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Respects of J. H. Moore.

REPORT

L. C. Glenn.

OF THE

COMMENCEMENT AND PROGRESS

OF THE

AGRICULTURAL SURVEY

OF

SOUTH CAROLINA,

FOR 1843.

BY EDMUND RUFFIN,

AGRICULTURAL SURVEYOR OF THE STATE

COLUMBIA:

PRINTED, THE 32 FIRST PAGES BY A. H. PEMBERTON, THE REST BY DUROSE & JOHNSTON.

1843.

INTRODUCTORY LETTER.

To His Excellency, JAMES H. HAMMOND,
Governor of the State of South-Carolina:

SIR:--In the annexed Report, I have the honor of submitting the results of the commencement and progress of the Agricultural Survey of the State of South Carolina, so far as my labors in conducting it have extended, and the observations have been completed, and are deemed worthy to be reported.

In addition to all other and obvious reasons for the deficiencies and imperfection of the operations and incompleteness of results, there have been some obstacles which have necessarily applied with peculiar force to the beginning of this work. These obstacles I beg leave concisely to mention, to serve as explanation and apology.

Before accepting the charge and conduct of the Agricultural Survey, with which I had been so unexpectedly and highly honored by your appointment, and in my first correspondence thereupon with your Excellency, I stated the reasons which made it expedient for me, if serving at all, to select from the very wide and diversified field of important subjects required to be investigated, and to confine my labors at first, and mainly, to the one department in which I counted upon rendering the most early and important services to the improvement of the soil and agriculture of South-Carolina. This selected object was the investigation of the extensive but heretofore neglected beds of marl and of lime-stone, and other rich resources for calcareous manures, in the upper as well as in the lower country; and it has been my aim, while ascertaining and making known their existence, extent and great value, also, by personal conference with, and verbal instruction to the proprietors and others interested, to urge and induce their speedy and proper commencement of applying these manures. And however imperfect may have been the execution of this plan of operations, because of the peculiar difficulties of a first investigation of deposites which had before attracted almost no notice, it is yet confidently believed that the benefits which have even already accrued from these labors have fully sustained the propriety of that direction of effort. But even with this course, the examination of the calcareous beds have necessarily been superficial, and generally very imperfect, and no where as thorough as was desirable, because of the want of time and opportunity, at suitable and safe seasons for proper exploration, and when the height of the waters did not hide the beds from view, or from full examination.

The calcareous beds of South-Carolina are so extensive, that as soon as general attention shall have been attracted to their existence and value, and excavations made therein for use in numerous localities, it will be quite easy for an observer to see and learn as much of the kinds and extent of the deposites in a day, as a previous and the earliest explorer could in two weeks. And my examinations, so far, with a few slight exceptions, have had scarcely any of the facilities which would have been afforded by the proprietors and neighboring residents having previous acquaintance with even the natural and existing exposures; and still less, from any actual excavations. Many such excavations have, since my visits, been commenced for marling operations, and will now be rapidly increased in extent and number. The difficulties of a first examination will thus be speedily removed, and cannot hereafter be estimated by comparison with what may be so much better done by future researches, made after these facilities are offered.

But though my attention and labors were mainly, they were not exclusively devoted to the calcareous deposites. My observations of agricultural facts on other subjects have been numerous. But they were necessarily superficial and incomplete; and the deductions from them too crude to be worth reporting generally, or in detail. Such information has not, however, been altogether lost; but as far as available, has been made use of in verbal and personal communication, as opportunities offered. A few only of the most important and general subjects will be presented, as parts of this report.

But though it was impossible for me, by my own direct labors, to supply all that would be wanting for a general Survey and Report, I aimed, and made an early effort to do so indirectly, by enlisting the aid of the many Agricultural Societies of the State. A request to this end was addressed to them, through the President of the State Agricultural Society, which, together with his circular letter, and the few communications which these requests drew forth, will be annexed to this report as accompanying documents.

As it is necessary for the action and convenience of the Legislature, that I should send in this report before the labors of the survey for the year are completed, as a consequence, I shall have yet to add such other important facts and corrections, as subsequent observations may require.

Very respectfully,

EDMUND RUFFIN,

Agricultural Surveyor of the State of South-Carolina.

Columbia, Nov. 30th, 1843.

REPORT

OF THE

AGRICULTURAL SURVEY

OF

SOUTH-CAROLINA.

GENERAL CHARACTERS, EXTENT AND DISTRIBUTION OF THE CALCAREOUS FORMATIONS OF LOWER SOUTH-CAROLINA.

The term *marl*, when properly restricted in its application, would designate a calcareous clay, compact and firm, as well as smooth and soapy to the touch, and usually homogeneous in texture and general appearance. But if insisting to thus limit its application, it would be necessary to banish the term altogether from the ordinary nomenclature of this country. For, there is so little of this kind of marl found, that it has not yet been used alone as manure, nor is it known to be available for use. Therefore, notwithstanding all the proper and strong objections to new and popular and incorrect applications of this term, it is necessary to yield to them in part, as I have heretofore done, and shall now in this report. * The name marl, then, will be here given to any compound or mixture of earths of which *carbonate of lime* in any form constitutes either the sole or chief value as manure, and is in such large proportion as to be an important value—and of which compound the mass is soft enough to be excavated and broken down by ordinary digging utensils. This definition is sufficiently plain and precise; and it includes the true marl, as found in Europe, the deposites of the generally loose fossil shells in earth and the looser shelly sands of lower Virginia. and also the compact and rich calcareous beds of lower South-Carolina; while it excludes all the soapy non-calcareous clays of England, which have been so often applied in practice, and referred to by writers, as marl, and also the extensive and valuable though non-calcareous *green-sand* beds of New Jersey, which have more recently, and as incorrectly, been called marl, not only by unlettered cultivators, but also in scientific publications. When considerable portions of a calcareous bed, or any separate layer or mass is not earthy in texture, but assumes a stony hardness, and is not capable of being dug, or pulverized enough for manure by ordinary implements, and requires for such use to be burnt to lime, then such calcareous rock will not be termed *marl*, but *marl-stone*. †

* See extended observations on the improper applications of the term "marl," at pp. 68, 69, and at 181 to 193 of "Essay on Calcareous Manures," 3rd edition.

