of them all. They *are* all good. We cannot do without them; and the time will soon arrive when, with a self-reaper, a farmer with one or two boys can cut and shock his own wheat, and thus save himself from that dreaded cleaning out of pockets the harvest-time brings.

But, in the meantime, the good old cradle cannot be spared. Fence corners, rocky ledges, around stumps, in new ground, the reaper would not go. People have to adapt themselves to circumstances. During the war, in the far South the people, having no cradles, or even sickles, actually pulled up the wheat as they pull up flax. Still, reapers are better. Another new invention has lately come into vogue, and that is the horse-rake. When we used as children to read, in the good old Book of books, the story of Ruth gleaning in the fields of Boaz, we thought she was doing a very poor business, and her chance of making a living for herself and Naomi a very precarious one. But the invention and use of horse-rakes demonstrates it to be a first-class paying business. Mr. Wm. P. Campbell says, in his most excellent letter, that he gets two or three bushels per acre. Numerous instances have occurred in which from one to two bushels have been secured. Where a field is situated so as to be used as a pasture, this saving is not of so much moment, as hogs thrive well on it; but it often happens that, from various causes, advantage cannot be taken of this, and the grain is lost. The careful farmer will see to it that the utmost economy is used. To be careful is not to be stingy; and he who will save at all the usual waste places can afford to supply himself with all the conveniences that make farming not only profitable, but pleasant. Every farmer should endeavor, as soon as possible, to use his own drill, reaper, mower and thresher. Should his crop not be large enough to justify him, he may get to use them for less provident neighbors, and thus lessen his expense.

CHAPTER XIX.

DISEASES OF WHEAT AND THEIR REMEDIES.

Fortunately for the Tennessee farmer, the catalogue of insects is very small compared with that of our Northern brethren. It will be unnecessary to enlarge on this subject, but confine ourselves to a simple enumeration of the insects injurious to wheat, except those that have invaded our State. These we shall notice more carefully.

As to the diseases to which wheat is liable, we can claim no exemption, having unfortunately experienced them all, either from ignorance or carelessness, and to remedy these evils as far as practicable shall be the object of this chapter.

Often a farmer sows a field of wheat in the most approved manner, and the field presents a most charming aspect through the season, and he has every hope of being well remunerated for his labor. This is too often only a promise to the eye, to be broken to the hope, for when harvest begins his prospects are all gone. Blight is on the field, and losses follow instead of gain. Unfortunately many of the insects and diseases to which wheat is subject have hitherto defied the efforts of all remedies. In this case a knowledge of the character, habits and origin of these evils leads observing persons to give thought to the subject, and by close observation and research some one of them may be able to discover methods more successful than heretofore used. Some of the causes that are deleterious to wheat are, to a certain extent, under the control of the farmer. Others are not, but by understanding whence the evil comes, though not able to overcome it, he can so arrange his plans as not to be affected by it. We all remember the time when we were

powerless before the ravages of smut. We saw the wheat wasted and destroyed by this fungus. We saw the bread looking blue with an offensive odor, and yet we could not avoid it. Now this vile disease is perfectly under the control of the farmer, and only a criminal negligence will allow him to suffer from it. So with the Hessian Fly. Before its nature and habits were studied the wheat fields were often devastated, and a man simply had to trust to luck. Now, since its habits have been developed, no one will suffer from it unless he still trusts to luck. If study and observation have been sufficient to protect the farmer in these instances, may not a prosecution of these enquiries finally result in eliminating the whole list of disasters from the farm?

There are many causes affecting deleteriously the wheat crop. For convenience they may be divided into terrestrial, atmospheric, agricultural and constitutional; and we will explain in a few words the definition of these terms:

Terrestrial causes are those that appertain to the soil, its capacity to grow wheat, and its changes either from additions by accident or intention.

Atmospheric causes are those that are the results of climatic influences. For instance, one year is called a good wheat year, and another bad—one year too much rain and heat, another too much drought. These climatic influences, as all know, greatly affect the welfare of crops of all kinds.

Agricultural causes are wholly within the control of the farmer, as they include the preparation of the soil and the process of cultivation, harvesting and storing wheat.

Constitutional causes are those which, through disease or insects, affect the plant. These causes of destruction or injury are, to a limited extent, under the control of the agriculturist, and it is to these the especial attention of every one is called.

We have in the preceding pages of this report discussed the terrestrial causes of injury, and noted the remedies in most cases, which are deep plowing, draining where necessary,

thorough tilth, such additions to the soil as seem to be required, time of sowing, selection of seed, and in fact all the preparatory processes requisite on the part of the farmer. These matters have only to be referred to, to see the views taken, and what deficiencies of the soil are to be supplied.

Atmospheric causes are so far removed from the control of man that he can only, by a proper observance of previous years, so mark the times and seasons as to take advantage of them, and by regulating the times of sowing and harvesting, avoid the ills as much as possible. Among the principal of these causes are late or untimely spring frosts, storms, hail, excessive rains, sudden changes of weather, etc. After long cool rains in the spring on rich land the wheat stalks sometimes become yellow, and many of them die. This is

Jaundice, and can be prevented by providing a way for the super-abundant moisture to leave the ground. The remedy is draining. If the land is too stiff, and holds water in excess, manure plowed in, or any thing to make the soil porous, will afford relief.

Blight.—This is a withered condition of the grain caused by dry weather just before ripening, after a strong, vigorous growth, from frequent rains. The dry weather has caused the grains to mature so rapidly the starch and gluten do not have time to fill the grain. This is unavoidable, and we can suggest no remedy.

Lodging.—When storms blow, the stalks bend before them, or break at or near the roots. All that bend, relieved of the rain drops, will become erect, but those that break fall to the ground, weeds grow up, and rust invariably attacks them, and the wheat is lost. This often results from wheat being sown on moist, rich land, deficient in silica. The stalks are large but watery, and easily broken. Nothing but draining and thorough cultivation will obviate this. It is better to avoid sowing on wet alluvial lands, unless well drained. Where a locality is liable to the

prevalence of storms, varieties of wheat with strong short straw only should be sown. But we have already sufficiently dilated on this subject in the preceding pages, and will at once proceed to discuss the

Agricultural Causes.—We have, in the whole of this report, adverted to the various agricultural appliances necessary to produce good wheat, also the causes of failure and the remedies. We have given the composition of the soils and their deficiencies, the preparation and sowing—in fact all the means by which the farmer might be benefited. One thing only is omitted of consequence, and this properly comes under the head of agricultural causes, and that is *germination of wheat in the shock*. When we remember that only last year the wheat crop was greatly injured by continued rains, and when we reflect that this is only one instance of many in the recollection of every one, this subject merits more than mere mention. Especially is this the case when we know that the remedy is wholly within the control of the farmer. In order to produce germination there must be heat and moisture. These two must be conjoined or there will be no sprouted wheat. After sprouting, wheat is nearly worthless, both for bread and seed. Therefore, it is but right and proper to provide against such a contingency. In the first place, if grain is just passed the dough state when cut, it will continue to fill up for a few days from the straw, and, until full maturity takes place, it will not sprout. That this method is preferred by many may be seen by reference to the appendix. The grain should never be allowed to remain on the ground exposed to the moisture of the earth, the dews, and the heat of the sun. It should at once be placed in such a position as to prevent the influence of moisture and favor drying. If properly shocked, it will remain safe from sprouting for an indefinite length of time. Almost every farmer has his favorite plan for shocking wheat; the conical, the diamond, the square and the hand stacks are all practiced. The conical shocks or

Dutch oven, are undoubtedly the best, and are easily made, and will protect the wheat as long as required. They are made by setting up four bundles, and around these four more, and then around four others, filling up spaces, until you have twelve bundles set up; then slip the bind to the butt end of a large bundle and, opening it out, spread it like a tent all around the shock so as to hide from view all the heads. Then gather the butts of the covering bundles into a close point and bind it with straw. Pull the cover down on the heads well, and this shock will withstand moisture and winds. It will also be ventilated sufficiently to prevent moulding.

Wheat is usually threshed from the shock, the wagoners hauling up as fast as it is threshed. I am by no means certain that this is the best method. When well stacked there are several advantages to be derived. One is that the farmer can wait until the price suits him, for it is a matter of regret that but few farmers in our State are provided with granaries, so that they are forced to sell at the time of threshing or suffer a greater loss from wastage on their wheat, or pay a considerable amount to a wheat merchant for storage. Another advantage from stacking is, that the wheat goes through a sweat and will keep much better, and is not so liable to the attacks of weevil.

But stacking wheat is a difficult thing to do well, and no novice should ever be put to this task. Of all grain, it is the most difficult to stack well. The middle of the stack must be kept well raised or else the beating rains will drive into the stack and greatly injure the grain. Having adverted sufficiently to these causes here and in the previous part of this report, we will now briefly consider the last, or

Constitutional causes, prejudicial to wheat. This head includes diseases of wheat and insects affecting it. Some of these are remediable, but unfortunately most of them are not, in the present state of our knowledge.

Vegetable Parasites.—If the reader will refer to the first part of our work, he will see that we divide the vegetable kingdom into two grand divisions. One, the *Phenogams*, that are propagated by seeds, and the other *Cryptogams*, or those having no visible seeds, but are propagated by spores. It is the latter class to which I now wish to call attention. Had it not been for the invention of magnifying glasses, we never could have known the nature of the *Cryptogams*, but by the aid of the glass we know that this humble class of vegetation has an organization, birth, life and death very similar to other plants. It has its flowers, roots, branches, seeds, etc., and though minute, are perfect in all their parts. Mushroom, puff balls, mould, mildew, rust, smut, and various others of the kind are samples of *Cryptogams*. Some of these parasites live at the expense of the plant upon which they fasten, as mistletoe, mould and many of the mushrooms. The seeds of these parasites are called spores, which are a mere dust, microscopic in character generally, and are blown by the winds to their place of reproduction, or hide themselves in the fine hairs of seeds, or in their follicular mouths, and remain ready to germinate when moisture and heat are applied. Some of these parasites select wheat as their place of concealment and growth, and are so exceedingly injurious to the farmer that the attention of scientific men has been turned to them for years, trying to devise some means for their eradication. We will first consider

Mildew—Scab, Spot.—Sometimes, in moist, warm days, this proves very destructive to wheat, coming at the time of maturity, just as everything is promising to the farmer. It is the same that forms a mould on cloth exposed to heat and moisture, and forms whitish patches on cloth or plants. This disease does not often appear in Tennessee, being, however, common in the colder Northern States. There is no remedy for it. It is a parasite that forms on, or rather under, the cuticle of the leaf, and

forms a dark colored scab on it, and this will soon destroy the leaf, or stem if located on it. It is called scab in some localities, and in others spot.

Caries or *Black Wheat*.—This is a fungous mushroom called *Uredo*, and is often mistaken for smut, which it greatly resembles. A marked distinction between them is that while a part only of the head, or even of a grain, may be affected with caries, it is not often the case with smut, the latter generally involving not only the whole head, but all the heads of one stool. The spores of this and other mushrooms of the same kind cling to the furs of a grain of wheat, and go into the ground with it. It is there taken up with the nourishment of the plant and passes into the body. When the head forms, the spores that have increased and traversed every part of the plant, now attack the grain, and the juices that are brought up to feed and develop the grain are absorbed by this voracious parasite, and it, growing with nourishment, soon fills the places designed to contain the berry. There is another marked difference between smut and caries. While the smut emits no odor whatever, the caries smells very disagreeable—like a spoiled fish. Bread made with caries in it will give that smell when broken open while hot. Smut can be knocked off by mills, but caries, being more tenacious, is not to be got rid of that way, and will stick to the wheat with any treatment short of washing, and imparts its odor to the bread. The stalk looks like a smut stalk except being deeper green than others, but later on it becomes tarnished. The heads are bluish, larger, and more bristly, and the substance blackish and greasy to the fingers. The same remedy as that applied for smut is equally effective, viz: blue vitriol or bluestone, (sulphate of copper). The most approved method is to dissolve two pounds of bluestone in two gallons of water and sprinkle this mixture on five bushels of wheat until it is thoroughly wet, then dry and sow, or sow without drying. This not only destroys the

spores of the mushroom, but it also destroys all diseased grains, and so lets the whole crop come up healthy; and besides, it protects the seed from insects and birds, the bluestone, being poisonous, kills insects easily. Another equally effectual way is to dampen the pile with salt water, and then sprinkle it with air-slacked lime. This also acts as a fertilizer.

Smut, like caries, is a parasite mushroom, and destroys and replaces the organs in which it is developed. Sometimes it attacks the leaves and stems, but generally the grains. It not only infests wheat but oats, barley and corn. The stalks are not easily distinguished in the field from those that are sound, except being a little paler and of a less height. Before ripe, the heads are of a grayish color, and as they ripen they become a dingy black. When broken, smut is a black powder and without smell. The sporules are very small and are produced within the plant, being carried there from the grain by means of the sap. Sometimes a large proportion of the field is smut, as much as two-thirds sometimes being involved. It attacks wheat in wet or dry weather alike, and on all kinds of soil. When a field has been affected with smut one year, it is very apt to be affected the next, as the sporules are scattered from the affected grain and remain in the soil growing, and pass thence into the next crop, even where the wheat has been treated with bluestone. The spores are not injurious to man when taken in as food, nor is the straw injurious to cattle. The same treatment that is used for caries is good for smut, namely: bluestone, salt and lime. By reference to the description of caries the reader will get all the necessary information on the subject.

Rust, like the others, belongs to the family of mushroom, and is developed on the stems, leaves and heads of the Graminaceæ. The spores of this parasite are carried by the winds and deposited on the different parts, where they soon take root and split the skin, and the sap exuding serves as nutriment to the excrescence. They are also taken

from the soil with the nutrient juices and carried into the plant, and wherever they stop they cause the skin to burst, and the fungus appears. By referring to the plate, fig. 6, two

FIG. 6.

sections of the stalk will be seen in which the rust has burst open the skin and shows itself on the surface. Fig. 3 shows the rust plants as they appear under the microscope, and Fig. 4 shows them still more magnified. Here they have every appearance of the mushroom. As a matter of course, when numerous, they extract all the nutrient juices for their own support, and the grain shrivels up and is worthless. When rust attacks only the leaves, little harm is done, but when it is scattered over the leaves and stalks, and the weather becomes warm and moist, it grows rapidly and quickly destroys the crop. After the rust begins, a complete arrest of the filling out of the grain takes place. If the grains are in the dough state when it begins, it is better then to cut the wheat; if the grains are in the milk state it will not be worth cutting. It rarely attacks wheat that ripens early, hence it is better to sow early varieties, so it will mature before the hot days aid in the development of the disease.

Here, as in all the mushroom diseases, well drained and well cultivated fields, early sowing and early cutting, are the only remedies except for smut, for which we have blue-stone. Still, that too, is to a great extent, avoided by this plan of thorough cultivation, making vigorous stalks that are able to withstand the ravages of these parasites. Some suggest sowing salt and lime on the ground, and these being powerful stimulants to the growth, no doubt act to advantage. A distinguished German agriculturist states that about six hours before sowing his wheat, he prepared a steep of three measures of powdered quick-lime and ten measures of cow urine, and poured two quarts of this on a peck of wheat, stirring the wheat until every grain was white with the preparation. By this he escaped rust entirely, although in neighboring fields a great part was affected with the disease. He has followed the practice for many years with complete success. It is probable this stimulating mixture made the growth of the plant so vigorous it escaped by its own inherent strength. A top dressing of stable manure, followed by harrowing, will have the same effect. The Hebrews considered this disease a special dispensation of Providence for the sins of the people. The Romans sacrificed a red bitch to the goddess Rubrigo to stay the hand of the destroyer. If this would effect any good result, would it not be a good idea to sacrifice a few of all colors?

Cutting wheat while affected with rust seems to destroy the parasite, and what juices remain in the straw go to fill out the grain. Good wheat has been saved in this manner that would have been worthless if left in the field to get ripe.

CHAPTER XX.

INSECTS INJURIOUS TO WHEAT.

We will give only a passing notice of those insects that have never troubled farmers in Tennessee. The list is a fearful one, but fortunately they, as a rule, are confined to cold, damp climates. By consulting the appendix, it will be seen that but few have committed depredations here, neither the Hessian fly, weevil, joint-worm, grasshopper, nor "fleas," as mentioned by one gentleman. Of these, far the most formidable and general is the Hessian fly—(*Cecidomyia Destructor*.) fly was not known America previous to the Revolution, and got its name from the Hessian soldiers, who were supposed to have introduced it. It traveled at the rate of twenty miles a year, until the whole United States became infested with it. It does not affect the whole country at once, but seems to ravage one section for a few years, and then disappears, and may not return for several years. It is smaller than the mosquito, which it greatly resembles. The female deposits its eggs on the blade of the young wheat before frost, where they appear like minute reddish spots, one-fiftieth of an inch in diameter. The eggs hatch in a week, if the weather is warm, and produce small, white maggots, which pass down the leaf until they reach the joint, where they remain until the pupa, or cocoon, is formed. These maggots suck the juices of the plant, which withers, though there may be several tillers from the same stool that make vigorous stalks. In the spring the young "fly" issues from the pupa, and again deposits eggs on the wheat, and the young maggots of the spring crop fasten on the upper joints, and again the work of destruction begins. The injuries of the fly are noticed

by the withered or broken straws to be seen all over the field, and this destruction is sometimes so complete the harvest is worthless. The joints where the maggot rests become swollen, and dispose the stem to break with the slightest wind. It does not penetrate the stalk, but rests in the boot of the leaf and stalk, or sheath. Various insects prey upon these maggots, and thus save immense quantities of wheat.