† Thus the term *lime-stone* is withheld from both marl and marl-stone, to which it has been so generally applied, and by scientific writers as well as in vulgar language. It is proper to confine the term lime-stone to the peculiar compact-stone well known as such in mineralogy and the arts. If we depart from this particular meaning, and deem everything limestone that is stony, and composed principally or entirely of carbonate of lime, then chalk, and masses of coral or madrepore, of travertin, of stalactites, all must be considered as lime-stone, and the term, by such extension, would lose all precision and value.

The marl region of South-Carolina is of great extent, even if it were limited by my actual observations already made of easily accessible localities, and by inevitable deductions from these observations. But it can scarcely be questioned that the principal formation is continuous, and also of immense thickness, and that this one bed alone underlies much the larger portion of all the country below the falls of the rivers; though it may not be accessible for profitable and practical use through the larger part of its wide extent.

The marls of South-Carolina which are sufficiently abundant to be valuable for use, are of four different formations, or geological ages, and each of distinct and marked character in regard to certain minor peculiarities, though all agreeing in the main chemical and agricultural characteristics, as defined above, and which only are of importance to the value of marl.

Before proceeding to describe these different classes of marls, it is proper to state generally and concisely what is understood by the great geological eras, and successive formations, and also such of the subdivisions of these ages and formations, in which it is deemed proper to place either kind of the South-Carolina marls. This reference of deposites to their relative geological ages is not a matter merely of curious or scientific interest, nor without practical utility to agriculture. On the contrary, there is a general character and quality peculiar to each of the well designated subdivisions in South-Carolina; and such character may be inferred from merely knowing the geological period to which a particular formation belongs; and that age may often be known by the exhibition of a single shell, or certainly by two or three distinguishing shells from each great bed. And thus, from such slight indications as a hand-specimen of marl would often furnish, or a few shells of it most surely, an investigator might infer certainly the formation to which it belonged, and from his previous practical acquaintance with the general quality and circumstances of the formation as seen elsewhere, he might deduce something like the probable thickness of the stratum, its general texture and strength in carbonate of lime, and value to agriculture.

Geologists divide all the rocks and interior strata of the earth into the three great classes of *primitive* or primary, *secondary, and tertiary formations.* The primitive rocks and strata contain no trace of fossil or organic remains, and therefore are inferred to have been deposited before the existence of animals. The secondary formation contains numerous organic remains, both animal and vegetable; but of races of animals all of which are now extinct, and of which no living representative is known in the habitable world. And this great formation is composed of sundry other minor successive formations, or subdivisions of different ages of deposition, each of which has a distinct fossil character, and exhibits the shells and other remains of races different for the greater part from each of the others. The tertiary formation is more limited in extent, and in the number of subdivisions. Still it has three of distinct and marked character. Of these, the lowest and oldest belongs to what is termed the *eocene* period. Of this the fossil shells are nearly all of extinct animals, and mostly of such as are peculiar to this period; but a very few species (supposed to be in number about 3½ per cent. of all yet known,) are of animals now in existence. The next minor formation of the tertiary belongs to the *miocene* period, which is still a newer deposite, and the shells generally of races distinct from those of the eocene, as well as from those of recent shells, (or of animals now existing;) but still a larger proportion, though yet a minority of the miocene shells, are of existing animals. The next

subdivision is the *pliocene*, of which a majority of the shells are also recent. Mr. Lyell, the author of this arrangement, divides the pliocene into newer and older. All these strata are supposed to have been formed or deposited, before the surface of the globe had its present form. And there is a still newer formation, of note and importance in South-Carolina, the *post-pliocene*, of which the shells are altogether recent, or of such races of animals as are now in existence, and which mostly, if not wholly, may be found now on the neighboring sea shores.

These marls will be first designated generally, in the order of their age, or original formation, and afterwards described separately and particularly.

1st. That which I shall term the *Peedee bed* is the oldest marl, and is part of the great secondary formation, (and that division called the cretaceous, and which is so fully developed in New Jersey,) as is manifest from its characteristic fossils, (principally *belemnites Americana and exogyra costata.*) This bed, so far as I have yet ascertained, is limited to the land bordering on part of the great Peedee River and some of its tributaries, as Black River ; all the formation being connected and lying in Marion, Williamsburg and Georgetown Districts.

2nd. The next oldest formation of marl is that which I shall designate as the *Great Carolinian bed.* It extends from east of the Santee to far across the Savannah. Its western limit is a line not far varying from parallel to, and from 25 to 35 miles below the falls of the rivers ; and eastwardly it stretches to and beneath the ocean.

This great deposite has been by different geologists considered as belonging to different formations. Vanuxem first, and also Conrad and Morton, afterwards supposed it the "upper cretaceous," or equivalent to the upper and newest of the chalk formation (secondary) of Europe. Lyell, from recent inspection, includes it in the eocene, or lowest tertiary. It becomes me to yield to the lowest scientific authority in geology, and much more to the deservedly exalted name of Lyell. Nevertheless, my personal examinations have been perhaps more extensive than any other person's, and thus I have been enabled to detect mistakes as to the presence or absence of particular fossils, which had misled other and more scientific students of the bed, by its supposed specimens. Thus Bartram reports that he saw belemnites at Silver Bluff, on Savannah, and Morton speaks of them as found at Nelson's Ferry on Santee, both of which places are within the limits of the Great Carolinian bed, and in all which there is certainly no such fossil, if my personal observations can be relied on. I understand from verbal report that Mr. Lyell deems the presence of the *ostrea sellæformis*, which is abundant near and all above Eutaw Spring, as determining the bed to be *eocene*. If so, however, it is in general character, and in most of its fossils, very different from the eocene of Virginia ; and in all the basin of Ashley River, and elsewhere in the lower or more eastern part of this great deposite, I have not been able to find a single *ostrea sellæformis*. If then, indeed, this is eocene, it must be an *older* eocene than elsewhere. The still remaining uncertainty as to the age of this great deposite will serve as my excuse for adopting for it a provisional name, that is merely and truly descriptive, and affirms nothing that may be hereafter necessary to retract. The "Great Carolinian bed" of marl will serve every present purpose of designation and distinction, as well as if it were definitively settled, and the bed named either "upper cretaceous" or eocene. The ascertained fossils of this bed, as well as the oth-

ers, will be stated hereafter, distinguishing those believed to be peculiar to particular sections or localities.