These insects are so numerous that, it is said, not more than one-tenth of the Hessian-fly eggs ever hatch. The *Platygaster* family and *Ceraphon Destructor* are the names of these silent friends of the farmer. No remedy has yet been discovered for the "fly." Late sowing, so the wheat will not rise out of the ground until after the frosts have destroyed the fly, is the most effective way of arresting its ravages. Thorough tilth, producing vigorous plants, also conduces to the protection of the grain. Selection of wheat that has a strong silicious straw, will protect it from being penetrated to the sap. The Mediterranean was at one time considered fly proof. A fertile soil, rich in all the elements necessary to mature the wheat early, is spoken of; also, soaking the wheat in stimulating substances, and rolling in guano, plaster, lime and ashes, have all been recommended. Grazing with sheep is said to destroy the eggs, but they hatch so quickly, it would be a difficult matter for them all to be destroyed before being reached by the animals. It can hardly ever be wholly destroyed, as the laws of equilibrium between animal and vegetable life are such they cannot be set aside, and all we can hope is to keep the fly within limits. It has been said the "fly," by stimulating the farmers to a better system of farming, has been an actual advantage to the country.

The Joint-worm.—This is a worm that infests the joints of wheat, and in some sections proves more destructive to wheat than all other insects, including the Hessian fly, with which it is often confounded. The insect is very much like the fly, but lays its eggs in the spring on the leaves. These

eggs hatch and drop into the sheath, and instead of remaining here, as do the maggot of the Hessian fly, they penetrate the joint, causing a swelling. The worm interferes with the passage of the sap, besides devouring all it needs, and then the stalk becomes brittle, and is easily blown down. It remains in the straw during the autumn and winter, and going into the ground the next spring, undergoes the usual changes, and becomes again a fly, to renew its depredations. Wheat straw affected with it should always be burned at the thresher, as this is the only way even to mitigate the evil.

Weevil (Calandre Granaria).—After wheat has been passed through all the perils of harvest, and escaped all the ravages of insects, diseases and storms, the farmer, having stored it in the bins, feels that at last he is rewarded for his toils, and his troubles are over. But sometimes when he visits his treasure he finds a funky smell, and notices a minute white dust all over his wheat. Pressing a grain, he finds it will easily crush in his fingers; in fact the wheat grain is a mere shell, partly filled with dust. The result of his labor is gone, and the enemy he had watched and fought so persistently has found an entrance to his domains. A small black beetle has lain in wait during all the cold months, being a lover of warm weather, and as soon as the wheat is stored, it comes out in myriads, and the female bites a minute hole in a grain, and deposits therein an egg. These insects penetrate the heap in all directions, going to the bottom of it; and when it is reflected that each female will lay thousands of eggs one may imagine their destructiveness. These eggs soon hatch, and young maggots begin to bore into and eat the starch. They continue to do this until grown, and by this time the grain is about exhausted, and then the worms go into the pupa state, and in six or seven weeks become weevils or beetles, which eat their way out of the grain, and go into some cranny for the winter.

The best method of getting clear of them is to store in some other place for a year or two, or fumigate the with bin

burning sulphur. Some farmers sprinkle air-slaked lime on the wheat, and yet others sprinkle it with salt. Both these remedies are effectual, but the sulphur will be sufficient. There are many other parasites that trouble the wheat farmers of other States, but this closes the list mentioned here, and we will only call attention to a few others, that the community may be on the watch for them.

Chinch Bugs.—The terror of all the Northern States. They destroyed nearly all the wheat in North Carolina from 1783 to 1809, and have troubled the State occasionally since. They are small beetles, black, with white wings, and make their appearance about the time of the ripening of wheat. They very soon destroy the crop, and then pass into any adjacent fields, and attack corn, oats, barley, or rye. They travel like grasshoppers, going from farm to farm in the course of their destruction. Dry weather favors them, while wet weather destroys them.

Midge (Chorodromus) is an insect allied to the Hessian fly, and in the Northern States is very destructive. They resemble common gnats, and hide during the day in the wheat fodder, but at night issue forth in clouds, and cover the heads about flowering time. They deposit their eggs in the husks, or glumes, of the head, and here they hatch. When the grain forms, or begins to form, the larvæ of the insect that have hatched out feed on the grain until it is destroyed. When only one or two larvæ are in a glume, or husk, the grain to some extent is developed, but if nine or ten are on it, all the juices, intended for the development of the grain, go to the worms. When grown, these larvæ double themselves up, and, like mites in cheese, spring to the earth, where they lodge until the next spring, when they go through the stage of pupa, the chrysalis, and lastly the fly, ready for a repetition of their ravages. In Maine alone, in one year, they caused the loss of one million dollar's worth of wheat. Let us hope this pest will not reach us soon.

The Wire-worm, a product of the common *Jack-snapper*,

a common bug, drives into the roots of wheat, and remains, greatly to its injury.

This ends the list of animal parasites we have to contend with, except the grasshopper that has proved so terrible to the farmers of the North-west. It has been on us only to a very limited extent, being free on account of our geographical position. It will hardly ever prove formidable.

In regard to these evils, the watchfulness of the farmer should be unceasing. We may take any measures we please, but failure will mark them all, unless we use the most sensible methods of culture. Whatever will conduce to make a large paying crop of wheat, will tend to protect it from the depredations of both vegetable and animal parasites. So the interest of the farmer is here advanced in a double way. No great outlay for remedies is required that will be a total loss to the farmer, but everything to be applied adds just that much to the value of the crop. It is in this way it was justly said the farmers of Long Island, when the Hessian fly first made its appearance, from being very slovenly farmers, reaping a very scanty return for poor work, in their efforts to overcome the fly, became in time the most intelligent and successful farmers of New York. In the appendix it will be seen much is said in regard to the disposition of straw. Some let it rot where threshed; some spread it on galled places; some rick or stack it for stock, and others burn it to destroy insects. Taken alone, wheat straw is very nearly worthless a manure, while, with manure, it will assist as an absorbent in making very rich compost heaps. It is also a fair feed to allow cattle to go to at will. Scattered on the ground, it amounts to simply, or nearly, nothing. Besides, it is an harbor for the concealment of all manner of insects, and will form a nucleus the next year for their depredations. A highly intelligent farmer of Middle Tennessee stacks carefully all the straw and chaff, the separators used for threshing throwing them

out together, and during the winter he makes large "racks," by crossing rails on a pole on the poor places on his farm. He fills one after another of these racks with the straw, and turns all his loose stock—cattle, sheep, mules, or horses—into the enclosure, and continues to fill the rack, and let them eat until, from the droppings of the stock, and the treading into the ground of loose straw, the soil is rich with manures. He then removes the rack to some other spot, and takes it through the same process. As soon after its removal as the ground will admit, he breaks up the land, turning under all the accumulations, and then sows it, as soon as the proper times arrives, with oats, clover and orchard-grass. This gives it a turf, and the vivifying influences of the clover gives it a new soil. In this manner he has restored all the worn places on his farm, and they no more remain as eye-sores. This is, beyond question, far better than either burning or scattering; besides, it is the best way to stop gullies.

APPENDIX.

APPENDIX.

Schedule of Questions Sent Out and Answers Received.

NAMES OF CORRESPONDENTS.	POST OFFICE.	COUNTIES.
1. J. H. Light.....		
2. Wm. Williams.....	Edgefield	Davidson.
3. Robt. P. Rhea.....	Blountville	Sullivan.
4. Jas. H. Patton.....	Trezevant	Carroll.
5. J. S. Lindsay.....	Jacksboro	Campbell.
6. P. A. Mitchell.....	Jasper	Marion.
7. M. J. Rannott.....	Strawberry Plains.....	Jefferson.
8. G. O. Cate.....	Ooltowah	James.
9. H. H. Matlock.....	Riceville.....	McMinn.
10. Geo. T. Allman.....	Cornersville.....	Marshall.
11. F. M. Woodall	Nashville	Davidson.
12. E. F. Sharp.....	Ten Mile	Meigs.
13. D. P. Williams.....	Brownsville	Haywood.
14. Wm. Johnson.....	Clarksburg	Carroll.
15. Henry B. Clay.....	New Canton.....	Hawkins.
16. Joseph Matthews	Athens	McMinn.
17. L. F. Leeper.....	Witt's Foundry.....	Hamblen.
18. W. P. Smallwood	Paris	Henry.
19. H. C. Whittaker.....	New Market	Jefferson.
20. J. J. Pope.....	Stephens Chapel	Bledsoe.
21. Cockrill & Hicks.....	Nashville	Davidson.
22. J. A. Turley.....	Cog Hill.....	McMinn.
23. H. H. Lovelace.....	Como	Henry.
24. J. A. Campbell.....	Murfreesboro.....	Rutherford.
25. P. H. Cook.....	Jasper.....	Marion.
26. Ham Hord.....	New Canton.....	Hawkins.
27. W. M. Clark	Franklin	Williamson.
28. Unsigned.....		
29. J. C. Murphy.....	Sevierville	Sevier.
30. W. F. Anderson.....		

NAMES OF CORRESPONDENTS.	POST OFFICE.	COUNTIES.
31. A. J. Halliburton.....	Murfreesboro.....	Rutherford.
32. S. E. Taylor.....	Brownsville	Haywood.
33. John Alley.....	Walnut Valley.....	Sequatchie.
34. W. E. Rucker.....	Cleveland.....	Bradley.
35. Elijah Dougherty.....	Baker's Gap.....	Johnson.
36. James Lamon.....	Chattanooga.....	Hamilton.
37. Wm. F. Jarratt.....		
38. W. C. Peak.. ..	Pinkhook Landing.....	Meigs county.
39. S. R. Saunders.....		
40. Daniel Haynes.....	Haynes' P. O.....	Union.
41. James M. Stewart.....	Dunlap.....	Sequatchie.
42. Erby Boyd.....	Benton	Polk.
43. H. Skaggs.....	Maynardville.....	Union.
44. A. E. N. Blunt.....	Cleveland.....	Bradley county.
45. H. C. Anderson.....	Carolina P. O.....	Haywood county.
46. J. Nat Lyle.....	Dandridge	Jefferson.
47. David McCrosky.....	Cleveland.....	Bradley.
48. Joshua Goode.....	Huntsville	Scott.

QUESTIONS AND ANSWERS.

Please give me the principal varieties grown in your county?

1. White and Walker.
2. Boughton, Fultz, Deihl and Mediterranean.
3. Mediterranean, Boughton, White, Blue-stem and others.
4. Red-chaff, Little Red, May and Purple-straw.
5. Tappahannock, Bearded Quaker, Fultz and Walker.
6. Boughton, Fultz, Walker, Spring-bearded and Harris.
7. Tappahannock, Boughton and Fultz.
8. Boughton, Golden-straw and White.
9. Boughton and White.
10. Tappahannock—miscalled Boughton-Fultz, and a dozen other varieties with local names.
11. Fultz, Boughton, Amber and May.
12. Boughton and White.
13. Early May, Red-chaff and Tappahannock.
14. Red-chaff, Mediterranean and White.
15. Lancaster, Red Quaker, Boughton and Fultz.
16. Boughton, Purple-straw and White, are all that are successful.
17. White, Quaker, Walker, Fultz, Boughton, Tubman, etc.
18. Tappahannock and Red May.
19. Boughton, Fultz and Lancaster.
20. White, Walker and Italian.
21. Amber, Fultz, Boughton.
22. Walker, Boughton and Fultz.
23. Tappahanock, Red-chaff and May.
24. Fultz, Walker, Boughton, Genessee and Mediterranean.
25. Boughton, Walker, Harris, Mediterranean or Cuba, Orleans and Fultz.
26. Mediterranean, known here as Penn, and Red-chaff.
27. Boughton, May and Amber.

28. Red May, Tappahannock, Red-chaff, White Bovers.
29. Tappahannock, Fultz and Walker.
30. Boughton, Walker and Blue-stem.
31. Red May, Red-chaff and Tappahannock.
32. Red May, and Red or Golden-chaff.
33. Moore or Mere White, Walker and Orleans.
34. Boughton, Pennsylvania, White Orleans, Quaker and Walker.
35. Boughton, Walker, Lancaster, Bearded-white and Fultz.
36. Boughton and White principally.
37. Red May, Red Chaff, White Boughton, Tappahannock.
38. Boughton and Fultz.
39. Walker, Red Fultz, Purple-straw and Mediterranean.
40. White or Blue-stem, Walker and Fultz.
41. Walker, Mediterranean, Orleans and Fultz.
42. Fultz, Red Boughton and White.
43. Walker, Boughton, Blue-straw, Red.
44. Boughton, Golden-straw, Fultz and Walker.
45. Red May, Tappahannock and Red-chaff.
46. Boughton, Fultz, Tappahannock, Capron and Walker.
47. Boughton, Fultz, Walker, Orleans, Golden-straw, (limited), Wheat limited.
48. Very little in the county.

Which variety is best suited to your soil and climate.

1. White is preferred.
2. Fulz and Boughton, and I am pleased with Jennings.
3. Mediterranean.
4. Red-chaff, Red May or Purple-straw.
5. Tappahannock and Quaker.
6. Walker is least liable to disease, but all other varieties do well, when free from disease.
7. White wheat generally, or Fultz.
8. This question is hard to answer correctly—Boughton is most sown.
9. The above variety.
10. The Tappahannock commands most; Fultz yields most bushels—each have enemies who claim theirs best.
11. Fultz.
12. The above.
13. Early May.
14. Red.
15. Lancaster, Red and Fultz.
16. The above varieties.
17. Quaker, White, Boughton, Walker and Fultz; all do well.
18. Tapahannock.

19. Fultz.
20. Walker and Italian.
21. Amber and Fultz.
22. Walker stands freeze best, but Boughton gives best quality and yield.
23. Tappahannock.
- 24.
25. Walker and Cuba; all named sometimes do well.
26. Mediterranean.
27. Fultz, Amber and Boughton.
28. Red May and Tappahannock.
29. Tappahannock.
30. Boughton or Walker.
31. I cannot say positively. May wheat has been longest in use and freest from disease.
32. I have succeeded best with Red-chaff.
33. Moore; don't know its generic name.
34. Boughton and Pennsylvania White.
35. All varieties named do well, but Fultz preferred by most farmers.
36. So far as my experience goes Boughton is best.
37. White Boughton.
38. Those who have tried both prefer Fultz.
39. Purple-stem and Mediterranean.
40. White or Blue-stem—same wheat.
41. Walker, Orleans and White.
42. Both well adapted to climate and soil; Boughton and White.
43. Red.
44. Golden-straw.
45. Red May, earliest, seems best, but Tappahannock yields most.
46. Tappahannock and Fultz.
47. Boughton and Golden-straw for strong lands; Walker and Fultz for thin.
48. White.

Varieties preferred by millers?

1. White; other varieties are not used as much as white.
2. Boughton and Fultz.
3. Boughton.
4. Red May Wheat.
5. Tappahannock and Fultz.
6. Boughton and Walker.
7. White, as they pay most for it.
8. Boughton.
9. Same varieties.
10. Any first-class white wheat.

11. Fultz.
12. Boughton and white.
13. May.
14. Red makes finer than Mediterranean.
15. Boughton.
16. The same.
17. White and Boughton.
18. Tappahannock.
19. Boughton.
20. White.
21. Amber.
22. Walker and Boughton, perhaps the latter.
23. Red-chaff makes largest yield.
24. Walker.
25. Boughton, Walker and Spring Wheat.
26. White varieties.
27. Amber.
28. White by 10 per cent. in bushel.
29. Tappahannock.
30. Boughton and white.
31. Red-chaff preferred by some, cannot say which is generally.
32. Red-chaff.
33. White.
34. Last two above-named.
35. No flour manufactured but for home use, not much difference in varieties.
36. It is most preferable by millers.
37. Red May or Red-chaff.
38. Divided.
39. Walker and Red.
40. White or Blue-stem.
41. White.
42. Boughton and White.
43. — —
44. Same, it makes more and better flour.
45. Some prefer White, others Red.
46. Walker or Amber.
47. Boughton and Golden-straw.
48. White.

Is there any Spring Wheat grown, and to what extent?

1. Very little, if any.
2. None.
3. None.

4. No.
5. None.
6. None.
7. None.
8. None.
9. None.
10. None.
11. None.
12. None.
13. None.
14. None.
15. None.
16. None.
17. None.
18. None.
19. None.
20. None.
21. None.
22. Very little, not satisfactory.
23. None.
24. None.
25. Half the crops of the county are Spring Wheat.
26. None.
27. None raised, tried and failed,
28. Small amount, and inferior.
29. None.
30. None.
31. Failures.
32. None, tried and failed.
33. None.
34. None, to my knowledge.
35. None worth noticing. Don't do well.
36. No Spring Wheat raised here.
37. None.
38. None, that I know of.
39. None.
40. None at all.
41. None.
42. None.
43. Very little.
44. None.
45. None.
46. Very little.
47. None.
48. Very little.

What kind of soil is best adapted to the growth of wheat?

1. Our district is usually gray limestone, rather red and black soil.
2. Rich land the most, poor land the best grain.
3. Gravelly and slate. High.
4. High thin land.
5. Limestone, stiff sub-soil, rich loam.
6. Clay loam.
7. Mulatto.
8. Our high mulatto.
9. Gravelly loam with stiff clay sub-soil.
10. Rolling and gravelly land.
11. Upland land.
12. Our mulatto land is said to be best.
13. ———
14. Land with clay foundation and fresh land.
15. Upland with clay sub-soil and river bottom.
16. High rich ridge land.
17. Strong sugar tree and beech land lying fair to the sun.
18. Clay.
19. Limestone clay.
20. Limestone soil and mulatto soil.
21. Clay.
22. Red mulatto.
23. Clay sub-soil.
24. ———
25. Lime and river loam.
26. Limestone clay.
27. Gravelly loam.
28. Dry, rich land containing the most lime.
29. Limestone mulatto.
30. Red mulatto.
31. A dry alluvial soil. Bottoms would do well if drained.
32. I succeed well on rich loam, well drained.
33. Loose gravelly upland.
34. Limestone first, black gravelly ridge land second, slate third.
35. All lands lying fair to the sun where the soil is good.
36. In my experience river bottom and alluvial mixed with sand.
37. High loam.
38. Red mulatto and black gravelly land.
39. Medium upland.
40. Blackhaw, heavy soil land hard to manage.
41. Strong limestone.
42. Red clay pan.
43. Limestone or valley clay.