3rd. The next oldest marl is *miocene.* or middle tertiary, which occurs in thick and extensive patches lying upon and immediately in contact with the older Peedee (secondary) marl, on the west side of that river. It also extends into Darlington district, and is exposed there along the course of Swift creek, and along Black creek, beyond any appearance of the secondary marl which underlies the miocene along the Peedee.

4th. The next and the latest formed of all marls, here or elsewhere, is the *post pliocene*, found in Edisto Island, and sundry other parts of the land not far from the sea shore.

Dismissing the foregoing order, and also all scientific arrangement, I will begin with the second and the most important of the above list of marly formations.

GENERAL CHARACTER, POSITION AND EXTENT OF THE GREAT CAROLINIAN BED OF MARL.

Throughout the whole extent of this great deposite, and not only within the bounds of South-Carolina, but also in the adjacent parts of North-Carolina and Georgia, where I have seen parts of its extension, there is a remarkable uniformity of texture, color, general appearance and qualities manifest to the senses, and also of chemical composition. In these respects, throughout the vast surface and depth of this bed, there is less variation of appearance and quality than is always found in the different exposures of Virginia in the same neighborhood, and even in the same excavation. Still there are minor and well marked differences, belonging to different localities, and also to different depths in this formation, which will be stated as each shall come under consideration.

In general, and with but few exceptions, this marl, as seen in the bed, is of a dingy, yellowish white color, or pale buff, of different shades. The exceptions, showing the greatest departure from this general character, in some cases are parts almost white, and others of brown, colored by ferruginous matter. Sometimes a dull greenish tint is added to the ordinary shades. The texture is close and firm, and the fracture something like that of chalk; though the mass is generally softer, and in some few cases more indurated, or approaching to stony, than of true chalk. The fossil remains are very few, except in some particular localities; and even there not of many species, and mostly very imperfectly preserved. Indeed, except a few of the oyster family, and others as remarkable for hardness, the shells have been almost entirely dissolved or disintegrated, leaving however in some cases their forms in perfect casts of the firm marl, which had filled their hollows, as well as enveloped them closely around. But so few are the fossils altogether, compared to the great extent of marl already exposed, and which was wholly formed by shells originally, that it is not surprising that many persons to whom such localities had been longest known, had not observed the existence of any such remains, and that but few others, either from that or any other indication, had ever suspected the earth to be calcareous. The general appearance to the eye, or to ordinary loose observation, is that of a poor clay, very largely mixed with silicious sand; though in fact there is usually but a very small proportion of sand.

Whether the marl is hard or soft, it breaks into lumps or crumbles more or less as it is dug. However moist in its bed, it is not plastic like fine clay, or yielding in the manner of moist clay to the blows of the digging utensils, but rather as firm sandy earth, and the hardest marl as very soft sand-stone, or very compact and dry clay.

The proportion of pure carbonate of lime in this marl, for much the larger number of exposures, yet seen, and of many analyses made, (which will be stated particularly hereafter,) varies from fifty-five to eighty-five per cent.; and more of others rise above ninety than fall below fifty per cent. This is a degree of richness, compared to the marls of other regions, as remarkable as is the great extent of this bed. The ingredients of the marl, other than the carbonate of lime, are mostly fine clay and silicious sand, colored by oxide of iron. No magnesia has been found. In many specimens there is a very small proportion of green-sand, which alone may be considered as of any notable fertilizing value in addition to the main and important ingredient, carbonate of lime. *

In some particular localities I have found green-sand forming so large an ingredient of this marl, that it must add a very important value to the marl as manure. And it is most probable that deeper excavations will show still richer and more abundant exposures of green-sand mixed with the calcareous marl, than I have yet been able to find. While I hold the green sand to be of inferior importance by far to the calcareous ingredient, still it is certainly, as an addition thereto, of very great agricultural value, however little is understood of the cause and manner of its remarkable and yet uncertain fertilizing action.

The dip, or degradation, of the surface of the great calcareous bed, or its angle with the horizon, is generally from north to south, and does not differ greatly from the general slope of the country, and the consequent courses of the rivers; but is greater than either. This greater general dip of the surface of the marl (or irregularity of surface) is much more marked on the Santee than on the Cooper, and on the Cooper than on the Ashley and those rivers still farther south and west, passing through this region. And the entire body lies deeper below the surface of the rivers as we proceed south-westward, in any line parallel with the sea-coast, with some exceptions from this general rule (on and near the Savannah,) which will hereafter be stated. Nor is it certain that this declination or irregularity of the surface indicates the true *dip* of the stratum ; as it may have been produced by denudation, or the washing away of the original surface of the marl, subsequently to its deposition. There are no distinct marks of stratification to be seen but in few places, and for small extent. And when such marks are seen, they are either so perfectly horizontal, (to the eye,) or are so obviously and irregularly contorted by some, violent and partially operating ancient convulsion, or upheaving of the bed,

* The marl of the Great Carolinian bed is not more remarkable for uniformity of character throughout its great extent, than for difference from all the marls of Virginia, numerous and widely differing as are the varieties of the latter. It is enough to say here that the marls of Virginia are generally much poorer than those of the body described above, the bed is comparatively very thin and limited in extent, and composed for the greatest part of shells and their fragments of more recent formation, (middle tertiary) in good preservation, imbedded in a looser and softer earth, principally and generally of sand. The many varieties of marls known in Virginia were described at length in a Report to the Board of Agriculture of that State, giving a full "description and account of the different kinds of marls, and of the gypseous earth, of the tide water region of Virginia," which forms part of the "Essay on Calcareous Manures," commencing at page 194.

that no correct knowledge of the true dip could be learned from the lines of stratification yet observed.

Marl of Ashley and Cooper Rivers and their Branches.

In ascending Ashley river for the purpose of tracing the marl, it was first seen exposed above low-tide on the land of Mr. John S. Brisbane, about 9 miles above Charleston. The land bordering on the Ashley, for much the greater part, is tide marsh, formed by comparatively recent river alluvion, and which, therefore, cannot contain and show anything of the much more ancient calcareous deposite. But at every bluff, or wherever the high land reaches to, and has been partly washed away by the river so as to present a precipitous cliff, there the marl is exposed to view. Thus it was traced and examined along the whole course of the river to Bacon's Bridge, the head of sloop navigation, a distance of 20 miles. The height of the perpendicular exposures of marl on this river, above the lowest point, vary from 4 to 8 feet above high tide; and when excavations shall have been made, no doubt the elevation of the surface of the marl, a little back from the river, will be found much higher than as first seen.

Though the natural exposures of the marl above water were few compared to the spaces where it was not visible, still it required but little investigation to infer with certainty that the body of marl is continuous, and of very regular grade of surface. Hence, it was manifest that the bed could generally be reached at moderate depths on any of the neighbouring lands, as none are of much elevation; and, as certainly, at greater depths under the river and its upper creeks and tributaries. The entire beds of Dorchester and Eagle creeks are of marl, which is left mostly bare at low tide. And the bed of the river generally, where clear of the alluvial mud, whenever I could reach and examine it, is so firm that it is manifestly the bed of marl. By using a steel gouge fixed to the end of a very long measuring rod, I was enabled to bring up specimens of the bottom for examination, of which the lowest was 26 feet beneath the water at low tide; and showing positively at least so much depth of the marl stratum. But subsequent developements showed a thickness so very far exceeding this, that it was no longer necessary to attempt such partial and imperfect measurements for that object.

The law of continuity and level of the marl, which my earliest observations thus enabled me to ascertain, however obvious it may now seem, was very recently not suspected by the proprietors most interested in its practical application. And by inducing their attention to these general indications of the position of the bed, where it was not visible, I enabled many persons to find it at once, and easily, by boring or digging through but a few feet of over-lying earth. And if the indications are thus pursued generally, and with but little effort by each individual, the accessible and available exposures of marl will be increased very far beyond all that is now suspected of their abundance.

Immediately on the margin of Cooper river, the lowest exposure of the marl above low tide is believed to be at Strawberry ferry. Above that place, it is exposed at every bluff; and within two miles above, at Mepkin, the marl shows 8 or 10 feet above high tide. At Steep Bluff, near the head of Cooper, is the highest and most remarkable exposure on this river. The perpendicular height here, above high tide mark, I found by measurement to be 26 feet, or 31 above lowest tide. Except one horizontal layer of about 18 inches thick, (of marl-stone,) all this cliff is of compact homogeneous marl, not so hard as to

be very difficult to be dug. But this height is not preserved above. And even the lower elevations of Mepkin Bluff on Cooper, and at Magnolia on Ashley, are also but slighter exceptions to the general degree of dip, or law of position of the surface of the bed of marl; which law seems yet more uniformly preserved throughout the area occupied by the waters of Ashley and Cooper rivers, than elsewhere.

The natural exposures of the marl on the Cooper are not confined to its borders, or to cliffs on the river and its large tributaries. It is also seen in various places in bordering lands, and along the public roads which pass on both sides of the river. The great Biggin Swamp, the source of Cooper river, which with all its branches consists o several thousands of acres, seems to be throughout underlaid by the bed of marl, and of which the surface is generally within 3 to 5 feet of the surface of the swamp land. This important fact, (as of many other swamps,) might be very safely inferred from the above stated law of position of the bed. But it is also sustained by more direct evidence. The lower level of the Santee canal, for three miles, passes through a higher part of this swamp land; and every part of it was dug into the marl, as appears from its remains still lying on and by the bank. It also appears at the different excavations for locks on higher levels, to Wantoot, seven miles up the canal. Further, I have made borings, and induced other persons to make them in sundry places in head branches of the swamp, and the marl has been always found as above stated. The most northern and remote exposure known of marl on any swamp leading into the Cooper, is in Deveaux's old mill pond, about 2 or 3 miles east of the Santee canal, and 5 miles due south from Pineville. And nearly as far north, about 6 miles west of the canal, in other head swamps of Cooper, the marl has been recently reached on the lands of Mr. Philip Porcher, and of others in the same neighborhood. This swamp, (according to the district map,) connects with Greenland swamp, which empties into the Santee, and which swamp also has marl under it; and Deveaux's old mill-pond is barely separated from another swamp, (Buckhall,) which is also connected with the Santee, but much lower down. Under the extensive Wassamasaw swamp, the marl is so near the surface, that it is exposed and brought up by the fall of trees uprooted by the winds.* And though the great Cypress swamp, which lies between and connects Wassamasaw with the head of Ashley, where my personal examinations stopped, has not been yet explored for this purpose, there can scarcely be a question that, like all the explored upper swamps of Ashley and Cooper, it is bottomed by marl, and that lying near the surface. Thus, these lines of exposure offered by nature in the numerous and extensive swamps, and also of marl easily accessible for use, will serve to exhibit the actual connexion of the marl of the Ashley and Cooper and the Santee. And also, if this mode of examination were pursued, it is likely that the calcareous bed would be in like manner found not only to be connected, but also accessible from the Ashley to the Stono river, and perhaps to the Edisto. But however easy it is for such examinations to be made by the numerous proprietors, each one operating on his own ground, it will be obvious on the slightest consideration of the circumstances, that my time and opportunity for such examinations could not extend far. Each proprietor, having full knowledge of the general localities and particular features, could bore into and find the level of the marl un-