44. Land underlaid by deep red sub-soil.
45. Clay soil with black pebbles mixed has made most for me. Pipe clay is good.
46. Gravelly upland.
47. Gray gravel, strong soil for quantity. Fertilizers improve.
48. Limestone.

After what crop does wheat make the largest yield?

1. Clover.
2. Depends a great deal on the season; am unable to tell.
3. Red clover.
4. Tobacco, clover, oats.
5. Red clover.
6. Clover.
7. Clover and perhaps tobacco.
8. Clover and peas.
9. Clover.
10. Some say cotton. I prefer clover, though all depends on thorough preparation.
11. Clover first, then potatoes, and then late millet.
12. Clover.
13. Clover.
14. Clover and tobacco.
15. Clover.
16. Clover plastered the previous spring.
17. Tobacco and clover.
18. Clover and peas.
19. After oats that have followed corn.
20. Clover; my experience is after corn.
21. Clover.
22. Clover and peas turned under in July or August.
23. Tobacco.
24. Clover.
25. Clover beyond a doubt.
26. Clover.
27. Clover, clover, clover.
28. Peas, tobacco and cotton.
29. Corn upon which cow peas are raised and turned under, clover and turned under.
30. After clover.
31. Cotton decidedly.
32. Clover decidedly.
33. Clover.
34. Clover and timothy, peas and tobacco.
35. Clover.

36. Clover turned over; grass and stubble better than corn.
37. Clover always.
38. Clover.
39. Clover.
40. Clover.
41. Clover.
42. Clover.
43. ———
44. Clover and cow peas.
45. Clover fallow.
46. Stable manure or red clover.
47. Stock peas after oats.
48. Clover.

What is the relative yield of wheat on clover, fallow, corn, or tobacco land?

1. From 8 to 20 bushels.
2. Am disappointed in sowing wheat after clover.
3. About 8 to 9 bushels.
4. Clover or tobacco, 20; corn or fallow land 12 bushels per acre.
5. Clover 15, fallow 12, corn 8, cannot answer as to tobacco.
6. Twenty per cent. in favor of clover land.
7. Clover 15, fallow 10, corn 8, tobacco, don't know.
8. Wheat after clover, from 20 to 35 bushels; fallow, 10 to 15; from corn, from 6 to 8; no tobacco cultivated.
9. Clover over corn from 50 to 200 per cent.; no fallow or tobacco.
10. Twenty bushels per acre in well prepared clover land; no tobacco raised only in small patches.
11. Don't know.
12. Clover will double corn land; we raise no tobacco.
13. Clover best, cotton next, corn, etc.
14. Clover, about 10 bushels; tobacco same; corn, about 6 bushels per acre.
15. Little or no fallowing; proportion—3 clover, 2 tobacco, 1½ corn land.
16. Clover about double any other.
17. Clover, 8 to 30 bushels; corn, from 4 to 10.
18. Clover 100, corn 80, tobacco 90.
19. ———
20. Clover land, 8 bushels; corn same; we rarely sow fallow; tobacco not cultivated.
21. Clover 25 per cent better than corn; no tobacco land.
22. Fifteen bushels on clover, 12 on fallow, 6 on corn, have not tried tobacco.

23. Clover, 12 to 15; corn, 8 to 10; tobacco, 15 to 20.
24. — — —.
25. Clover, 10 to 12; corn, 5 to 6; fallow, 8.
26. Clover 1; corn $\frac{1}{2}$, unless corn follows clover, then $\frac{2}{3}$.
27. Twenty-five, 15, 8 and 15 bushels.
28. Can't answer satisfactorily.
29. Clover or fallow yield double corn without cow-peas; no tobacco land.
30. Clover, 12 to 18; corn, 6 to 10 bushels per acre.
31. But little clover cultivated here; and no tobacco until recently.
32. Raise no tobacco; corn land preferred to fallow.
33. Clover 15, corn 10.
34. Not prepared to answer.
35. Clover-fallow is far best, 40 per cent.; no tobacco raised of consequence.
36. Clover, 18 bushels; fallow in prime condition, same; no experience with tobacco.
37. Twelve or 15 bushels.
38. Clover, 11 to 12; fallow, 8 to 10; corn, 4 to 6.
39. Clover, $33\frac{1}{3}$ per cent. better.
40. Clover, 14 per acre; corn or fallow, 8 to 10.
41. Clover, best by 25 or 50 per cent.
42. Clover, 33 highest.
43. Eight to 12 bushels.
44. In proportion, 10, 7, 6, 5.
45. Our yield from 6 to 20 bushels, as the land is good or bad.
46. Safe to say 2 bushels to 1.
47. No test worth reporting.
48. Not much difference between clover and tobacco land.

What is the best yield, and what the average per acre?

1. About 12 to 15 bushels.
2. Twenty bushels and 10 bushels.
3. —.
4. Purple-straw, 12 bushels.
5. An average of 42 bushels in a ten-acre field.
6. Thirty-five bushels; average 6 bushels.
7. Best, 24 bushels; average in ten years, 11 bushels.
8. Thirty bushels; average 8 bushels.
9. Forty-five bushels best yield; 6 bushels average for county.
10. Twenty-five bushels for some years; I hear of 30.
11. In 1876, 36 16-60 bushels; in 1877 the average will be 12.
12. About 25 bushels; average 6.
13. Twenty bushels; average 8.

14. Twenty bushels; average 6; mostly corn land sown.
15. Thirty-seven bushels in 1857; average below 7.
16. Best, 30; average, 5.
17. Forty bushels, but this is not common.
18. Thirty-five bushels; average 8 bushels.
19. Forty bushels; average of county, 5 or 6 bushels.
20. Sometimes 30 bushels; average not over 7.
21. Twenty bushels; average 10 bushels.
22. A wide range, 2 to 30 bushels per acre; average 10.
23. Thirty-five bushels; average 10 bushels.
24. Best, 20 bushels; average 10 bushels.
25. Twenty, best in county.
26. Twenty bushels often made; average 7 bushels.
27. From 3 to 35; average about 8.
28. About 25 bushels; average 7.
29. Best, 25 bushels; average 9 bushels.
30. Eighteen to 20; average from 7 to 10.
31. Clover best; cannot state average yield.
32. I have made on clover 82 bushels per acre; average in county 8 bushels.
33. Average per acre, $7\frac{1}{2}$.
34. Forty-one and 36 bushels on well prepared land.
35. Best, 25 to 30 bushels; average not more than 8.
36. Best, 30 bushels; average 8 bushels.
37. Best, 25 bushels; average 12 bushels.
38. Best, 20; average 8.
39. Best $29\frac{1}{2}$, Golden-chaff; average $7\frac{1}{2}$ bushels.
40. Average, 8 bushels.
41. Twenty-five bushels; average 7 bushels.
42. Twenty-five best; average 7 bushels.
43. Twenty; average 5.
44. Best yield by myself, per acre, 67 17-60 bushels, Golden-straw.
45. Very best, 33; average 9 or 10.
46. Best, 40 bushels; average, 5 to 7.
47. On small plat, 37 bushels; others, 18 bushels.
48. Best, 15 or 20; average 11 bushels.

To what diseases is wheat liable, and what remedy do you apply?

1. Smut; soak the grain in blue-stone.
2. Rust, none. Smut, sulphur and copper.
3. Joint-worm, spot and rust; apply no remedy.
4. Smut, use blue-stone. Rust, sow thick and early.

5. Rust, smut, spot, Hessian Fly ; no remedy for rust or spot, blue-stone for smut.
6. Rust, smut, spot ; use no remedy, but blue-stone is remedy for smut or salt.
7. Smut, remedy blue-stone ; rust and fly, no remedy that I know.
8. Rust, on lowland spot ; I know no remedy for either.
9. Rust, spot and smut, and occasionally joint-worm ; blue stone for smut, superior culture and manure for others.
10. Smut and rust, blue-stone for former, nothing for latter.
11. Rust and smut, blue-stone for smut.
12. Rust and spot, no remedy.
13. Rust and smut, blue-stone.
14. Scab, rust and smut, blue-stone for smut.
15. Smut, spot and scab, blue-stone for smut.
16. Smut, rust and fly, use blue-stone to prevent smut.
17. Rust and smut, blue-stone for smut.
18. Smut and rust.
19. Smut and spot, blue-stone or lime for smut, spot no remedy.
20. Smut, and blue-stone for it ; rust and spot.
21. Rust, and let her rust.
22. Spot and rust, smut, worms, etc., best remedy is lime sown on land liberally.
23. Smut, blue-stone.
24. Rust and smut, well matured seed and blue-stone for latter.
25. Smut and rust.
26. Fly, rust, spot and loose stock.
27. Rust and smut, early sowing and blue-stone.
28. Rust, drain your land ; smut, early sowing and blue-stone.
29. Smut, rust and spot, blue-stone for smut.
30. Rust, and no remedy.
31. Smut, blue-stone.
32. Rust and smut, sow early for former, blue-stone for latter.
33. Rust, smut and spot, no remedy known.
34. Rust, smut, fly and mildew ; blue-stone for smut.
35. Rust and spot, no remedy.
36. Spot and smut, only once in ten years, and that year soaked my wheat in blue-stone.
37. Rust and smut, blue-stone for latter, for former fully ripe seed.
38. Smut and rust, blue-stone for smut.
39. Rust, no remedy. Smut, blue-stone.
40. Smut and rust sometimes, clover and grass sure.
41. Salt, rust and spot, blue-stone for smut.
42. Rust, smut and spot.
43. Rust and smut.

44. Early sowing for fly Sept. 10, in ashes for rust, salt and blue-stone for smut.
45. Rust is our greatest enemy, can only succeed as we can prevent smut.
46. Rust and smut, also fly. For fly sow as late as October. Rust is an atmospheric influence, chloride gas is the remedy; for smut, sow when the ground is very dry. Blue-stone is worth nothing.
47. Rust, scab, smut, salt, lime and blue-stone.
48. Rust and spot, blue-stone.

Are you troubled with insects, to what extent, and what is your remedy?

1. Grub worm, blue-stone is a preventive.
2. ——— ———.
3. Yes, considerable; none.
4. Hessian fly and grasshoppers.
5. Yes, Hessian fly. Remedy, pasture close with sheep.
6. Not to any serious extent.
7. Nothing but Hessian fly and weevil, no remedy.
8. We have never had much trouble from insects.
9. Joint worm to limited extent, no remedy tried.
10. Very little.
11. Am not.
12. None, except fly, which only injures early sowed wheat.
13. So little no remedy is applied.
14. We are troubled with them.
15. Fly, joint worm; no remedy for latter, sow after frost for former.
16. None.
17. Early sown wheat subject to fly.
18. Doubtful.
19. Hessian fly on early wheat, not on late.
20. Hessian fly in fall at times, no remedy.
21. Fleas, and pennyroyal.
22. So far not troubled.
23. Hessian fly, sow after frost.
24. Fly occasionally, on foul land especially.
25. Blue-stone for smut.
26. Fly, joint worm and weevil, no remedy.
27. Fly, sow after frost and you'll escape.
28. Fly and worm cutting top joint.
29. Fly if sowed before frost, preventive better than cure.
30. Fly, no remedy.
31. To no extent that I know of.

32. No trouble.
33. No trouble noticeable.
34. Fly, only insect, and hat only in a dry winter.
35. Hessian fly only insect, no remedy.
36. Only once in ten years, and then it was grasshoppers.
37. No.
38. Fly, and no remedy.
39. Not much.
40. I am not.
41. Fly in fall.
42. Yes, fly, no remedy.
43. No trouble.
44. Never to any extent,
45. No insects have troubled us.
46. Fly principally, sow your wheat about the middle of October.
47. Insects not troublesome; remedy, good soil well prepared.
48. Sometimes, no other insect.

What is the most approved time of sowing?

1. September 20 to October 20; I've known good wheat up to December 20; early sowing best.
2. Last of September and October.
3. September 20 to October 10.
4. From October 1 to 20.
5. September.
6. October 1.
7. September 20 to October 20.
8. September 15 to October 15.
9. September 15 to October 15.
10. Earlier the better; prefer sowing in September.
11. October 1 to November 15.
12. About October 15.
13. October 1 to 15.
14. October 1.
15. September 20 to October 15.
16. First ten days in October.
17. September 25 to October 15, to avoid damage from the fly.
18. October 1 to 15.
19. September 15 to October 15.
20. October and November.
21. October.
22. September 10 to October 10.
23. October 1 to November 15.
24. Early Fall.

25. September 15.
26. September 15 to 30.
27. October 1 to 15.
28. September 15 to October 20.
29. October 10 to October 25.
30. October 1 to October 31.
31. October, but often neglected; result, winter killing.
32. September 15 to October 15.
33. October 1.
34. September 5 to October
35. September
36. September 10 to October 10, never later.
37. October 1.
38. October.
39. Last of September to October 15.
40. White or Blue-stem, from October 1 to 10.
41. October 1.
42. In October.
43. October, new moon.
44. Early in September as possible, is best.
45. October 10 to 25; often as late as December 10 and 15.
46. October 1 to November 15.
47. About the first of October.
48. September; the full moon.

Which is the better plan of sowing—drill or broad-cast?

1. Drills are not used in this district.
2. Drill.
3. Drill.
4. Broad-cast; when the drill is used, apt to rust.
5. Drill, it don't freeze so much in winter.
6. Broadcast is the only mode here.
7. Have no experience with drill.
8. By drill.
9. Drill decidedly.
10. I am satisfied by drill is preferable.
11. Drill.
12. Drill.
13. Drill.
14. Broadcast; have not used drill.
15. Broadcast.
16. Drill, emphatically.
17. About same if ground is prepared well.
18. Drill.

19. Broadcast, and seed plowed in.
20. Broadcast; don't use drill.
21. Drill.
22. Drill, unqualifiedly.
23. Drill.
24. Drill.
25. Broadcast.
26. Have not used the drill; little difference.
27. Drill, if land permits.
28. Broadcast.
29. Broadcast, if as well prepared as for drill.
30. Drill.
31. Broadcast, have not used drill.
32. Drill, if possible.
33. Broadcast exclusively; think, however, drill is the best.
34. Drill, when ground is in condition.
35. Broadcast; drill not practiced; best farmers favor drill.
36. By drill the yield is a quarter more than broadcast.
37. Broadcast is preferred.
38. Drill preferred.
39. Drill.
40. Don't know the drill, but hear it well spoken of.
41. No drill used in this country.
42. Drill preferable.
43. Broadcast.
44. Drill all the time.
45. Broadcast; many favor drill.
46. Broadcast, and harrow both ways.
47. Drill always.
48. By drill.

What amount of seed is used in sowing by either plan?

1. From 1 to $1\frac{1}{4}$ bushels.
2. Drill, 3 pecks to 1 bushel; broadcast, 1 to $1\frac{1}{4}$ bushels.
3. One to $1\frac{1}{2}$.
4. One bushel to the acre.
5. About 1 bushel per acre.
6. One bushel per acre.
7. Broadcast 1 to $1\frac{1}{2}$ bushel per acre.
8. From $\frac{3}{4}$ to $1\frac{1}{4}$ bushels per acre.
9. Drill $\frac{7}{8}$ bushels, broadcast $1\frac{1}{4}$.
10. Drill $\frac{1}{2}$ to $\frac{3}{4}$, 1 bushel broadcast.
11. Drill $\frac{3}{4}$ to 1 bushel, broadcast 1 to $1\frac{1}{2}$ bushels per acre.
12. Broadcast from 1 to $1\frac{3}{4}$ bushels, drill $\frac{3}{4}$ to 1 bushel.
13. Three-fourth to 1 bushel.

14. One bushel per acre.
15. Three-fourths to 2 bushels.
16. Drill $\frac{7}{8}$, 5-4 to 6-4 broadcast.
17. From $\frac{3}{4}$ to $\frac{1}{2}$, generally 1 bushel.
18. One bushel.
19. One and a half bushels.
20. One bushel broadcast.
21. Drilled $\frac{3}{4}$, broadcast 1 bushel.
22. Drilled $\frac{3}{4}$, broadcast 5-4 bushels
23. $\frac{3}{4}$ to 1 bushel per acre.
24. Three-fourths to 5-4 bushels.
25. One bushel.
26. One bushel.
27. From $\frac{3}{4}$ to 1 bushel.
28. Broadcast 1 bushel.
29. One to 2 bushels according to soil.
30. One bushel and a peck generally.
31. If sowed in time 1 bushel, if late more.
32. From $\frac{3}{4}$ to 1 bushel.
33. One bushel per acre.
34. Broadcast, $1\frac{1}{4}$; drill 1 bushel.
35. From 1 to $1\frac{1}{2}$ bushels.
36. One bushel sound seed.
37. Broadcast 1 bushel, drill $\frac{3}{4}$.
38. Broadcast 1 bushel, drill a little less.
39. Drill $\frac{3}{4}$ to 1, broadcast 1 to $1\frac{1}{2}$.
40. One to $1\frac{1}{4}$ bushels per acre.
41. One bushel per acre.
42. One bushel per acre.
43. One bushel.
44. Drill $\frac{7}{8}$, broadcast $1\frac{1}{4}$.
45. Am not prepared to say with drill; broadcast $\frac{3}{4}$ to 1 bushel.
46. From $\frac{3}{4}$ to 1 bushel, according to size of grain.
47. Drill $\frac{3}{4}$, broadcast 1 to $1\frac{1}{4}$.
48. One bushel to the acre.

What is your estimate of the cost of cultivating an acre by either plan? [The answers only estimate the work done in seeding.]