*For this fact, and for a specimen of the marl, I am indebted to Mr. H. W. Ravenel, as well as for making at my request some other accurate examinations, to which I could not attend personally.

der his inland swamp with the labor of a few hours. And if the general facts of the presence of the marl be such as I infer, the discovery will have a most important bearing, not only on the enriching by use of the marl of adjacent ands, but also on schemes of extensive and perfect drainage of swamps, and even of greatly extending inland navigation, by the same general plan of operations. If the Santee canal, instead of rising at once, as it does, to a higher level, had been carried from the Cooper river through the lowest part of the swamps, and without a lock, as far as the level and height of water would have permitted for good sluice navigation, there might have been obtained, in addition to the navigation, the perfect drainage of more than as many thousands of acres of rich swamp, as there are now kept overflowed of swamp and high-land, as reservoirs to supply scantily with water the summit level of the canal. And the marl obtained by the excavation, if applied as manure, would have produced value as great as the cost of the digging. Subjects for the like mode of combining the three great improvements of marling, draining, and inland navigation, (and to which perhaps may be added, in a very important degree, lessening the diseases from malaria,) are offered in the head swamps of Ashley river, and perhaps in many other such swamps, which are now but the producers of pestilence, and are among the greatest, and almost only grievous natural evils which oppress lower South-Carolina. It seems to me not unlikely that the very existence of the numerous swamps of this region, and of their great extent, may be owing to the stratum of marl lying generally beneath, and not far below the surface of the land. For this earth so strongly resists the washing by water, that both continued action and great force of current would be necessary to scoop out channels of sufficient depth and width for the passage of the rivers. Where the bottom is of marl, even though there be abundant fall for drainage, it is difficult to conceive how the rivers should be otherwise than they are—the larger bordered by numerous swamps, and the smaller rivers and streams being scarcely anything else than swamps. Yet their courses are so rapid as to show very considerable fall. If the underlying strata had been altogether of sand and clay, without marl, (or with but a thin and comparatively poor stratum of marl, lying high, and easy to be cut through by currents, as in Virginia,)then the rivers of South-Carolina, as those of Virginia, would have scooped out their channels so deep as to bring the tide up to the falls, and thus offered sufficient fall and outlet to drain all the swampy margins, below as well as above the falls.

It may safely be presumed, and would perhaps be inferred from the foregoing observations, that the original surface of this great bed of marl, at the time of its being first formed under the then ocean, by the death of shell-fish, and the gradual deposition of their shells, was as uniformly even and level across the present beds of the rivers as elsewhere. But when this former bottom of the ocean had been upheaved, and had become high land, then the receding waters sought and found passages by scooping out and washing away (as much as their force could effect) channels in the surface of the before even and level marl sub-stratum, as well as through the more recent and looser deposites above, which now constitute the entire soil and sub-soils of this region, and thus formed the present courses of the rivers. Therefore, whenever the surface of the marl can only be reached in the bed of a river, by sounding to a great depth, that depth is no indicaton of a greater than the general original depression of the marl ; but only that so much of the original thickness of the stratum had been swept off by the current. Thus, calcareous stones, which are

manifestly but the harder parts of the marl stratum, are found, either fixed or in loose fragments,to form nearly the covering of the whole bed of the Ashley, and are exposed on the bottom at many places. This hard or stony bottom is found as low as the lowest ferry, within a mile or two of Charleston. The occurrence of the hard bottom here, impenetrable to the piles, which were used under the supposition that the bottom was of deep mud or penetrable clay, caused the bridge which was formerly constructed there to be carried away by the first storm. It is said that far out in Charleston harbor, and in deep water, soft calcareous rock is often drawn up by the anchors of fishing boats. Of one of these, from the depth of 42 feet, I was furnished with a small specimen by Dr. Edward Ravenel, which, though the mass was penetrated and inhabited by recent boring shell-fish, seems to be certainly a part of this great marl formation. The same gentleman informed me that he had found hard bottom, (of course the marl,) by an anchor more than 40 feet deep off Cote-Bas on Cooper river. Though not able to reach and obtain specimens of the solid marl any where under the deep waters of this river, in my attempts, another not less interesting fact was ascertained. This was, that wherever the ordinary dark gray mud of the river bottom (similar to the marsh mud) could be pierced through by the instrument used, there was found beneath a soft yellowish clay, which upon being tested was found to be calcareous, and was evidently derived from the marl stratum. This bottom of marl, formerly in part taken up by the washing of the current, and again deposited by the more tranquil state of the water, I found off Cote-Bas, and below Red Bank, in other deep parts of the river, so as to induce the belief that this feature is not rare, and perhaps is universal under the more deep and still waters.

In Virginia,the beds of marl which I have there worked, or examined through their depth, have rarely exceeded fourteen feet in thickness; and it is seldom near so deep before the marl becomes so poor as to be not worth removing. It was therefore erroneously deemed necessary for me to learn the depth of the stratum here, as well as its superficial extent. And to this end, the facts and indications above stated, showing by actual observation and testing a thickness of rich marl of twenty six to thirty one feet, and inferences of much more, were deemed valuable, while no nearer approach to certainty was known, or expected to be obtained. But more recently, other and surer means of information have left no doubt of the solid and uniform body of marl being at least one hundred and eighty-nine feet thick under the city of Charleston, and probably two hundred and forty-two feet. Having learned that of the earth obtained from various depths in boring three hundred and thirty-five-feet for water, in 1824, samples had been preserved and were in the Medical College, I sought and obtained permission to examine them, and to take smaller portions of each one for testing. The samples were formed in the shape of small bricks, and each marked with the depth from which it had been taken. There was no sample seen from nearer the surface than one hundred and twenty feet, and none deeper than three hundred and nine feet. Within their extremes, embracing one hundred and eighty-nine feet, I examined a sufficient number to be assured that they were all parts of the same great stratum of marl of which the upper portion only is exposed to sight and examination, as it ranges higher up the country; and which conclusion may be deemed certain, not only from the texture of the samples, (however altered in appearance by being worked up when soft by the auger and by the hand, to mould them into their present form,) but still more

from their proportions of calcareous matter, which will be stated hereafter in connexion with trials of sundry specimens of marls obtained at or near the upper part of this and of other formations.

But this known and certain thickness of the stratum, of one hundred and eighty-nine feet, is not all that may be safely inferred. The published report of Dr. Moser, who conducted the boring,* is by no means clear enough as to the precise nature of the kinds of earth passed through. But it is however distinctly stated that the boring was in precisely the same kind of compact, yet easily penetrable stratum of earth, from the depth of sixty-seven feet to two hundred and twenty-three feet. And, therefore, to the one hundred and eighty-nine feet, (between one hundred and twenty and three hundred and nine,) which the samples tested enabled me to ascertain, there may be added with as much certainty, the previous boring from sixty-seven to one hundred and twenty feet, or in all two hundred and forty-two feet of marl, rich, and not anywhere of stony hardness, except of a few very thin layers, of what from its hardness may be considered as marl-stone. And the highest of these thin and hard layers are as low as two hundred and sixty-three feet below the surface, or one hundred and ninety-six feet below the top of the stratum of marl. Further; below the depth of three hundred and nine feet, which furnished the lowest of my samples, it appears from the words of Dr. Moser's report, (however indefinite and obviously incorrect in application,) that the earth passed through afterwards must have been a continuation of the same marl, (though he does not apply to it that name,) merely altered in sensible qualities by admixtures of other earths, shells, and the excess of water.†

The marls of the Ashley and the Cooper, vary somewhat from each other as well as from those of other localities hereafter to be described. The Ashley marls are generally softer and more easy to dig than those of the Cooper. The latter more generally lie higher and better exposed, and on the general average are richer. But in regard to the comparative strength, &c., it should be observed that not a single excavation had been made for manuring, and remained open, nor any deep digging for any purpose, at the times of my first examinations; and my observations and selections of specimens were therefore generally and necessarily confined to the upper surface, or the naturally exposed sections. This may have caused, in the results of analyses of specimens, more apparent difference than really exists. If a section were taken at any one place, for say twenty feet depth, or the marl were excavated to that depth, perhaps the general average would not vary as much by half, as do the particular specimens taken from such parts, some high and others low, as were then accessible. But on trial, all the specimens from this region, in their contents of carbonate of lime, vary from fifty-four to seventy-eight per cent. of which the poorest may be deemed rich, compared to the average strength of the marls of Virginia which have been used so largely and so beneficially.

There are very few fossil remains and still fewer shells, in the marls of the Ashley and Cooper. But about five or six miles above the head of the latter

*Copied in Mills' Statistics of South-Carolina.

†The words are these:—"300 feet 8 inches to 302, hard lime-stone, 302 to 308, 5 soft carbonate of lime; next 6 inches hard crust; 308-11 to 311, soft carbonate and mud; 311 to 314-3, first foot lime, balance a very tenacious clay and soft lime: 314-3 to 317-2, shell, marble, sand, clay and some thick solid marine shells broken; 317-2 to 331 blue lime-stone rock, 331 to 331 chalk, clay and mud; thence a solid limestone rock to 335-4, in which the auger was broken, and the boring ceased.

river, along the swamps leading thereto, the fossils become more numerous, and in kinds are generally like those of the Santee river. The area from and through which these highest sources of the Cooper flow, agrees in other respects connected with the calcareous bed with the borders of the Santee, to which it joins, and which peculiar characters will be hereafter described.

The surface of the marl bed near the Ashley and Cooper rivers seems generally approaching to level, or to a horizontal plane. There are no certain marks of stratification seen. There are but few if any fissures, crevices, or other passages for springs issuing from the marl, so far as visible at first.

Besides the great body, there are three varieties which should be noted. At Col. James Ferguson's plantation on Cooper, and also a few miles distant at a hill in the Monks' Corner Road near Broughton's Swamp, there are exposures of a different and peculiar kind of marl. The stratum was exposed in the road by the washing of a gully, and at Col. Ferguson's by the recent digging of a canal, as well as formerly on another part of the same plantation by the digging of a well, which was sunk to the depth of eighteen feet through the marl, without reaching its bottom. It is a grayish clay, not tough or adhesive, but which crumbles easily, and the lumps are entirely reduced soon after being exposed to the air. It has no signs of fossils, and no resemblance to any other known marl of this country, and agrees more nearly with the European descriptions of marl, and with marl proper, as defined in the beginning of this report. In that at Col. Ferguson's, there are many nodules, enclosed in the general mass, of pure white, and though firm, yet of soft and fine chalky texture and apparent qualities, and which I found to be composed almost entirely of carbonate of lime.

This marl, though so very different in appearance, I infer was derived from the ordinary kind, by a part being washed off by the rush of waters which acted to denude the whole body of marl, and was suspended in that manner, mixed with fine clay, and then again deposited.

Another peculiar marl is seen at Mr. R. Mazyck's plantation near the Santee Canal. This differs from the ordinary kind in having its upper part, for the depth of above two or two and a half feet, intermixed with a large and valuable marl of green sand. Below this, the green sand nearly disappears, and the marl is white and very hard, or changes to marl-stone.

A third but slighter variation from the marl characters is seen at the Grove, Dr. Edmund Ravenel's plantation, three miles from the river, and fourteen only from Charleston, being the most south-eastern, or lowest exposure yet known on or near the Cooper River, and above water, of the Great Carolinian bed. At this place the marl is granular, and softer than the great body; and there is also a difference in the prevailing fossils. A very similar marl in texture I afterwards observed in one place only, Gen. Erwin's mill, Barnwell, near the Savannah River.

Before this year, not one trial of the marl had ever been made on or near the Ashley River, nor on any one of the Cooper River plantations.* On

* It was not until long after my observations and careful inquiries had been made in this neighborhood, and written as above, that I learned when far distant, and by an accidental communication, contrary to all previous information, that Dr. Philip Prioleau, a former resident, had some years ago made an unsatisfactory experiment with marl at Sportman's Retreat. The entire ignorance in reference to this fact, among the near neighbors, presents in even a stronger point of view the general and total disregard to this mode of improvement.

plantations on tributary waters of this river, there had been two individuals who had marled, and with satisfactory results. These were Dr. Edmund Ravenel and Mr. Frederick Porcher, who each had some years ago, applied marl to something more than twenty acres.