1. From .75 to \$1.25.
2. \$3.00
3. About \$1.00.
4. \$3.00 per acre.

5. \$5.50.
6. Have not tested.
7. \$6.50.
8. \$4.50 to 5.00.
9. From \$7.00 to \$12.00—drill somewhat cheaper.—Estimate is made on best preparation of soil.
10. \$4.00 for thorough cultivation by broadcast, \$5.00 by drill.
11. About \$3.00 per acre by either plan.
12. \$3.75 by drill, broadcast .75 cents less.
13. Broadcast \$3.00, drill \$5.00.
14. \$4.00.
15. About \$6.00.
16. \$3.00 per acre drill; don't sow broadcast.
17. From \$5.00 to \$6.00 if well prepared, as it should be for both.
18. \$5.00 with seed and saving crop.
19. \$6.00.
20. \$2.00.
21. \$10.00.
22. \$5.75.
23. \$1.50.
24. \$3.00.
25. \$6.75.
26. \$6.00 broadcast.
27. Without seed or harvesting \$3.00.
28. \$3.50 ready for granary.
29. Broadcast \$3.00.
30. \$1.50 drilled, .75 cents to \$1.00 broadcast.
31. \$5.00 will put it in well and save it.
32. Can not answer.
33. \$6.00 in granary.
34. \$2.50 broadcast, plowing, rolling and harrowing; never use a drill.
35. \$4.00 inclusive of seed.
36. \$3.50.
37. \$4.00, sowing and hauling included.
38. Don't know.
39. \$7.50 with seed.
40. \$3.00 per acre.
41. \$5.00.
42. \$2.00 per acre.
43. _____
44. \$7.00.
45. \$2.00 to \$6.00.
46. Seventy-five cents to bushel gathered.
47. \$1.00 for bull-tougning as usual—\$6.00 to \$7.00 if done well.
48. I haven't studied much about it.

What is the estimated profit of wheat culture per acre?

1. From \$3 to (per acre clear profit.
2. About \$3 to \$4 per acre, if yield is 10 bushels and price \$1 per bushel.
3. None.
4. When wheat is \$1 per bushel the profit is \$6 per acre.
5. On an average \$2 per acre.
- 6.
7. My average is \$2.65.
8. Very small, from \$3 to \$25; average about \$5; depends on preparation of land.
9. For an average of ten years, profit \$10 with best farmers; for others \$2 to \$3.
10. \$12.50.
11. \$10 per acre.
12. That depends on amount made per acre
13. Can't guess at it.
14. Depends on price; one dollar per bushel is \$1.50 profit.
15. Difficult to answer, on account of fluctuating price and varying yield.
16. Owing to variations in yield and price, hard to estimate.
17. From nothing to fifteen dollars.
- 18.
19. No profit below an average of six bushels, and price one dollar.
20. \$2.50 to \$3.
21. Nothing.
22. From nothing to \$10 or \$15 per acre.
23. \$5.
24. \$5, at ten bushels per acre.
25. Simply a change of land from corn.
26. Very little.
27. \$12.
28. \$3.50 to \$22.50.
29. \$4.50.
30. \$5 to \$7.
31. Have kept no record and am not prepared to say.
- 32.
33. About \$5 per acre when raised for profit.
34. I'm not prepared to say, average is so irregular.
35. From \$3 to \$5 per acre.
36. Average yield 8 bushels, \$8. Deduct expenses, leaves \$1.40.
37. About \$6.
38. About 100 per cent.
39. \$5 or \$6.
40. Depends on price of wheat at time of sale.
41. Very small in this county.

42. On first-class ground, \$20 per acre.
- 43.
44. \$7 at \$1 per bushel.
45. Actual profit \$5; advantage to land immense. Wheat, grass and clover only hope of West Tennessee.
46. Very small.
47. By the latter it should average \$10 per acre; by the former it is money out of pocket.
48. Sometimes very little, \$8, \$10, \$12 to \$18 and to \$20 per acre.

What is the relative profit of wheat culture as compared with other crops?

1. Oats, corn and wheat; last most profitable.
2. About same as corn, less than hay, and far less than potatoes.
3. Wheat and oats, but little profit.
4. Wheat most valuable crop we make.
5. Pays as well as corn and better than oats.
6. Equal with other grain crops.
7. Equal to corn, better than oats or rye, tobacco more profitable.
8. Wheat poorest crop for profit.
9. Wheat best on upland; on bottoms corn is best.
10. Best money crop, $33\frac{1}{3}$ per cent more than any other.
11. No profit in corn at present prices.
12. Wheat most profitable grain crop raised.
13. I think wheat is a small per cent over others.
14. About same as cotton and corn, profit light on all.
- 15.
16. Wheat is first on land suitable to wheat-growing.
17. Same as other crops.
- 18.
- 19.
20. Much less than corn.
21. Other crops pay better.
22. Better than corn or spring oats on upland, less than cotton, tobacco or winter oats.
23. As paying as any grown.
- 24.
- 25.
26. Corn more valuable if fed on farm.
27. Wheat and barley are best for field crops.
28. Wheat \$3.50, corn \$6, cotton \$9.
29. Not as good as grass, 25 per cent. better than corn.
30. Fifty to 75 per cent better.
31. Cannot say; raise only for home use.

- 32.
33. About equal when properly cultivated.
34. Wheat is the most profitable crop in my county.
35. Wheat produces more profit than other crops.
36. As a general thing corn pays better than wheat.
37. Wheat is most profitable.
38. About 50 per cent. better than any other crop.
39. Wheat at 100, other crops at 75.
40. I can make more money on grass than on any grain.
41. Less than any other grain.
42. Wheat is 40 per cent. over all others.
43. About equal.
44. Profits of wheat very little, corn ditto.
45. Profits greater than other crops on lands manured.
46. Hardly as good as corn or oats, if latter is a good crop.
47. It does not pay as well as any other crop.
48. Very good in some places in the county.

Give me your estimate of amount of wheat raised in your county and number of acres sown.

1. Cannot say—pretty large I think.
2. Have no idea.
3. ———
4. I do not know. My crop is 100 acres and will make 1,200 bushels.
5. Twenty-five thousand bushels, number of acres sown 4,000.
6. Have no statistics.
7. Have no means of even guessing.
8. One hundred and fifty thousand bushels, 19,000 acres.
9. Can give no intelligent answer.
10. It is guess work—300,000 bushels, 30,000 acres sown.
11. ———
12. Nine thousand acres and 54,000 bushels.
13. Have no means at command for determining.
14. About 200,000 bushels on 33,000 acres.
15. ———
16. Cannot give an estimate.
17. Thirty-five thousand two hundred and thirty-eight bushels 5,934 acre
sown.
18. ———
19. One hundred and twenty thousand bushels, 20,000 acres.
20. Twelve thousand six hundred bushels, 1,800 acres.
21. Ask the tax assessor.
22. Have no data to answer.
23. Eighty thousand bushels, 10,000 acres.

24. Thirty-five to forty thousand bushels, 3,000 to 4,000 acres.
25. Twenty per cent. of cultivated land sown in wheat.
26. No means of answering.
27. Two hundred and fifty thousand bushels on 30,000 acres.
28. Have not estimated the county; 8,000 bushels in this district.
29. Average crop 75,000 bushels.
30. Seven thousand acres, 56,000 bushels.
31. I can only say more than usual sown and yield over average.
32. Am not well enough posted to answer.
33. One hundred thousand bushels, 15,000 acres.
34. ———
35. Can't give an estimate.
36. It is impossible to say, guess 33,000 bushels.
37. Don't know.
38. ———
39. Can't approximate.
40. One hundred and twenty thousand bushels, 14,000 acres.
41. Ten thousand bushels, 1,500 acres.
42. Twenty-thousand bushels, 3,500 acres.
43. Twenty-five thousand bushels.
44. Five thousand acres and 100,000 bushels.
45. Am not prepared to answer; amount planted double any year previous except 1875.
46. Have no idea, but this county is about the best in East Tennessee.
47. Not prepared at present to do this.
48. I can't say, for I don't know what amount has been sown.

Is the acreage of wheat increasing or decreasing?

1. Average probably good this year.
2. Increasing.
3. Increasing.
4. Increasing.
5. Increasing.
6. Small increase.
7. I think increasing.
8. Not much change, if any an increase.
9. Increasing.
10. Increasing—25 per cent more than any prior year.
11. Increasing largely.
12. Can see no increase or decrease.
13. Increasing I think.
14. Increasing.
15. Less this year on account of drought last fall.
16. Increasing.

17. Increasing as a rule.
18. Increasing.
19. Decreasing.
20. Little difference, perhaps on the increase.
21. Increasing.
22. Increasing,
23. Increasing.
24. Increasing.
25. Increasing I think.
26. Less this year, generally much the same.
27. Increasing.
28. Increasing 20 per cent.
29. Increasing.
30. Increasing.
31. Increasing certainly.
32. Increasing.
33. Increasing slowly.
34. Increasing.
35. Increasing.
36. About the same as formerly.
37. Rapidly increasing.
38. Increasing.
39. Increasing 25 per cent.
40. Decreasing.
41. Decreasing if any change.
42. Increasing.
43. Increasing.
44. Increasing as rapidly as the quantity is diminishing.
45. Very largely increasing.
46. Rather increasing.
47. Increasing.
48. I think decreasing.

What kinds of fertilizers are used for wheat?

1. Scarcely any; stable manure if any.
2. Clover and stable manure.
3. None except from the stable.
4. Clover.
5. Clover and barnyard manure.
6. None.
7. Barnyard, lime and commercial manures in small quantities.
8. Very little of any kind; stable manure in small quantities.
9. Stable manure principally; phosphate and guano slightly and did well.
10. Not one in a thousand uses any.

11. I have never seen any used in this county.
12. None except a small amount of barnyard.
13. None.
14. Small quantity of stable manure and pea vine.
15. Stable manure and not enough.
16. Very little ; stable manure and guano are excellent.
17. Stable manure and ashes.
18. None but clover and peas.
19. Stable manure.
20. None.
21. None.
22. Horse and cow manure, few use guano.
23. Plaster and salt to limited extent.
24. None worthy of notice.
25. None.
26. Little stable manure and no other.
27. Ashes and plaster to a small extent only.
28. Cotton seed and lime compost.
29. Stable and barnyard.
30. Lime and plaster of Paris
31. Little of any sort ; many of us have *heard* that manure is good for wheat.
32. None of consequence.
33. Farm manures.
34. Barnyard, ashes, etc.
35. Barnyard and ashes—no fertilizers bought.
36. None used but stable manure and clover.
37. Cotton seed, lime and ashes.
38. Barnyard.
39. Stable manure used by some.
40. No fertilizers, some manure from stock.
41. None used.
42. Barnyard compost.
43. ———
44. Stable manure and compost.
45. Barnyard and cotton seed.
46. Clover and stable manure.
47. Next to none—barnyard lightly.
48. No kind.

What use is made of wheat straw, and what is its estimated value per acre ?

1. Scattered on poor land or destroyed.
2. Bedding for horses and spreading on ground.

3. Fed to cattle.
4. Straw is a good manure for wheat land.
5. Fed to cattle; value per acre .75 cents.
6. Left to rot where threshed.
7. Winter forage for mules and cattle; value per acre \$1.00.
8. Fed to cattle and thrown on farm; value very small.
9. Fed to cattle; value \$2.00.
10. Most leave it loose, some pen it for cattle.
11. Making paper and packing eggs; value \$4.00 per acre if properly stacked.
12. Generally spread on poor spots to rot.
13. Manure, no value.
14. Scattered on ground to rot; value .50 cents per acre.
15. Fed to cattle and bedding stock; good land \$2.00, upland 30 cents.
16. Left to rot.
17. Cattle feed; \$1.00 per acre.
18. Nearly valueless.
19. Left to rot; chief value cattle bedding.
20. Cattle feed; value low.
21. Cow beds; \$2.00.
22. Cut and mix with bran for horses and cattle, also bedding for stock; \$2.00.
23. Cattle food; \$1.00.
24. Left to rot.
25. Cattle food; \$2.00.
26. Cattle food; manner of feeding constitutes its value.
27. Fed to cattle—generally wasted; worth \$2.50.
28. Scattered and plowed in; \$2.00.
29. Fed to cattle in barnyard; worth \$1.00.
30. Feed to stock and cattle; 0.75.
31. Seldom any care taken of it.
32. Manure heap.
33. Fed to cattle; value .75 cents per acre.
34. Stock feed and manure.
35. Don't value it, wasted by cattle.
36. Left to rot.
37. Fine feed for out-stock; \$1.00 if stacked.
38. Cattle feed.
39. I would rather have it as feed than millet.
40. Fed in a wasteful way to stock; \$1.00 per acre.
41. Left on the ground for cattle.
42. Fed to cattle and mules; \$1.00.
43. Stacked and fed.
44. Feed stock; \$1.00 per 2,000 lbs. at stack.
45. No profit as feed, but good for bedding for stock and to stop gullies.

46. Put under carpets, make straw beds, feed to poor cows, horses and mules.
47. Left to rot or wasted at stack.
48. Cut it up and feed it to stock; very valueless.

What use is made of the chaff, and what is its relative value as a feed.

1. No care is taken of it, generally thrown with the straw.
2. But little used as feed.
3. Feed for cattle and horse^s.
4. As a feed it is worth nothing, but it is good for manure.
5. Fed to cattle; better than straw.
6. Left to rot.
7. Same as straw; no great value.
8. Used for feeding cattle, and better than straw.
9. Fed with straw; better than straw.
10. It is very fair feed, beats straw badly.
11. Am unable to say any use is made of it; good food for horses and cattle.
12. Same as straw.
13. No use made.
14. Left to rot.
15. Smooth wheat chaff good for stock; bearded not.
16. Use as cattle food, worth half as much as hay.
17. Mix meal or bran for cows, good feed.
18. Nearly valueless.
19. One-third of clover hay.
20. Chaff uncared for.
21. Rick it, and cattle will eat it.
22. Use like straw, worth 50 cents to \$1.
23. Cattle food, better than straw.
24. Very little attention paid to it; a few pen it for cattle to eat at pleasure.
25. Allowed to waste; splendid for calves.
26. Bearded chaff worthless.
27. Not separated from straw.
28. Scattered for manure.
29. Fed as straw; not much value.
30. Same as straw.
31. Goes generally with straw.
32. Goes with straw.
33. Better than straw; no attention given it.
34. Same use as straw; better for packing eggs, etc.
35. Mixed with meal and fed to cattle, considered good.
36. Left to rot with straw; mixed with meal makes good feed.
37. Excellent feed.
38. Feeding cattle.

39. I will say it is preferable for cattle to straw.
40. Fed to stock.
41. Fed to cattle ; small value.
42. Fed to milch cows ; 50 cents per acre.
43. None.
44. Better than straw for feed.
45. Fed to horses, and mixed with bran to milch cows.
46. Mixed with hot water and fed to milch cows ; good for that use.
47. Same as straw ; don't know.
48. Chaff is fed to stock.

What is your estimate of the value of harrowing or rolling wheat in the spring ?

1. Spring harrowing is good, but rolling in spring is scarcely ever done.
2. One-tenth increase.
3. It will pay well.
4. Is of no worth.
5. Don't know ; havn't tried it.
6. Both beneficial.
7. I regard it as beneficial.
8. From 20 to 50 per cent.
9. Like harrowing, but dont approve of rolling.
10. Adds ten per cent to yield.
11. Broadcast wheat is benefited ; drill not so much.
12. No experience.
13. No answer.
14. Increased yield one bushel per acre.
15. Have no tests though I pursue it.
16. Harrowing useful preceding clover, rolling injurious.
17. Harrowing an advantage, if wheat is not too rank ; rolling good in light soils.
18. Beneficial.
19. Rolling, one to ten dollars per acre ; harrowing uncertain.
20. No experience.
21. Harrowing worth 2 bushels per acre.
22. Rolling varies from one-half to 3 bushels per acre.
23. Adds ten per cent. to value of wheat.
24. Advantage, bnt seldom done in this section.
25. Governed by crop and kind of land.
26. Increased yield from 1 to 2 bushels per acre.
27. Harrowing and rolling always good, according to close or loose soil.
28. No experience.
29. Harrowing is good ; have not tried rolling.
30. Rolling valuable, harrowing injurious.

31. Cannot say from experience; both good, however.
32. Harrowing good; have tried it.
33. Never tried it, but think both good.
34. Pays best, hard dry winter.
35. Not practiced here.
36. Sometimes one is better, sometimes the other; harrowing for soft, the other for hard land.
37. Injures if ground is in condition.
38. Ten to 15 per cent.
39. High estimate on both; rolling best.
40. I am told it is a benefit.
41. I have no experience in either.
42. Twenty-five per cent. for rolling.
43. Owing to
44. Improved the crop a tenth.
45. Have never tried only on small scale. drilled and plowed with bull-tongue and hoed it. Yield was enormous.
46. Prefer the harrow.
47. Ten per cent in favor of both.
48. Either way is good.

What stage of ripening is most favorable for harvesting?

1. Rather in green state, the flour is better.
2. Full ripe for seed, ripe for flour.
3. Let it get ripe.
4. Good ripe.
5. For flour dough state, for seed fully ripe.
6. Soon as grain passes from dough state, straw changes color.
7. I prefer to cut before it is considered ripe.
8. For all purposes except for seed just ripe, for seed very ripe.
9. Just so ripe no waste occurs by shelling.
10. Just as the grain leaves dough state.
11. When it is in a hard dough state.
12. Don't see any difference from stiff dough to dead ripe.
13. When just hard enough not to shatter.
14. When straw is bright yellow, before grain is fully hard.
15. Just before thoroughly ripe.
16. Ripe, but before straw gets dry.
17. Just as wheat is getting out of the dough state.
18. A little under ripe
19. About five days before fully ripe.
20. Fully ripe.
21. Dough state.

22. When straw first reaches a clear yellow.
23. Just before heads turn or full ripe.
24. Fully ripe.
25. For good bread, soon after passing from bread to dough.
26. Stiff dough.
27. Ripe.
28. As it goes out the dough state.
29. Ripe. Cutting green seed makes smut also sowing in wet land.
30. Well matured, grain, hard.
31. Cut early, farmers prefer ripe.
32. Ripe so it won't shatter.
33. Good ripe without rust, pretty green with it.
34. Very soon after stiff dough stage.
35. Dough stage best for flour, but should be ripe for seed.
36. Medium hard berry and nice yellow straw.
37. When the head begins to turn down.
38. A little beyond stiff dough.
39. When the grain is hard enough to crush between the teeth.
40. Head and straw yellow, grain a little out of the dough.
41. Stiff dough.
42. In good dough.
43. When the grain is fully matured.
44. In dough state.
45. Stiff dough state.
46. Early.
47. For flour dough state, seed thoroughly ripe.
48. Cradling and Maying.