Marls of the Santee River and its Branches.

The lowest part of this river where the marl of the Great Carolinian bed is first seen, is a mile below Echaw Creek, which empties from the southern side into the Santee about five miles above where the river divides into two passages (forming the North and South Santees) to the ocean. The marl is also seen in the high land on the northern side, back of the swamp which there borders the river, somewhat about the lowest locality on the opposite side, and along the lands on Cedar Creek, which empties just above, and four or five miles below Lenud's Ferry. Thence, it is seen on most or all the lands up the river to Baggy branch, which enters the Wittee Lake, (one of the passages of the Santee,) about six miles above the ferry. No exposure is known above this limit in Williamsburgh district.

Higher up the river, in the southern and lower part of Sumter, the marl shows in many places in and along the borders of Potato Creek, or has been formerly reached and excavated for lime-burning. This creek empties into the Santee nearly opposite the northern end of the Santee canal. The marl on and near Potato Creek is exposed to view only about three feet high above the water. Higher up the river, there is no known exposure of the body of marl in Sumter, its depression being too great. Across Scott's Lake, below Wright's Bluff, (the ancient bed of the Santee,) only, the surface of the marl may be traced quite across. I found it there nowhere less than four feet below low water of the river, and varying from that to eight feet. The marl at this place was traced across the lake, which is about one hundred and twenty yards wide, and was felt some eighty yards in the other direction, or that of the general course of the river. It seemed to be most elevated in the middle, or as a gently rounded ridge, of which the sides were depressed until lost to observation under the mud which is rapidly filling the lake.

On the southern and western side of the river, the marl is seen from Warren's, below Echaw, (above mentioned) on every plantation to Dr. John S. Palmer's plantation above Lenud's Ferry, and still higher at sundry different places along the river as high as the lower part of Mattasee Lake. This whole distance on the map is about twenty-two miles in a straight line. Of all these localities, I examined personally only the extensive exposures on the lands of Dr. John S. Palmer and Col. Samuel J. Palmer below in Charleston District, and Dr. Robert Gourdin's, Georgetown, and also the highest known exposure, (on Glass' land) in Williamsburgh, and at and above Scott's Lake. For the other localities of actual exposures, I relied on the information of the above named gentlemen, (and on specimens furnished by them,) who were all among the most extensive marlers of the few in the state, and who were well acquainted with the marls and the localities of their neighborhood. From the highest exposure named, at Mattasee Lake, the marl sinks to a much lower level, and is no more seen along the river, until reaching Greenland swamp, where it is again invisible, but still lying loose. This interval is about fifteen miles in a direct line. On the two branches of Rock's Creek, I again saw the marl and in abundance, and extending several miles back from the river; and it continues to Eutaw Spring increasing in

visible quantities and in elevation. From this place it is abundant, or easily available, on every plantation to Half-way swamp, in Orangeburgh. It is as abundant, and also rises high on the hill sides on the southern side of that stream; but disappears entirely on the northern side, (so far as known,) though the hills are as high, and there is no apparent difference in them in other respects. This remarkable and obvious difference had caused the long and yet continuing prevalent belief that no marl existed anywhere above Half-way swamp. But this is a mistake; as it is seen on a southern branch of Stout's Creek, some three miles above Half-way swamp. This is the highest known exposure near the Santee.

From the lowest exposure on this river, to above Eutaw Springs, the marl is the richest known. It seems generally to be formed almost entirely of fragments of minute corals, scarcely distinguished from a homogeneous mass of close texture, except where the long exposure to rain has washed the surface, and made its peculiar structure and materials obvious. The usual proportions of carbonate of lime vary from eighty-six to ninety-four per cent. In some cases, as at Eutaw and Rock's Creek, the marl of this description is as white as chalk; but generally, as in the neighborhood of Lenud's Ferry, it is colored, and in some cases deeply, by ferruginous matter.

At the cliffs about Vance's Ferry, the marl loses the peculiar character just described, and becomes more clayey in appearance, and like the richest of the Ashley and Cooper. Again, at Adam Felder's, and thence to Half-way swamp, the marl is more like chalk in texture, though still of the general pale buff color.

In connexion with the Santee marls (including those of the upper branches or swamps of Cooper, which as already stated, seem alike,) there is a smaller proportion of marl-stone. This is not always richer than the softer marl, and sometimes is poorer; and therefore the stony hardness is owing to some other cause. The marl-stone is generally highest, and in detached blocks or masses. These are often separated from each other, as well as from the marl below, by interposed red clay. Extensive observations of the hard marl-stone induced me to believe at first that it was always above the marl, and always detached from it, even when in contact. But afterwards, at a low state of water, I found the marl-stone in some cases below the upper marl, as at Lenud's Ferry. Also, it appears in layers passing horizontally through and connected with the marl in the cliffs above Vance's Ferry. These stony layers are there principally composed of large saddle-oyster shells, (*ostrea sellæformis*) held together closely by a stony cement. These oyster shells are also scattered there more thinly through all the lower and softer stratum. But none of these remarkable shells were found lower on the Santee than a few miles below Eutaw; and not one on the whole extent of the Cooper and Ashley rivers. And when these shells are left protruding from the face of the river cliffs, near Vance's Ferry, (where generally covered by the water,) by the softer marl having been gradually washed away by the river, the shells appear as if corroded and mostly dissolved, and the outside of what remains is coated with and penetrated by oxide of iron, and is as black as iron. This effect may be produced by the decomposing action of sulphate of iron, (copperas) held in solution by the river water. And if so, sulphate of lime (gypsum or plaster of Paris) is formed, and carried off dissolved by the water. The wasted appearance of the hardest marl, and even of marl-stone, below the

usual level of the river, would indicate that this chemical action has been of very extensive and continued operation.