What kind of wheat yields the best flour ?

1. White.
2. White and Amber.
3. Boughton.
4. Little Red May wheat.
5. Tappahannock.
6. Boughton as White, and Walker as Amber varieties.
7. White, best flour.
8. Boughton or Golden-straw generally preferred, but Walker is best.
9. Boughton.
10. White flour preferred. I like a golden tinge to it.
11. Fulz, as I am told.
- * 12. White makes most, don't know about best.
13. White or Tappahannock.
14. Red-chaff.
15. Lancaster Red.

16. White wheat.
17. White, Tubman and Boughton.
18. As a practical miller, let wheat be good, that is the question.
19. Fultz.
20. White.
21. Sonnd wheat.
22. White wheat richest, Walker whitest.
23. Tappahannock.
24. Walker.
25. Boughton; depends on mill and time grinding.
26. White fairest, Mediterranean preferred by farmers for home use.
27. Amber.
28. Tappahannock.
29. Tappahannock.
30. Walker.
31. Cannot say.
32. Red-chaff—would like to know its name. [Name correct; see list of wheats.—ED.]
33. White.
34. Boughton and Walker when well matured.
35. Boughton.
36. Boughton wheat is superior to any wheat, and makes the best flour.
37. White Boughton.
38. Millers differ.
39. Boughton, Walker, Red, Purple-stem and Mediterranean.
40. White or Blue-stem.
41. White.
42. White.
43. Walker and Boughton.
44. Fultz and Golden-straw.
45. Amber, Red May and White, a new kind.
46. Amber best quality.
47. Boughton and other white wheats.
48. White.

Is it customary to pasture wheat, and to what time?

1. It should not be pastured unless very thick, and then not later than January 25 or first of February.
2. Some pasture until March 15; others do not.
3. Yes, until middle of March or first of April.
4. It is from February to March.
5. Yes, to March 1.
6. Partially, until February 1.
7. Only when very forward, say from February to April 1.

8. No; yet it is done by our best farmers sometimes for benefit of stock.
9. To a limited extent, not so much as formerly, until March 1.
10. Yes, to March 1 or 1st April.
11. Yes, to March 1.
12. Some good farmers pasture, some do not. Take off April 1.
13. No.
14. By some on early to March 1.
15. I pasture Lancaster red to April 10.
16. Not a general custom; sometimes when too forward; not after April 1.
17. Often done, but doubt the custom.
18. If ground dry, yes, until April 1.
19. To some extent until March 10.
20. Pasture until March 1.
21. Yes, till April 1.
22. I think it bad policy; stock eats small, and leaves large and manured spots untouched.
23. Not customary.
24. Some pasture till April 1, some don't pasture.
25. By some it is; do not approve, only to check growth in spring.
26. Yes, some to late in March.
27. Some do, but the practice is waning.
28. It is not customary, some do until March 1.
29. I pasture until March 1.
30. Not customary.
31. A good many pasture wheat, some until late in March.
32. When sowed early may be pastured until April.
33. Not when raised for profit.
34. Sometimes in a dry, warm fall, until freezes.
35. It is only practiced when wheat is very forward, to prevent damage from frost.
36. I never pasture under any consideration; I think it injures it.
37. If forward and ground dry, may pasture until first of April.
38. Not customary.
39. From November 27 to March 27.
40. I do not, but some do.
41. From December 1 to March 15.
42. Yes, in dry winter, until the first of March.
43. Until March 1 to 15.
44. It is, and a bad, ruinous custom it is, too.
45. Some do, generally to February and March.
46. Some do, some do not. I think pasturing predisposes to cheat.
47. It is, to March 1 usually.
48. Some pasture it in the winter.

Does pasturing wheat injure or benefit it?

1. I believe it is rather an injury.
2. Benefits if early, injures it if late.
3. Owing to circumstances.
4. Sheep or calves benefit it.
5. If not too close or too late it benefits.
6. If wheat is early and rank, and ground loose and dry, it is good; if wet not.
7. Very early is saved by it from frosts, otherwise injurious.
8. Rank or early it helps; if late it is injurious.
9. Nine times out of ten it is injurious.
10. Very early sown may be benefited; it is a mooted question.
11. Injures it at any time.
12. In proper manner and time it is good; if not it injures.
13. Injures.
14. Early is benefited, late is injured.
15. On good land benefits Lancaster Red, a strong grower.
16. Variable.
17. As a rule it is not benefited, but often injured.
18. If forward beneficial, otherwise not.
19. Sheep benefit it.
20. I think it injures it.
21. It helps the cows.
22. Can only benefit by packing earth, and rolling does it better.
23. Owing to circumstances; if too early, beneficial.
24. It is probably an advantage to pasture early wheat lightly.
25. Injures, as a general thing.
26. No, unless pastured until after March 1.
27. It injures beyond question.
28. I think it injures, causing cheat, smut, and making it late.
29. If rank pasture, if not do not; don't pasture when wet.
30. Very ruinous.
31. Sowed early is probably benefited by pasturing.
32. Many old farmers think it benefited if stock is kept off when ground is wet.
33. Injures and causes more or less cheat.
34. No benefit unless to keep out the fly.
35. I think it does not benefit it only to protect from frost.
36. In my experience it damages it.
37. If dry, no; if wet, yes.
38. Consider it an injury.
39. I think not.
40. Consider it injurious, but there is a difference of opinion.
41. I cannot think it a benefit.

42. It is an advantage to cattle and horses.
43. It is a great benefit.
44. Injures wheat and land.
45. I think it benefits new land if rightly done, but old it makes too hard.
46. I think it predisposes to cheat.
47. We think it injures on close land and benefits on loose.
48. I don't think pasturing any way can help it much at all.

Is blue-stone a positive preventive of rust (smut)? [This question was improperly presented. The question should have been does it prevent smut.]

1. It is good, but I think not a positive preventive.
2. No; I think it prevents smut.
3. Don't know.
4. No; it is of smut.
5. It is of smut.
6. No, but is of smut, so is salt.
7. Never heard of it except for smut.
8. Think not, but is for smut.
9. No, but is for smut.
10. Don't think so, but is of smut. Warm moist weather produces rust—don't follow hard freezes only on late sowing.
11. It is of smut.
12. Suppose you mean smut—it is if properly done.
13. Is not for rust but is for smut.
14. I think not, but is for smut.
15. Don't know if positive.
16. Don't affect rust; sure preventive of smut.
17. Wheat is not injured by smut if soaked in bluestone.
18. Yes, for smut.
19. It is considered so though have not tried it.
20. Does for smut—not rust.
21. Yes—smut.
22. Bluestone for smut only.
23. It is for smut.
24. Not for rust but smut.
25. It is for smut, not for rust—rain produces rust.
26. Never used it.
27. Smut yes, rust no.
28. I think it is, sown in due time, otherwise not.
29. No, it is caused by hot wet weather, but is for smut.
30. Not for rust but smut.

31. Not rust but smut.
32. It has proved so with me.
33. To a limited extent only.
34. It is for smut but not of rust.
35. It is not thought to be a preventive of rust.
36. Ten years since I soaked in bluestone and had smut, haven't tried it since and have had none.
37. It is for smut but not for rust.
38. I think not, but is for smut.
39. Don't affect rust but prevents smut positively.
40. Don't know—never used it.
41. I think not.
42. No sir, it is not.
43. I think not.
44. No sir-ree
45. It is positively no humbug.
46. I think not.
47. Can't tell.
48. I think *hit* is good.

What amount of bluestone do you use, and how long do you soak it?

1. I don't think you can use too much; one to two days' soaking.
2. Make a strong solution and soak all night.
3. None.
4. For smut, 2 lbs. for 12 bushels, soak 12 hours.
5. One pound to 5 bushels, soak 15 hours.
6. One pound to 10 bushels; 12 to 24 hours.
7. One pound to 8 bushels, sprinkle until all the heap is wet.
8. One pound to 5 bushels; 12 to 24 hours.
9. One pound to 5 or 6 bushels dissolved and sprinkled on wheat.
10. I make it strong and soak 24 hours.
11. One-fourth pound to a bushel; 12 hours.
12. Don't know exact proportions; 12 hours.
13. One pound to 10 bushels; 10 to 12 hours.
14. Two ounces to a bushel; 24 hours.
15. ———
16. One pound in 5 quarts of water, sprinkle and sow.
17. Dissolve enough to make the water blueish and soak one or two hours.
18. One pound to 5 bushels; 12 hours.
19. One pound to 10 bushels; soak 2 or 3 hours.
20. One pound to 10 bushels; 12 hours.
21. ———
22. I smut my wheat and don't use bluestone.

23. One ounce to a bushel ; 24 hours.
24. One pound to 10 bushels ; 12 hours.
25. One-fourth pound to bushel ; 12 hours.
26. ———.
27. So the wheat is saturated with a strong solution.
28. One pound to bushel ; 12 hours.
29. Four ounces to bushel first soaking, then add two ounces to bushel and soak again.
30. One-half ounce to bushel ; 24 to 36 hours.
31. Any amount ; 12 to 14 hours.
32. Twelve hours with blue water.
33. Never tried it much.
34. Three pounds to 10 bushels.
35. Blues'one is only used to prevent smut.
36. I do not use it under any consideration.
37. One pound to 5 or 6 bushels ; 24 hours.
38. One pound to 8 or 10 bushels ; 36 to 48 hours.
39. Three ounces to bushels ; sprinkle the heap until wet.
40. Use none, but it is soaked a night.
41. One pound to 7 bushels ; 24 hours.
42. One pound to 10 bushels ; 12 hours.
43. We've quit the use of bluestone.
44. Two pounds to gallon of water ; 10 hours.
45. One pound to 10 bushels ; 6 to 12 hours.
46. Never use it ; I rarely have rust or smut.
47. One pound to 5 bushels ; 24 hours.
48. Two ounces to the bushel.

Which is the best plan of harvesting—cradles or reapers—and which the cheapest ?

1. My opinion is, there is not much difference. Reaper's work is the best method for saving.
2. Reapers, reapers.
3. Cradles.
4. Cradles.
5. Reaper, if land is smooth ; not much difference in cost.
6. Reapers for large crops and lands smooth ; otherwise cradle.
7. Reapers decidedly, they cut so clean.
8. Reapers best and cheapest.
9. On heavy or tangled grain reapers best and cheapest ; on light, cradles.
10. Reapers by far ; cuts cleaner and saves enough to pay for reaper on a hundred acres.
11. Reapers cheaper, saves grain better.
12. Reapers.

13. Reapers.
14. Reapers, if prepared well, if not, cradles.
15. Reapers save cleanest, but cradles cheaper.
16. Use reapers when you can, cradles when you have to.
17. Where land is rough, cradle; when smooth, reapers.
18. Reapers, reapers.
19. Reapers when crop is good, cradles best and cheapest for poor crop.
20. Cradles, owing to condition of our land.
21. Cradles cheapest, reapers best.
22. Reapers best when it can be used. Rake will save 2 bushels more than cradles.
23. Reapers, reapers.
24. Reapers better and cheaper.
25. Reaper best and cheapest when it can be used.
26. Light wheat, cradles; reapers in heavy wheat.
27. Reapers.
28. Use both; cradles for poor, and reapers for rich land.
29. When labor is cheap cradles are cheapest.
30. Cradles, from the roughness of the country.
31. Reapers doing cleanest work, but cradles cheapest.
32. Reapers cheaper.
33. Reapers save the best but cradles never break down as badly.
34. Reaping, where ground will admit, is cheapest.
35. On smooth land where the reaper can be used it is the cheapest, on rough and steep land the cradle is preferred.
36. Good cradlers and good sharp cradles are the cheapest. I have a good drop-reaper and have thrown it aside.
37. Reapers all the time.
38. Cradles suit our country best.
39. Reapers are best and cheapest.
40. Reapers.
41. I think cradles best and cheapest.
42. Reapers best and cheapest.
43. We use the reaper very little.
44. Reapers, reapers.
45. Reapers in old land, cradles in new.
46. Very little difference.
47. Reapers—costs about the same.
48. Cradles are cheapest for small grain.

Please give your experience in raising wheat.

1. On fallow land, shallow plowing I prefer, unless done very early, then deep plowing. After this crop, plow and harrow. Will never sow without a good season. I prefer to sow on the full moon, never on

- the light if I can avoid it. My opinion is the straw will be shorter and grain heavier.
2. Raising wheat is rather a matter of necessity with me. The clear profit, as a rule, is but little for land, sometimes does well for pasture. Clover with wheat does well. A farmer should raise all he consumes on the farm, if the crop pays but little for labor and rent.
 3. I have raised 15 bushels to the acre. We will have to use fertilizers or quit sowing wheat. When are you going to visit Sullivan county? We need stirring up.
 4. I prefer raising wheat to any other crop. According to our present system of labor it pays best. I prefer sowing clover or oat land. Smut is our greatest trouble, and I prevent this by the use of blue-stone.
 5. I have had the best crops when I have plowed under in August a large crop of clover and weeds; then about the middle of September harrow the land; then sow one bushel per acre. Plow with short plows, running the furrows very close, but not harrow after plowing.
 6. The foregoing answers express my experience as well as I can in this small space.
 7. I have, after 10 years' experience, learned the ground must be clean of sprouts and briars. It is useless to sow in very poor ground without fertilizers. Stable manure is best, if it has no oats, cheat or cockle. Break well with turning plow July or August; harrow when it is not too dry; sow sound, clean seed, $1\frac{1}{2}$ bushels per acre from September 20 to October 20; put in with long gopher plow, without harrowing after sowing. Always wanted to roll, but had no roller. Would roll in February or March.
 8. Wheat sown in October makes best quality and most in quantity. I have raised as much as 30 bushels to the acre, but the general average is 12 to 14. This year I have 65 acres sown on clover with drill. I think it will average 20. I use no fertilizer.
 9. A good two-year old clover sod, on which plaster has been sown; both crops mown or pastured off; then plowed early and deep, harrowed and rolled until from $2\frac{1}{2}$ or 3 inches from the top soil is well compacted. Then drill in seed from Oct. 5. to Oct. 10 gives the best yield of wheat.
 10. I have made close observation for over 40 years, and above opinions have been yearly strengthened. I see clearly wheat is to be the crop of this portion of Tennessee. This, together with grasses and labor-saving machinery is to be the order of the day. Fifty per cent more machinery bought in 1877 than any previous year.
 11. There is no crop that pays the farmer better for thoroughly preparing the land than the wheat crop. Land half prepared will produce half crops. I am satisfied I can find plenty of land in Davidson

county with proper preparation and cultivation will yield 40 bushels of wheat per acre.

12. My experience in smut raising this year: I sowed 50 acres that the seed was well soaked. My bluestone was about to give out so I could not make the balance of my wheat (10 bushels) as strong with it as I wished, but thought it would do. The last 10 bushels is full of smut while there is none in the 50 acres.
13. Little experience—raise enough for family use.
14. Wheat should be sown early, at least by the 1st October, in order that it get fully set to the earth and the roots become matted in the ground. If not sown early I would wait until the first of December, so that the wheat will not freeze or spew out. November sowing is worse for that than early or late.
15. But a small amount of land in this county is in condition to make profitable crops of wheat, and we are too far from market also. My best yield is 18 bushels per acre, with an average of 13 bushels per acre.
16. Turn ground early as practicable, harrow when dry and roll if cloddy. Wheat fallow should be turned earliest. Turn clover sod in deep soil 10 or 11 inches, in light soil to the clay. Use all the stable manure you have, turning it under. Drill $\frac{3}{4}$ to $\frac{7}{8}$ bushels good clear seed to the acre, beginning about the 1st of October. If not previously manured, use 60 to 100 bushels best Peruvian guano to acre—drill it in with the wheat. Top dress in the spring with all the manure you have. If the wheat is too forward pasture with light stock when the ground is dry 'till the 1st of April. Sow one quart or three pints of Timothy seed with drill in fall, then three quarts of clover seed per acre in the spring. Plaster young clover as soon as fairly up. Let it stand one year then wheat again.
17. Clover land not plowed or mowed, limed 50 bushels to the acre before plowing, turned early or sub-soiled. Then at sowing time cross-plow thoroughly and harrow. Early sowing is the best if it escapes the fly. Wheat sown from the 25th of September to the 15th of October does well and is seldom injured by insects. Soak seed-wheat in solution of bluestone. Give your ground a top dressing of well rotted pulverized stable manure mixed with slaked ashes. Seven-eighths bushel white wheat, or other kinds same sized grains is plenty to sow to the acre. Sow more if larger grained. I have had 40 years' experience.
18. There is nothing absolutely certain except disappointment, and it comes as regularly as seed time and harvest.
19. I make a clover sod the foundation for a wheat crop. My plan embraces a six years rotation as follows: 1st. Corn on clover land which has been turned under in the fall. 2nd. Spring oats or millet. 3rd. Wheat, then clover for three years. I have all the ma-

nure we make on the oat stubble, and turn it under as soon as possible. In September the wheat is plowed in and harrowed. My crop for the past year has not been less than 22 bushels per acre and land improving.

20. I have about given you my experience in answering the above questions.
21. Take too long.
22. Wheat farming is the most delightful part of farming, and should share a large portion of the pride of every East Tennessee farmer. It yields the readiest return for manure, comes into market and always commands ready cash at a time when our farmers have no other crop to dispose of.
23. My best success was by breaking my land after cutting my wheat, sow in stock peas, pasture them off, break and sow to wheat again. By this method I greatly increase the yield, improve my land and get two crops per year.
24. I have been pressed for time to devote to this very important branch of industry, consequently the delay. Ever ready to do all I can.
25. I have raised five crops in the county and only one paid out, which was sown on clover; all other crops were sown after corn or oats. I think if we would sow more clover and use more fertilizers and lime we would do better raising wheat, and keep our lands in better state of cultivation for all other crops. There is no question but what wheat will pay tolerably well in this county after clover.
26. I make wheat crop one in the rotation of crops to follow clover. I use my fall manure on this crop and have, for some years, been able to average some 15 bushels to the acre on this land. We have no doubt the drill would be advantageous if fertilizers were used with it.
27. My experience is limited and not worth detailing.
28. My experience is limited. I have sown wheat for thirty years—most of the time in small amounts. One settled fact in my mind is that late sowing produces smut in spite of soaking in bluestone.
29. For clover or fallow land I turn as early as possible in July and August—never in September if I can avoid it—and harrow in if a heavy litter, if not, plow in closely with bull-tongues. Turn corn land if convenient, if not, plow with bull-tongues both ways and leave in that condition. Prefer manuring before plowing, or light top-dressing when well rolled—this should be done when dry or frozen. Never sow wheat when the land is wet, if I do I look for smut. I prefer sowing in dust.
30. When wheat is sown early it will stand the winter much better, and wheat raising in this country is to a great extent dependent upon the winter. If the ground is put in proper condition and has a dry May we will make very good wheat, particularly after or on clover land.

31. Although I have raised wheat for many years, it has been a sort of routine business, sowing mainly for home use and always on cotton land. It is true, some years the yield has been quite small, but I am fully convinced that the farmers of this county should raise wheat for home and non-producers of towns and villages.
32. I have been raising wheat ever since I have been farming. When I could get the wheat in the ground in good time, say by 15th of October, I have made at least a respectable crop. Last year I made almost a failure by planting late and in the mud.
33. It is a pretty hard way to get to heaven. Causes *more* anxiety than other crops on account of bad weather, diseases, etc. After clover or corn eaten down by hogs—can be made interesting and profitable. Without proper culture better let it alone.
34. My experience is limited, but find the early varieties to mature and the better state of cultivation the ground is in the less the wheat is liable to disease and the greater the yield and profit. Please send me a little of the earliest variety of stiff strand that I may experiment on it.
35. I have no great experience in raising wheat, though I raise some every year, but I'm satisfied that 20 bushels per acre is attainable with proper cultivation on our wheat lands, but the farming is carried on in such a bad manner that it does not yield more than half it ought to. We are lacking scientific knowledge, industry and enterprise.
36. In ten years my average has been 18 bushels per acre. I mostly sow on clover land, or, when I have an extra heavy crop of grass, turn it under. Two years in clover, turn under, last crop is equal to a good coat of stable manure. I turn ten inches deep if surface is not rough, and harrow fine with a 40 steel tooth harrow, then put in my wheat, harrow fine not later than the 1st of October. Plow deep, sow good seed, not too late, on good soil and I will insure you a good crop.
P. S.—I have wheat this year which will make $33\frac{1}{2}$ bushels per acre. It was grown on two river bottoms. An immensely heavy crop of grass was turned under which made the heavy wheat. It was two years in clover but that was all dead.
37. Fallow land as early and deep as possible with two-horse steel plow, sow and harrow in. Best yield after clover; does finely after peas and well after weed land if plowed early and well; splendid after cotton and good after corn. Sow from 1st of October to 1st of November; always plow deep and well.
38. My experience is that careless preparation is one great cause of the failures of a remunerative yield. I don't think on high dry lands the wheat is so subject to disease. I think along our river bottoms wheat is more subject to rust than anywhere else.

39. Land should be deeply broken in the month of September and 1st of October, then harrow well; sow and harrow in, which plan has attained better results than any I have ever adopted.
40. I don't consider much profit in it—I am for *grazing*. In this country if a man expects to make a living or money on wheat it will most break him up. There is about one out of fifty will make money out of wheat. We grass our lands and raise stock.
41. No answer.
42. I have been raising wheat twenty years and have made a success every year, not having made a failure, and from my experience I find that proper cultivation in good time with necessary fertilizing will ensure a crop.
43. Harvest when thoroughly ripe, then sow on light of the moon after extracting all the dwarf grains by scum or seive. Then roll in lime or ashes—is before bluestone in my own experience. I have had no smut since I tried the above.
44. For some years I have experimented with 38 different varieties of wheat. The most successfully raised and best of the white smooth is the Golden-straw, which ripens earlier and makes more flour and better grain than any other. I enclose some papers relating to my wheat, etc. I send also by this mail a sample of Golden-straw just as it came from the fan.
45. Not much since the war, but I have been a close observer and noticed all the pros and cons in wheat raising, as I had determined to abandon cotton for rest. To raise cotton year after year with no wheat, clover or grass, is like killing the goose that layed the golden egg. Nothing but ruin and devastation awaits the farmers if they continue this suicidal practice. Our lands are being washed away and forever ruined. The business of farming has become most disagreeable, harassing and unprofitable of all others.
46. I have been in the wheat raising and milling business for some years. Clover and stable manure, with the ground turned in July and August is the thing for wheat. Change your seed every year. Secure your seed from different soil and different climate. Put it in when the ground is perfectly dry if possible. Let it ripen moderately well before cutting. Let it sun well before hauling in or you will be troubled with weevil.
47. With thorough cultivation and judicious fertilizing we can and do make it profitable, but when we adopt the "slip shod" style usually practiced, it never pays. For level lands we don't get the best results from sub-soiling, but steep hill-side lands do much better for sub-soiling directly for the crop. Any lands are better for wheat when sub-soiled once in about three years, but not directly for the wheat crop. We practice soaking seed in strong brine about 24

hours and then rolling in lime—2 quarts to the bushel. Thus treated the crop is generally free from rust and smut.

48. I never raise much wheat for we have no mill in the country for grinding flour. You are a stranger to me and I to you. I live seven miles south of Huntsville. I would like to see you out here and show you the county. I got well acquainted with old Capt. Chandler when he was at the tunnel working the convicts. He can tell you about me.

EXPERIMENTS IN WHEAT CULTURE.

EXPERIENCE OF MAJOR VANDERFORD.

“Major C. F. Vanderford, of Rutherford county, one of the most successful and enthusiastic wheat growers in the State, gives his experience in growing wheat, through the *Rural Sun*, under date of August 13, 1877. He says:

Let me give a leaf from my own experience. Last fall I had no clover sod to turn for wheat. Eighteen acres of very broken, run-down land, which had been cultivated in very poor style by a tenant in 1875, and suffered to go to weeds in the spring and summer of 1876, was plowed last August. The work was well done, and completed by the 25th of that month. Nothing more was done until the first week in October, when the land was thoroughly harrowed and cross-harrowed, leaving the surface to a depth of three inches in very fine tilth. This piece was seeded by broadcasting three pecks per acre, and plowing in with bulltongues, finishing up by the 20th October. In November and December, as opportunity offered, about four acres of the poorest hill-sides were top-dressed with stable manure, about four thousand pounds per acre. In February of this year the field was harrowed and rolled. Yield of the eighteen acres, 378 bushels—twenty-one bushels per acre.

Sixteen acres of good land, from which in 1874, I harvested 580 bushels of Fultz wheat, had been planted to corn in 1875, and again in 1876. The corn was gathered late in October, stalks chopped down, the land well plowed and harrowed, and immediately thereafter seeded in same manner as the eighteen acres above mentioned. Yield 201 bushels—twelve and a half per acre.

This was simply from bad management. It was not good farming to grow two corn crops successively on the same ground; and it was worse still to put wheat upon such land. If the corn had been put into shock a month earlier, and the soil broken so as to lie three or four weeks before seeding, the result would have been somewhat better. My object was to get the various fields of the farm so arranged that hereafter a proper rotation may be practiced. I did not expect a very good crop; but the result was much worse than I looked for.

In the business of farming, as well as in all other undertakings, as much can be learned from failures as from success. It is of just as much importance to know what ought not to be done, as to know what ought to be done.

So far as I have heard, there will be an increased acreage of wheat sown this fall; and the probability is that nearly one and three-quarter millions of acres in this State will be devoted to this crop. In view of the immensity of the interests involved, I may be pardoned for making the following suggestions—premising that they are based upon actual experiences in the management of the clay limestone soils of Middle Tennessee.

First, and of supreme importance: Let good, clean, well-ripened seed, of the variety known to be best adapted to the soil, be obtained, if possible, direct from the grower. If seed must be purchased from the grain-dealers, buy only from parties of established reputation. In every instance of purchase from warehouses, or at second hand, let the grain be well soaked in the blue-stone solution. Smut spores are found in all grain warehouses, in railway cars, in second-hand sacks, etc. The cost and trouble of soaking seed is very little, and should never be omitted unless the seed be grown at home and known to be absolutely free of smut.

Second: Let the wheat land be plowed as early as possible. If a green crop of weeds, grass or clover, is to be turned under, every endeavor should be made to get this part of the work done by or before the middle of September, beginning with that part of the land which has the heaviest growth of weeds, etc. It is a good plan to so manage that annual weeds shall be turned down while in bloom, both because of the greater amount of fertilizing material, and that the weed seeds may not be suffered to ripen. At least six weeks ought to intervene between the breaking and the seeding of the land.

Third: On no account put a plow into the soil when at all wet. This is the most fruitful source of disappointment and loss.

Fourth: Prepare the soil for seeding by harrowing the surface, two or more times if necessary, to secure a fine tilth. This is essential. Cross-plowing is rarely, if ever, advisable, unless the breaking has been done unusually early, or the soil has been too much compacted by heavy rains.

Fifth: Put in the seed, either with the drill or by plowing in. A good crop from seed harrowed in is exceptional. If it were possible in our soils to place every grain at a uniform depth of one and a half inches, it ought to be done.

Sixth: After the seeding is completed, go over the field, and wherever there is probability of defective drainage, lay out and open wide water furrows, sufficiently deep and of proper fall to carry off immediately all surface water. These drains should be looked after during winter and kept open.

Seventh: Surface manuring or top-dressing, will always pay handsomely. This may be done from seeding time until the period of jointing in the

spring. Great care should be taken that manure applied upon the surface shall be evenly distributed. A small quantity will go a long way, thus applied. I have frequently used no more than four thousand pounds per acre upon land which had not produced ten bushels of corn, and thus secured more than twenty bushels of wheat. Note—The earlier the application, the more satisfactory the result.

Eighth: Harrowing in February or March, twice at intervals if possible, and only when the soil is in proper condition for working, will increase the yield on ordinary land from one to five bushels per acre. For this purpose, a sloped-tooth harrow, with numerous small teeth and those well-sharpened, will be found most useful. Upon the lighter soils, the roller should follow the harrow.

Ninth: All the operations of harvesting and threshing should be conducted with the most scrupulous care. At this time it is best not to be in too great a hurry. Cutting, binding and shocking should be nicely done.

All the advantages derived from previous operations are not unfrequently set at naught by a careless and wasteful harvest. A little here and a little there adds up to many bushels upon a large field. Judging from what I have seen of harvesting and threshing in Middle Tennessee I venture an estimate that the loss by slovenly harvesting in this State this year was not less than two millions of bushels—a year's supply for four hundred thousand people!"

IMPROVING WHEAT.

A California farmer has been making some experiments in planting wheat in hills, and cultivating as we do corn and cotton. In his last experiment he put only one seed in a hill, and the seed 26 inches apart, so that one pound of wheat planted an acre. On one half acre he harvested 40 bushels, and on the other half 30 bushels, making 70 bushels sound wheat from one pound of seed. At sixty pounds to the bushel, the return gives 4,200 pounds of this cereal from one pound, or a harvest of 4,200 fold. Nothing is more indefinite than the tillering of this grain, and the number of seeds that may be developed in each head. We have seen fifty stems from one grain in Tennessee, and have counted one hundred and sixty grains in one head of wheat in Western New York. In the town of Wheatland we had over 40 varieties of wheat under experiment in 1846. There is a farmer in England who raises 700 acres of "Pedigree" wheat in one year. Assuming that one seed will produce fifty heads in one year, and each ear contains one hundred and sixty seed, the harvest would be the enormous yield of 8,000 fold. We know but little about vital evolution, especially in regard to the cereal grasses. Pedigree plants are more important than pedigree horses and sheep.—DR. LEE, in *The American*.

VALUABLE EXPERIMENTS.

During the winter of 1870 I turned and subsoiled two acres of land. About the 15th of May I sowed it down with one bushels of cow peas to the acre; let the peas grow until the ground was covered with a luxuriant growth of vines, and until the earliest peas were fully grown, when I turned it all under, where it remained undisturbed until the middle of September, when I run a two-horse harrow over the surface and drilled three pecks of pure wheat to the acre. The yield was forty-one bushels, and I fed four shocks off to my hogs. A yield of five bushels to the acre under ordinary circumstances would have been a fine one. I sowed altogether forty acres which yielded $294\frac{1}{2}$ bushels, but ten acres with which I drilled unleached ashes, owing to the caustic nature of the ashes and the drought was a total failure. Fourteen acres of the remainder was put in without manure of peas, and yielded five or six bushels per acre. Seven acres of the remainder was well manured, and while I did not keep the wheat separate, yet I feel warranted in saying that it made over twenty bushels per acre. The remainder of my crop was fresh land, put in the usual way, but made a good yield. One crop in this vicinity, of about thirteen acres, sown in stalks on land that was something near medium in point of fertility, but which had been farmed on the corn and hay plan, yielded $18\frac{1}{2}$ bushels, or about $1\frac{1}{2}$ bushels per acre. You have, therefore, the two extremes of this vicinity.—[*T. of Athens Post*.

LARGEST YIELD OF WHEAT REPORTED IN THE UNITED STATES.

Mr. Herman Powers, in the Patent Office Report of 1853, makes this statement:

“The average crop of wheat in this portion of the State (Niagara city, New York) is about 25 bushels per acre, although in many instances from proper cultivation the yield has been more than double. My neighbor, Mr. Wm. Hotchkiss, who exhibited the largest yield at the World's Fair in London in 1852, on a field of six acres in 1848-50, averaged $63\frac{1}{2}$ bushels per acre of wheat weighing sixty-three pounds to the bushel. It attracted much attention from the wheat-growers of Europe, who could scarcely believe so much wheat could be taken from a single acre. There was nothing unusual in Mr. Hotchkiss' cultivation. He plowed deep, taking good care to pulverize soil well, and to intermix the top with the sub-soil, subduing grass, etc. The seed was drilled in near the end of August (1st October

here), two bushels of 'Soule wheat.' But extraordinary as this yield was, it was exceeded in the summer of 1853, by Mr. Thomas Powell, of this county, who averaged on a field of seven measured acres, within a small fraction of seventy bushels per acre, namely 489 bushels. This latter yield was so unusual I deem it proper to give the particulars of the method pursued in its cultivation. In the fall a heavy dressing of swamp muck was applied. During the winter the field was used as a yard for stock, including a flock of sheep. In May there was carted on a liberal supply of barn-yard manure, which was immediately plowed in very deep. Up to the 15th August it was used at night as a sheep-yard, when the field was again plowed three times, until the soil was perfectly pulverized and thoroughly intermixed with the manure. Then two bushels of "Soule wheat" was lightly plowed in, sown broadcast, and the process was completed. The "Soule wheat" in Western New York is the Genesee White Flint."

BYRD DOUGLAS' CROP.

For rent of wheat field.....	\$190 00
Paid for seed and soaking in bluestone, 44 lbs. per acre.....	35 00
Plowing, cross-plowing, harrowing and cross-harrowing 35 acres clover field.....	70 00
Cash for new drill \$75, sharpening plows \$8.....	83 00
Cash paid extra harvest hands \$70, use regular hands, reaper and 4 mules \$30, board of hands.....	128 00
Cost of hauling and stacking for threshing.....	66 50
Bill for threshing wheat paid Clees Bro.	108 00
Extra hands to attend thresher.....	70 75
Use of regular hands while threshing wheat \$8, board of hands \$27.25, making.....	35 25
Extra cost of stacking straw.....	15 00
Transfer of wheat to market and toll-gate.....	36 00
Warehouse charges for weighing, storing, etc.....	36 50
Warehouse commission, selling, etc.....	37 50
Total cost of production.....	\$ 911 50

CREDIT.

By sale of 63,975 lbs. No. 2 St. Louis Amber at \$1.46.....	1,556 82
By sale of 1,049 lbs. No. 2 St. Louis wheat at \$1.46.....	25 42
By sale 147 lbs. do.....	3 17
By present value drill.....	50 00
By value 20 stacks straw.....	150 00
Total.....	\$1,785 41
Net profits of 35 acres wheat.....	\$873 91
Per acre, nearly.....	25 00

Mr. Douglas was not less skillful in selling his wheat at top price than in providing a crop of clover to feed bountifully his wheat plants. He is a merchant as well as farmer. Shall we call the \$190 rent which he charges his thirty-five acre clover field, the value of the raw material consumed in making his staple? Wheat is not formed from nothing, while restitution to the soil of the elements of crops is found to be indispensable. Unless Mr. Douglas is willing to ignore the principle of feeding the land that feeds him, his statement should take account of the capital in the things sold off the farm in the shape of grain. If the elements of the grain taken from the soil have no value, that fact should be stated and the reason for it. We impoverish land more now in one year than in ten years fifty years ago, by our improved implements in tillage and husbandry. Hence the necessity of restitution to the soil. One Tennessee farmer, writing to a Northern journal, says his wheat yielded over sixty-seven bushels per acre, according to the "report of a committee." Such crops prove that the climate of Tennessee is very favorable to this cereal; for the Cleveland farmer who gets sixty-seven bushels from an acre, has no better climate than thousands who harvest only one-tenth of the quantity named per acre. The causes of this wide difference in yield should be universally known, and we shall pursue the discussion in the future, to show why 40 lbs. of seed give one man a harvest of sixty-seven bushels, and another man not over six or seven bushels.—DR. LEE, in *The American*.

MARK COCKRILL'S CROP.

FULTZ WHEAT.

The land was clover lay, and broken up in August and September with a three-horse plow; harrowed immediately afterward with Share's harrow; rebroke in September with two horses; sowed broadcast from 1st to 10th October, three pecks to the acre; plowed in with double shovels, and har-

rowed with a hollow-tooth harrow. Yield, twenty-three bushels to the acre.

On corn-land the wheat was sown about 1st October, on plats of ten acres, and the double shovels run both ways. Yield, fourteen bushels per acre.

1877.—COST OF RAISING WHEAT ON 28 ACRES OF CLOVER LAND.

Cost of breaking with three horses, 28 acres, at \$1 33.....	\$37 24
Cost of harrowing three days, at \$2 25 per day.....	6 75
Rebreaking with two horses.....	32 76
Harrowing with broad harrow, covering 11 feet.....	2 00
Sowing, one man two days.....	2 00
Seed wheat, three pecks per acre, at \$1 25 per bushel.....	27 25
Plowed in with double shovels.....	7 00
Harrowing after sowing.....	2 00
Cost of use of Reaper, at \$1 per acre.....	28 00
Five binders, at \$1 for 2½ days.....	11 66
Three shockers, at \$1 for 2½ days.....	7 00
Two two-horse wagons for two days, at \$3.....	12 00
Two four-horse wagons for two days, at \$3 50.....	14 00
Twelve men for two days, at \$1.....	24 00
Toll paid threshers, one-tenth, 644 bushels, at \$1 37.....	88 22
Hauling to market, 579.6 bushels, at 2 cents.....	11 59
Rent of land, 28 acres, at \$5.....	140 00
	<hr/>
	\$453 47

CR.

By 644 bushels, at \$1 37.....	\$872 28
Deduct cost—raising, threshing, etc.....	453 47
	<hr/>
	\$428 81
Fourteen tons of straw at \$5.....	70 00
	<hr/>
Total.....	\$498 81
Amount net per acre.....	\$17 81
Equivalent to.....	22 81 for rent.

COST OF RAISING 65 ACRES OF WHEAT ON CORN LAND.

Seed wheat, 65 bushels, at \$1 25.....	\$ 81 25
Sowing 5½ days, at \$1.....	5 50
Plowing in two days with double shovels.....	32 50
Cost of cutting corn stalks.....	6 50
Use of Reaper, \$1 per acre.....	65 00
Four binders, four days, at \$1 each.....	16 00
Two shockers, four days, at \$1 each.....	8 00
Hauling two days with four wagons.....	26 00

Seventeen men at \$1, for two days.....	34 00
Toll, one-tenth, 91 bushels, at \$1 27.....	115 57
Hauling 819 bushels, at 4 cents.....	32 76
Rent of land, \$3 50 per acre.....	227 80

\$650 58

CR.

By 910 bushels wheat, at \$1 27.....	\$1,155 70
Deduct cost.....	650 58

Net proceeds.....	\$ 505 12
Add straw, twenty tons, at \$5.....	100 00

Total net proceeds.....	\$ 605 12
Amount net per acre.....	9 31
Equivalent to rent per acre.....	14 31

REPORT OF MAJ. R. I. WILSON, CHAIRMAN OF FARM COMMITTEE OF THE EAST TENNESSEE UNIVERSITY.

KNOXVILLE, July 24, 1877.

I have the honor to report the wheat crop growing on College Farm this season under the management of Mr. Robt. Cummings, Farm Superintendent. The ground occupied consisted of field "B," four acres, and field "A," seven acres; total eleven acres. Field "B" had its last crop in corn, manured at the rate of twenty five cart loads to the acre. It was broken up with double plows from 14th to 18th September, 1876, harrowed and cleared of trash, then cultivated. On the 27th October it was sown with five bushels of wheat put in with a drill. It was cut June 19. Field "A" had for its last crop corn on a clover lay. October 6, 1876, began cutting corn-stalks and cleaning up the field. The ground was then deeply plowed, twice harrowed, and once rolled with a heavy iron roller. It was exceedingly dry. October 26, manured with 225 bushels of lime and muck or river soil, in equal parts. October 26, wheat sown at the rate of $1\frac{1}{2}$ bushel per acre, cross drilled. March 5, 1877, on five acres ten bushels salt spread. June 18, crop cut. From the beginning, field "A" was a little better looking and continued so. The cross-drilling spread the seed more evenly over the ground, and as a consequence the stalks were more uniform in size and ripened more evenly. The five acres of salt d wheat took on a brighter color and continued so. The two fields yielded, of first-class wheat, 337 bushels, being an average of little over 30 bushels an acre. Counting the screenings and tailings, the amount was fully thirty-one bushels per acre. Below I give a detailed statement of expenses of the

crop, taken from Mr. Cummings' book. From the figures given, that field "A" cost at the rate of \$14.10 per acre; field "B" at the rate of \$7.75, being a difference of nearly two to one. This difference is due to the amount of salt and manure applied to "A" and not to "B." Field "B" had received last year nearly one hundred loads of manure, which rendered it unnecessary to apply any this season. In this case we have an illustration of the great difficulty of rigidly estimating the cost of any given crop. Unquestionably "B" was greatly benefited with the manure left over from the preceding corn crop, and in strict justice should be charged with a part of the cost, but just how much it would be impossible to say. The only experimental features in the crop are the cross-drilling and the salting. I have tried the first with success heretofore; of the other I have no experience, and the testimony of others is about equally divided for and against salting. In this case it seemed to be a good thing to do, but I should require several seasons' trial before recommending the practice. The wheat was sold to Mr. J. P. Beech, whose skill as a miller has already rendered his brand "gilt-edged" in the best markets.

Respectfully submitted,

HUNTER NICHOLSON.

EFFECTS OF LIME.

Mr. P. M. Reeves, of Johnson City, gives to the Knoxville Chronicle some interesting experiments with lime. Its effects upon the production of wheat, according to his statements, are very great. Lime should always be applied to soils where there is a heavy growth of vegetable matter. It hastens the decay and corrects the acidity engendered by the decomposition of vegetable matter.

The chemical effects of lime are,

1st. It combines with the acids and sweetens the soil. The compounds formed enter the roots and feed the plants.

2nd. It decomposes the compounds of alumina, iron and magnesia, and renders them harmless to vegetation.

3d. It decomposes organic matter.

4th. It renders soluble the nitrogen in the soil.

Mr. Reeves, in the communication referred to, says:

"I have been experimenting with lime since 1869, and, from careful tests, I think I can not be mistaken when I say that as small a quantity as 50 bushels to the acre will do so little good that no difference will be noted. The smallest amount which I have found to be of value is 140 bushels per acre, and this amount is much too small. I have fields that have re-

ceived the following grades of measure: 140, 250, 300, 350, 450 and 550 bushels per acre, all of which, except the last, have been tested in culture, and the best results are from the larger quantities.

I have tried the mode of plowing under soon after applied, and find it a serious error. With such treatment, no favorable results are appreciated until after the soil is turned back and allowed to remain (the lime exposed) for at least one season.

My experience is, that the true mode consists of allowing the lime, after being evenly scattered over the surface, to remain thus for at least twelve months, and, if for two years, all the better.

I will leave the agricultural chemists to explain how and why such favorable results follow; only I will state this much: After the lime-dressing has remained about one year, the soil, which before looked like a brick surface, shows a green mould of a mossy character. This largely increases the second year, when the plow may be used with the assurance of a good crop. Were I to make a chemical guess, it would be this: that the limed surface attracts the gases from the atmosphere, (formed from decaying vegetable matter) and thus forms and combines with the soil (or clay), the salts of a fertilizing character. A lime dressing is valuable, if thus left exposed, for a clay surface, where the soil has all been washed off, but if the dressing be soon turned under and remains, no good results are noticeable.

My mode of applying the lime is to haul out as soon as it is cool enough; deposit in regular heaps, and as soon as slaked scatter evenly over the surface.

The land upon which I have been experimenting has been in cultivation from 55 to 60 years. About one-half of the area is what may be called oak and hickory, and the other chestnut land. At the time I commenced using lime, (I refer to that receiving the dressing 350 to 450 bushels per acre), the best yield of wheat was not above seven bushels per acre. Now, for the past three years, the yield has been from 25 to 26 bushels per acre. Before the lime was applied 20 to 25 bushels of corn was the best average yield. Now the yield is from 45 to 50 bushels. Before lime was applied, clover would die out the first year after sowing, now it sticks well and gives a good yield of hay and of seeds the same as to timothy.

Another feature: What we call wire grass and sheep sorrel (both noisome pests) disappear after the ground is well limed. The labor of preparing the wood and rock and burning the lime cost me not in excess of 1½c. per bushel. As will be seen, the increase yield for one year is largely in excess of the expense of liming; and, after several years continued crops, the improvement to the soil seems of a permanent character; that is, it seems to be restored to something like its condition and strength soon after it was first cleared.

To apply the facts as I have learned them by experience, take one acre of land not worth for cultivation more than ten dollars, and put 500 bushels of lime on it, at a cost of \$7.50, and after two years chemical operation the acre is worth at least thirty dollars.

I fully believe that there are at least 200,000 acres of land in East Tennessee badly needing lime, and now not worth more than \$2,000,000, but which if treated to the lime per acre I suggest, at a cost of \$1,800,000, will be worth fully \$6,000,000, a net gain over all expenses, of \$2,200,000. Apply the figures to a single farm, say of one hundred acres, now worn to a hard clod-formation, *blossoming out with red knots*. As a farm, this one hundred acres is dear at one thousand dollars. The owner feels he is doing his best if he gather 700 bushels of wheat, or 2,500 bushels of corn from it, but let him add 50,000 bushels of lime to it, at a cost of \$750, making the starting value and cost of improvement amount to \$1,750, and it is worth to him \$3,000. Why? Because it yields him 2,500 bushels of wheat (1,800 bushels more), or 5,000 bushels of corn, (2,500 bushels more). Farmers with worn out land should "go to liming" instead of "going West." Just now burning lime pays better than any other labor."

STATISTICS OF WHEAT.

EXPORTS OF WHEAT.

As an exhibit of the important position the United States occupies as a grain-growing country, and her capacity to feed foreign nations, I append the statistics of the exports from 1865 to 1877, inclusive. By referring to these tables it will be seen we are not only feeding our own population, but we are also contributing largely to the support of the teeming populations of Europe. Many countries, from their peculiar location as climate, etc., are unable to feed their people, and they must consequently draw upon other countries situated in more favorable localities, while they themselves must engage in such pursuits as will afford them the means of purchasing these supplies. Still other nations have such a dense population the soil is not capable of feeding it, and these also must go elsewhere for food. England belongs to the latter class. Even now gaunt famine, with her aid, pestilence, is stalking over the plains of India, destroying thousands of the poor natives, and the armies of two great wheat-producing nations, Russia and Turkey, are marshalled in hostile array, taking from the country the laboring classes, thus cutting down their own products; while we, with bursting barns of cereals, are awaiting the call to empty them. These and other causes will make the present crop of great value to us, and the fluctuations of prices are now due to combinations of purchasers, and as a consequence will be temporary. We think the agri-

culturists of America need have no fear of the ultimate remunerative price of all her breadstuffs, not only for the present but for the next year.

STATEMENT QUANTITY OF WHEAT AND FLOUR EXPORTED FROM 1825 TO
JUNE 30, 1877.

	BUSHEL OF WHEAT.	BARRELS OF FLOUR.
Five years ending in 1830.....	125,547	4,651,940
" " " 1835.....	614,145	5,241,964
" " " 1840.....	1,842,841	4,092,932
" " " 1845.....	2,946,861	6,274,697
" " " 1850.....	10,184,645	12,284,828
" " " 1855.....	16,446,955	13,149,518
" " " 1860.....	38,898,573	15,778,268
" " " 1865.....	138,306,907	19,757,733
" " " 1870.....	81,808,364	11,451,785
For 1871.....	34,304,906	3,655,841
" 1872.....	26,423,080	2,514,535
" 1873.....	39,204,285	2,562,086
" 1874.....	71,039,928	4,094,094
" 1875.....	53,047,179	3,973,001
" 1876.....	55,073,122	3,935,512
" 1877.....	40,325,611	3,343,665

STATEMENT SHOWING THE VALUE OF WHEAT AND FLOUR EXPORTED
FROM 1865 TO 1877 INCLUSIVE, FROM JUNE 30 TO JUNE 30.

	WHEAT.	FLOUR.
1865.....	\$ 19,308,028.....	\$27,507,084
1866.....	7,842,749.....	18,396,686
1867.....	7,822,555.....	12,803,775
1868.....	30,247,632.....	20,887,798
1869.....	24,383,259.....	18,813,865
1870.....	47,171,229.....	21,169,593
1871.....	45,143,424.....	24,093,184
1872.....	38,915,060.....	17,955,684
1873.....	51,452,254.....	19,381,664
1874.....	101,421,459.....	29,258,094
1875.....	59,697,863.....	23,712,440
1876.....	68,382,899.....	24,433,470
1877.....	47,135,562.....	21,663,947

STATEMENT SHOWING THE EXPORT PRICE OF WHEAT AND FLOUR.

YEARS.	WHEAT PER BUSHEL.	FLOUR PER BARREL.
Ten years to 1840.....	\$1 04	\$6 06
Ten years to 1850.....	1 19	5 41
Ten years to 1860.....	1 35	6 25
Ten years to 1870.....	1 35	7 22

STATEMENT SHOWING THE NUMBER OF BUSHELS GROWN IN THE UNITED STATES FOR THE FOLLOWING YEARS.

	Bushels.
1869	287,745,620
1870	235,684,700
1871	230,722,400
1872	249,997,100
1873	281,254,700
1874	309,102,700
1875	292,136,000
1876	289,356,500
1877	325,000,000

The average annual production for the past five years has been about 284,000,000 bushels, of which about 65,000,000 were exported. The amount kept at home was about 219,000,000 bushels, of which about 33,000,000 were used for seed. The exports from Tennessee now average about 6,000,000 bushels per annum.

AMOUNT GROWN IN TENNESSEE ACCORDING TO THE ESTIMATE OF AGRICULTURAL DEPARTMENT AT WASHINGTON.

	Bushels.
1869	6,188,926
1870	7,357,000
1871	5,149,000
1872	10,298,000
1873	7,414,000
1874	11,121,000
1875	13,130,000
1876	11,260,000

The acreage and value of the wheat crop for this State in

	Acres.	Value.
1875.....	1,544,705	\$13,261,000
1876.....	1,356,626	10,071,800

The crop of 1877 will probably go to 11,000,000 bushels, valued at \$13,200,000.

AN ESSAY, READ BY JOHN M. MEEK, BEFORE THE EAST TENNESSEE FARMERS' CONVENTION, HELD AT KNOXVILLE, ON THE 10TH OF OCTOBER, 1877.

Topic—The Proper Time to Sow Wheat.

In the brief time allotted for the consideration of this subject, only a few of the most important facts gained from observation and experience

in the culture of this cereal may be presented in connection with what has been learned from the tested results and experience of the most successful wheat producers of the world. The first suggestion, then, presenting itself for consideration, in determining the proportion to sow wheat, is climatic influence, and the kind of wheat sown—though, inasmuch as very little spring wheat is grown in this latitude, our inquiries may be limited to the proper time of sowing fall or winter wheat. With proper information as to the probable changes of weather induced by the recurring seasons, we may determine, with a sufficient degree of certainty, the proper time to sow; and it may be stated here, in general terms, that this time is included between the 15th of September and the 25th of October; notwithstanding, wheat sown previous to and succeeding these dates has been known to produce good crops. These dates are considered the extremes, and a safe mean between them, as in most other enterprises, is more surely to yield profitable results.

It may again be stated, as a general maxim, that the proper time to sow is when the ground has been put in proper condition to receive the seed. To determine this requires a knowledge of the natural history of the plant, its chemical needs, and necessary environments, to insure a healthy and vigorous growth and prolific yield. The farmer who has produced fifty bushels of wheat upon an acre of Tennessee soil can better elucidate this phase of the subject, than he who has produced ten bushels per acre.

The time to sow is also governed, to a great extent, by the kind of soil upon which it is determined to sow wheat. If it be stiff clay loam, it demands early seeding, because, in such soil, more time is required for the germination of the seed, demanded by its greater resistance to atmospheric influences. If, on the other hand, it be a light, porous soil, such as is found in the limestone formation, or the rich alluvial deposits, it will bear later sowing, for the reason that such soils respond readily to atmospheric forces, and hasten germination.

Time should be given the plant to fortify itself against the rigorous assaults of winter, by a sufficient growth of lateral roots.

The tap root is easily broken by the lifting process of freezing, and if the plant is not supplied with lateral roots, it is killed, or makes but a feeble growth preceding the time when all its strength is demanded to produce the stalk, the blade, and the full grain of wheat. The average production of wheat per acre in Tennessee, which is about eight bushels, would seem to indicate that there is no proper time within our limits in which to sow wheat. On the other hand, isolated cases, in which the yield has been made to reach as high as sixty bushels per acre, demonstrate beyond a doubt that there is a proper time.

The average farmer may not be able to reach so great a yield as this, unless the average production can be raised from its present low rate, it is a fact capable of demonstration that there is no proper time to sow wheat in the State of Tennessee. The farmer, to be successful, cannot

give time to the production of unremunerative crops, and no intelligent farmer will agree that eight bushels of wheat per acre will pay cost of production, and leave sufficient margin to justify its cultivation as a source of profit.

But it has been shown that, with our advantages of soil and climate, thirty, forty, fifty, and even sixty bushels per acre may be produced, when it surely follows that there is a proper time for sowing, which may be determined by a close observance of the growth, habit and food of the wheat plant. In addition, it is necessary to know, also, whether the soil is in a condition to meet those requirements. It is, then the natural history and physiology of the plant will indicate the time of sowing with the necessary safeguards against its enemies. Here is opened a wide field for research, and the acquisition of valuable information. It may be objected by some that this will demand too much of the farmer's time. So it has been urged since the time when Cincinnatus left the plow-handles to guide the Roman Empire; yet it has slowly dawned upon the world, through the labors of such men as Leibeg, that successful and intelligent agriculture demands more patient research, and a higher degree of administrative ability, than any of the learned professions. The solution of the question, then, as to the proper time to sow wheat, resolves itself thus: The necessary ability and willingness on the part of the farmer to acquire and practically apply, in the cultivation of his fields, the knowledge that is acquired in the successful cultivation of this mighty agent of civilization.

The want of this information has already depleted our once fertile lands of their productive strength, and barren fields, with bristling sedge scattered over our State, are the sad monuments of our lamentably and ignorance. Chronic discouragements rest like an incubus upon the productive energy of our people, and many are silently gathering their household goods and seeking homes elsewhere. For those of us who remain there is left a great work. The resurrection of our drooping energies, and the re-animation of our faith that there is life in the land yet, is ours, and the preservation of the heritage once so rich in possibilities. It is ours to stimulate the flagging zeal of toiling masses, and attract the introduction of new people, energy, and capital. It is left us to show to the world that God has given us the fairest domain the sun ever shown on, with capabilities of wealth, such as were never dreamed of by the pioneers of the Western World. We can do this by intelligent farming, by increased production, by increased immigration to take the places of those leaving us, by clothing our fields in grass and clover, and covering them with herds of blooded cattle and flocks of thorough-bred sheep; and thus demonstrate that there is a "proper time to sow wheat" by an increased yield of from thirty to sixty bushels per acre, and that we have discovered that time to be in accordance with intelligent culture and wise rotation of crops.

ON THE BEST MODE OF PREPARING STRAW-CHAFF FOR FEEDING PURPOSES.

By Dr. Augustus Voelcker, F. R. S.

Mr. Samuel Jonas, of Chrishall Grange, Saffron Walden, England, gave an interesting account of a plan of preparing straw-chaff for feeding purposes, and preserving it for winter use, which he found extremely useful in practice.

The peculiarity of Mr. Jonas' plan consists in the use of a small quantity of green rye or green tares as a fermenting agent.

Mr. Jonas, who for many years has been a great advocate for the consumption of a large portion of straw chaff for feeding purposes, uses a twelve-horse power engine by Hornsby, for threshing, dressing and bagging the corn ready for market, and cutting the straw into chaff at the same time. With a ton of straw-chaff he uses about one hundred weight of rye or tares, cut green into chaff, and one bushel of common salt. This is done in spring and summer; the chaff is not used until October or the winter months.

The addition of the green stuff causes the straw-chaff mixture to heat; the volatile and odoriferous principles produced by the fermentation are retained by the straw-chaff, itself undergoing a kind of slow cooking process, and they impregnate the whole mass with an extremely pleasant flavor, scarcely inferior to that which characterizes well made meadow-hay.

It appears to me interesting if not useful to compare the nutritive properties of straw-chaff, prepared according to Mr. Jonas' plan, with ordinary wheat straw, and I therefore made a careful analysis of a sample of chaff taken from the bulk at Chrishall Grange, and kindly supplied to me by Mr. Jonas.

The following results were obtained in the analysis of this straw-chaff:

Moisture	7.76
Oil and fatty matter	1.60
Albuminous compounds (flesh-forming matters)*.....	4.19
Sugar, gum and other organic compounds soluble in water.....	10.16
Digestible fibre.....	35.74
Woody fibre (cellulose).....	34.54
Insoluble mineral matter (chiefly silica)	3.20
Saline mineral matters (chiefly common salt).....	2.81

	100.00

*Containing nitrogen, .67.

In explanation of the term woody fibre (cellulose) in the preceding analysis, I would observe that it applies to that portion of the straw-chaff which remains behind after successively boiling the material with water, dilute sulphuric acid and dilute caustic potash solution, and exhausting

the residual dried substance with alcohol and ether. There can be no doubt that the different alkaline and acid secretions in the animal organism exercises similar, probably even more energetic effects upon straw than these successive exhaustions with various chemical agents in the laboratory. The treatment with dilute acid and alkali, therefore, affords a better insight into the digestibility of the bulk of straw than the mere exhaustion with water. Let us now compare the preceding analytical results with the composition of ordinary wheat chaff.

The following is the composition of a sample of well harvested wheat straw, which was neither under nor over ripe:

Moisture.....	13.33
Oil and fatty matter.....	1.74
Albuminous compounds (flesh-forming matters)*.....	2.93
Sugar, gum and other organic compounds soluble in water.....	4.26
Digestible fibre.....	19.40
Woody fibre (cellulose).....	54.13
Insoluble mineral matter (chiefly silica).....	3.08
Saline soluble mineral substance.....	1.13
	<hr/>
	100.00

*Containing nitrogen .47.

A comparison of the composition of ordinary good wheat straw with that of straw-chaff prepared by the system pursued by Mr. Jonas, brings out several points of interest, on which a few observations deserve to be made.

1. In the first place it may be remarked that both kinds of straw-chaff contain about the same proportion of oil. The oil exhausted from straw by means of ether has a bright yellow color, is sweet to the taste and renders straw more palatable and more nutritious than it would be without this constituent. It is appreciable in quantity, for according to the preceding data, one ton of straw-chaff contains about thirty-nine pounds of oil.

2. It will be seen that fermented straw-chaff contains rather more than four per cent. of albuminous or flesh forming compounds, whereas ordinary wheat straw contains in round numbers only three per cent. The prepared wheat chaff, therefore, is one-fourth richer in materials which produce the substance of the lean fibre of meat, or the muscle.

3. Common wheat straw, of good quality, contains about four and a half per cent. of sugar, gum and similar soluble organic compounds. In over-ripe straw the amount of these soluble matters is less. On the other hand, in the sample of fermented straw-chaff analyzed by me, the per centage of sugar, gum, etc., amounted to 10.16, or nearly two and a half times the amount which occurs in good unprepared wheat straw. The much larger proportion of sugar and other soluble matters in the fermented straw, no doubt, is due to the green stuff employed in its preparation; but, at the

same time, the process of heating the mixture, it is quite probable, may have had the effect of rendering the chaff more soluble in water.

Bearing in mind that the chaff prepared by Mr. Jonas contains so large a proportion of succulent matter, it is no wonder that cattle and sheep are fond of it, and thrive upon it in a much higher degree than upon ordinary wheat straw.

4. A comparison of the relative proportions of digestible and of woody fibre in fermented wheat-chaff, with their proportions in common wheat straw, exhibits striking differences, which cannot fail to arrest the attention of stock-feeders.

Taking together digestible and woody fibre, we have, in the fermented straw-chaff, 70.38 per cent., and in ordinary wheat straw 73.53 per cent; showing a slight difference in favor of the fermented chaff, which, being richer in sugar and other matters soluble in water, contains about three per cent. less vegetable fibre than common wheat straw.

When the vegetable fibre of each kind of straw-chaff, or the material insoluble in cold and boiling water, is treated with dilute acids and alkalis of the same strength, for the same length of time, and in all other respects precisely alike, a certain proportion of the vegetable fibre is rendered soluble. This soluble portion figures in the preceding analysis as digestible fibre; whilst the matter insoluble after treatment with the various chemical agents, is termed indigestible or woody fibre (cellulose).

Although it is not meant to convey by these terms, the idea that animals have the power of resolving crude vegetable fibre into digestible and into woody fibre, in precisely the same ratio in which we can separate them in the laboratory, a tolerably good opinion may be formed of the relative digestibility of various foods consisting principally of vegetable fibre, by submitting them to the process usually employed in the laboratories for the determination of woody fibre.

In the cases before us, it will be seen that, of the total amount of vegetable fibre present in the fermented wheat-chaff, thirty-five and three-quarters per cent. were rendered soluble by the treatment prescribed, and thirty-four and a half per cent. (in round numbers) left behind as indigestible woody fibre, whilst the seventy-three and a half per cent. of vegetable fibre present in common wheat straw chaff were resolved, by treatment with dilute acid and alkaline liquid, into nineteen and a half per cent. only of digestible, and into fifty-four per cent. of indigestible woody fibre. In other words, the same treatment rendered soluble 59.85 per cent of the vegetable fibre of the fermented prepared chaff, and only 26.38 per cent. of the fibre of common wheat straw.

These differences are very marked, and well calculated to explain, in a great measure, the great superiority of the fermented chaff as a feeding material over the common straw-chaff.

The fermentation to which the straw is submitted in Mr. Jonas' plan, thus has the effect of rendering the hard and dry substance which consti-

tutes the bulk of straw more soluble and digestible than it is in its natural condition. But, as useful as is the effect of the slow and moist heat, developed in the mixture of straw-chaff with green rye or cut tares, which is no doubt in rendering the fibre of the chaff more digestible, this is not the only recommendation of Mr. Jonas' admirable plan of preparing a really very nutritive and important food for stock.

Another recommendation is, the extremely delicate flavor and the palatable condition which is conferred upon the straw in the process of fermentation. The prepared straw-chaff kindly sent to me by Mr. Jonas had all the agreeable smell which characterizes good green meadow-hay, and a hot infusion with water produced a liquid which could hardly be distinguished from hay tea.

Although fermented chaff resembles hay so much in taste and smell, it need hardly be stated that the latter is more valuable for feeding purposes. However, the difference in the nutritive properties of meadow-hay and straw chaff made from rather under-ripe wheat straw prepared and fermented in accordance with Mr. Jonas' directions is not so great as might be imagined by some. A little cake, ground into meal and sprinkled over the chaff, would go far to obliterate the difference in the feeding quality of the two kinds of chaff.

I would particularly recommend for that purpose a cake rich in albuminous compounds. Green German rape-cake, or decorticated cotton-cake, added to the straw-chaff in but small quantities, will bring up the percentage of albuminous compounds to what it is in good meadow-hay. Best decorticated cotton-cake contains about forty per cent., green rape cake about thirty-three per cent., and the finest linseed-cake from thirty to to thirty-two per cent. of albuminous compounds. About 2 cwts. of decorticated cotton-cake, ground into meal and added to one ton of fermented straw-chaff, presuming it to have always the same composition as the sample analyzed by me, I find constitutes a mixture which agrees closely in composition with good meadow-hay.

In order to enable others to compound a mixed food from straw-chaff, resembling in composition good meadow-hay, I have placed in the following table the analysis of ordinary wheat straw, of the fermented sample, and the mean results of twenty five analyses of common meadow-hay:

	COMPOSITIONS OF		
	Common meadow-hay.	Fermented and prepared straw-chaff.	Wheat-straw chaff.
Moisture.....	14.61	7.76	12.33
Oil and fatty matter.....	2.56	1.60	1.4
Albuminous compounds (flesh-forming matters)*.....	8.44	4.19	2.93
Sugar, gum and other soluble organic compounds.....	41.07	10.16	4.26
Digestible fibre.....		35.74	19.40
Indigestible woody fibre (cellulose)	27.16	34.54	54.13
Mineral matter (ash).....	6.16	6.91	4.21
	100.00	100.00	100.00
* Containing nitrogen.....	1.35		.4

Meadow-hay, it will be seen, contains rather more than twice as much albuminous or flesh-forming matter as the sample of straw-chaff of which the analysis is here given; hence the advisability to add to the latter some oil-cake, which, moreover, will have the effect of raising the percentage of oil, and bringing it up to about the same amount as is found in meadow-hay.

Chaff, especially if made from over-ripe straw, is not much liked by sheep and cattle, on account of its insipid taste and harshness; and considerable difficulty is experienced to induce stock to consume straw-chaff in as large a quantity as is desirable. To meet this difficulty, several stock-feeders with whom I am acquainted have found it useful in practice to use straw-chaff with some treacle previously diluted with sufficient water to impregnate uniformly the chaff with the sweet liquid. The only fault I have to find with this otherwise good plan of rendering chaff more palatable is, that the farmer has to pay from £13 to £14 per ton for the treacle, and obtains in that material only about fifty-four to sixty per cent. of sugar, the rest being water and impurities of no feeding value.

By Mr. Jonas' plan, straw-chaff is not merely made more palatable, but as it is mixed with a little green food, it undergoes a slow cooking process, and becomes more digestible and permeated by a delicate hay flavor. Thus the most is made, both of the green stuff and the straw, and an excellent food is provided, at a trifling expense, greatly superior in feeding properties to treading ordinary straw-chaff, which costs more money.

The great simplicity of preparing and storing straw-chaff, and the inexpensiveness of Mr. Jonas' plan, are further advantages, which all who consume much straw for feeding purposes may secure to themselves.

The more one looks into this subject, the more one becomes impressed with the great practical value of Mr. Jonas' plan of preparing a most useful and nutritious auxiliary food; and it is much to be desired that this extremely simple, inexpensive and, in all respects, excellent plan of dealing with straw for feeding purposes, may be spread throughout the length and breadth of the country.

WEST TENNESSEE AS A WHEAT PRODUCING REGION.

Since the foregoing pages were put to press, the writer has paid a visit to those regions of West Tennessee, from which but few reports were received. The investigations show that the natural productive capacity of part of West Tennessee for this cereal surpasses that of any other division of the State. Lake county, which is a bed of alluvium, lies between Reelfoot Lake and the Mississippi river. The average production of wheat for the year 1877 was twenty bushels per acre. Thirty bushels are not uncommon, and one gentleman made 53 bushels per acre.

On page 106 it is stated that in Lake county, owing to the exuberant fertility of the soil, wheat is apt to bed and rust. This remark needs modification, and applies only to the later varieties of wheat. The earlier varieties rarely fail to make a heavy yield. This is true, also, of the wheat sown on the rich terrace soils of Shelby, Tipton, Lauderdale, Dyer and Obion, known to geologists as Bluff Loam or Loess. The average production upon these soils after clover is not far from twenty bushels per acre.

The soils of the Lagrange sands occupying Fayette, Haywood, Crockett, Gibson, Weakley and Madison, and the western parts of Henry, Carroll, Hardeman and a small portion of Henderson are not so prolific, but with thorough preparation after clover or peas, the average yield of wheat

is from 12 to 15 bushels per acre, though from 20 to 25 bushels are not uncommon in favored localities.

The soils between these last-mentioned counties and the Tennessee river are not so productive. The surface is either very flat, so as to retain water, or very rolling, sometimes rugged, though many good areas very fruitful in the production of cereals are met with.

As a general thing the lands of West Tennessee are much fresher than those in either of the other divisions of the State, and the average production of wheat per acre is not far from 13 bushels.

It is curious to observe that the quantity of wheat sown per acre in West Tennessee is much less than in the other divisions of the State. From a half to three-quarter bushels per acre is all required on these fertile soils. It tillers in a remarkable degree.

In Middle Tennessee the average yield is about ten bushels, and in East Tennessee eight bushels. It must not be inferred, however, that the really good wheat lands in the two last mentioned divisions are inferior to the best in West Tennessee. In McMinn, Monroe, Loudon, Knox, Jefferson, Hamblen, Greene and Washington counties are found soils that are capable of making from 30 to 40 bushels of wheat per acre, while throughout the Central Basin, in Middle Tennessee, and on that tier of counties lying on the Kentucky line, on the Highland Rim, notably Robertson, Montgomery and Stewart, the lands, when well preserved, grow wheat with a remarkable fecundity.

The best wheat soils of West Tennessee are very tender, and require a high degree of watchfulness to keep them from washing. This is true of all the counties named except Lake and the western parts of Dyer, Lauderdale and Tipton, which are in the Mississippi bottoms. A belt extending two or three miles back from the river, and parallel with it, and including also all of Lake, is above overflow,

probably, one year with another, will make a larger average of wheat and corn than any other equal quantity of land in the State: The plant food here has been gathered from all that vast region drained by the upper tributaries of the Mississippi, and, with any sort of care, will last forever. In no part of the State is the production of wheat extending more rapidly than in West Tennessee, and where it is proving to be a more remunerative crop. The attention paid to the preparation of the soil, its remarkable fertility, its contiguity to the best wheat markets, all lead to the belief that this division of the State will soon outstrip both Middle and East Tennessee in the production of this important cereal.

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ERRATA.

Several forms of the present work passed through the press during my unavoidable absence from Nashville. In consequence this it is marred by many typographical errors. The following are the principal:

Page 13, third line, for *dicotyeldon* read *dicotyledon*.

Page 15, third line, for *Himalays* read *Himalaya*.

Page 26, twenty-third line, for *excites* read *excite*.

Page 28, ninth line, for *oder* read *odor*.

Page 29, twelfth line, for *gardner* read *gardener*.

Page 33, nineteenth line, for *facts* read *fact*; twenty-fourth line for *were* read *was*.

Page 35, seventeenth line, for *The explain* read *It is explained*.

Page 37 eighth line, for *them* read *it*; twentieth line, for *has* read *have*.

Page 40 thirty-first line, for "*Syria which compared with*" read "*Syria compared with which*."

Page 41 thirtieth line, for *continues* read *continue*.

Page 42, seventh line, for "*until he had*" read "*he soon had*."

Page 44, last line but one, for *minutia* read *minutiae*.

Page 45, last line but two, for *it* read *them*.

Page 47, twelfth line, for *statements* read *estimate*; last line but two, for *pound* read *pounds*.

Page 50, last line but three, for *Clanson* read *Clawson*.

Page 53, last line but five, for *sprout* read *sport*.

Page 71, third line, for *matter* read *matters*; last line but four, for *become* read *becomes*.

Page 73, second line under first table, for *enters* read *enter*; second line under second table, for *is* read *are*.

Page 75, ninth line, for *fine* read *find*; in eleventh line, put the word *should* between *substances* and *be*.

Page 96, last line but three, for *its* read *their*.

Page 97, thirteenth line, for *is* read *make*; last line but one, for *humu* read *humic*.

Page 98, second line, for *humis* read *humic*.

Page 101, fifteenth line for *portion* read *portions*.

Page 103, twenty-eighth line, for *its* read *their*.

Page 105, eleventh line, for *abtained* read *obtained*; *thirteenth* line, for *is* read *are*.

Page 105, twenty-eighth line, for *soil* read *oams*.

Page 120, twenty-fourth line, for *was* read *were*.

Page 121, thirty-first line, for *shows* read *show*.

Page 124, second line, for *freeze* read *freezes*; twenty-fifth line, for *p'owing* read *planting*.

Page 127, twelfth line, expunge the word *or*.

Page 215, last line but one, for *crop plow* read *cross-plow*.

Page 217, under 17th answer for *clover land not plowed* read *clover land not pastured*.

Page 219, under 34th answer read *stiff straw* for *stiff strand*.

Several minor errors appear in the appendix which the reader can easily correct.

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