The marl of the Santee, or at least all below the neighborhood of Vance's Ferry, has a very uneven upper surface, presenting continually high rounded elevations, and deep depressions between them, both of various sizes and irregular occurrence, just as if a violent and long continued torrent of water had torn away the softer parts. Generally a fine red clay is the covering of such parts, and also forms a complete coat surrounding detached masses, whether of marl or marl-stone.

At the Rocks creek, below and near the Eutaw Springs, the upper marl and limestone are such as have been described. But at the lowest excavation, (and as low as the rising of the water permits its examination,) the marl, though still composed principally of minute fragments of coral, is very soft and loose, contains a notable quantity of green-sand, and has many of the *ostrea panda*, in good preservation, a remarkable shell which I found but rarely elsewhere in South-Carolina.

At Eutaw Springs, the marl is about twenty-five feet above the level of the river at low water. At Vance's Ferry, nine miles above, (in Orangeburgh district,) it is full thirty-five feet where highest, which is somewhat back from the river. And it maintains a height generally as much or more then twenty-five feet as far up as Half-way swamp. At the only exposure above this stream, and the highest yet known near the river, on the branch of Stout's creek before mentioned, the marl is only about four feet above the stream. No excavation had been made to show its depth below. It there has a large and valuable proportion of green-sand. The lower stratum at Hale's old mill, is also rich in green-sand. A thin middle stratum at Dawshee cave, below Eutaw, and the upper layers of marl at the deserted site of the old Huguenot village, Jamestown, (on Col S. J. Palmer's land) have also green-sand in considerable proportion, though less than those marls previously named, and near the upper boundary of the bed. In sundry other specimens elsewhere, very small proportions of green-sand are discoverable.

Another striking peculiarity of the Santee marls, and especially seen more marked as descending the river, is that they are full of crevices, fissures, and even some considerable caverns are seen, and many more doubtless have existed in remote times, which no longer exist for causes to be stated. In consequence of this character, water passes freely through this marl in every direction; so that where the bed lies lower than the surface of the river, in freshets, it is impossible to dig it lower until the water subsid s, as the water rises in every natural sink or excavation, as high as the then level of the river. Throughout the whole known area of the Santee marls, there are numerous circular basin-shaped depressions of all sizes, from a few yards across and very deep in proportion to their width, to some containing many acres, and so shallow that their character is scarcely noticed. All such depressions, or "sink-holes," as the deeper are called, I suppose to have been originally caused by caverns having been previously existing in the marl or marl-stone beneath; and that by the roofs of such caverns falling in, was produced the sinking of the earth from the surface, and of the marl down to the cavern. Indeed, such sinkings of the surface occur now, and not unfrequently.

Another effect of this fissured and cavernous nature of the marl, is that the

spring waters from above, and running streams, are often swallowed by some of these sinks, while many others vent bold springs, and enormous discharges of "rotten lime-stone" water, as it is termed. Thus, the existence of such sink-holes, (which are also to be seen in many other parts of the lower districts, as Beaufort, Colleton and Barnwell,) or the strong boiling up of such springs, which is of still more frequent occurrence, may be safely assumed as true indications of marl or marl-stone below, though it may perhaps be at a great or even an inaccessible depth. These marl-stone fountains, when of great volume, are objects of remarkable beauty. The water is of the most perfect transparency. It is usually warmer than that of other springs and wells. The temperature of the celebrated and beautiful Eutaw Spring, I found to be 64 degrees, (Fah.); and two marl-stone springs at the foot of the cliff at Shell Bluff on the Savannah, were respectively 66 and 68 degrees.

The cliff of marl at Vance's Ferry extends about four miles down the river, and from one to two miles above. It is perpendicular, and even often overhanging the water, for its whole extent, except where a narrow edging of swamp separates, but does not hide it from the river. The general height of the face of the cliff of marl is twenty-five feet, and in some cases more. The upper and lower parts are of compact, but not very hard marl; and passing horizontally through, is a thin layer of hard marl-stone, which, like a shelf, supports not only the enormous mass of marl above, but which mass in addition is thickly covered and loaded with growing trees, many of them of considerable size, which cling to the side of the precipice by their roots running into every crevice, and whose matted fibrous roots often descend like a close veil, outside of the face of the cliff, until they dip into the water of the river below. The marl under the layer of marl-stone has been scooped out by the washing of the current, or decomposed and dissolved by the chemical action of the sulphate of iron in the water, so that the shelf and the whole cliff above jut out and over-hang the river often six to ten feet, and sometimes fifteen and even twenty. It is wonderful that the enormous weight, aided by the force of wind on the trees, does not frequently throw down parts of the overhanging cliff. But in viewing closely its whole extent, I saw nothing of such recent results. The steep and threatening cliff, where noticed, was everywhere of the usual dark gray tint of a long exposed surface; and elsewhere is covered with a thick green drapery of luxuriant and beautiful creepers, and of trees, giving evidence of long undisturbed repose of the marl and marl-stone in which they are rooted.

Marls of the Edisto River and its Branches.

On the Four-Holes swamp, the principal eastern tributary of the Edisto, I was enabled to examine the marl at but two places, which are both among the highest or most northern known localities, and serve to mark part of the general outline limiting the great deposite. From visible indications and some loose general report, I infer that marl is plentifully offered by its convenient position on this long stream. When I visited its lower and middle region, the water was too high to see any exposure, if existing; and nothing could be learned of marl by inquiring in the neighborhood on my route, because nothing seemed to have been before heard or thought on the subject.

The first of the two localities referred to are on the lands of Mr. Thomas Zimmerman, on the eastern side of the main swamp, and about three miles

from its highest source. The surface of the marl lies lower than that of the land at the edge of the swamp. The specimens obtained showed a considerable proportion of green-sand, together with the ordinary richness in carbonate of lime. On Lime-kiln creek, a western and upper branch of the swamp, is the other exposure of marl, well known because lime has been long burnt there, in large quantities, the business having been first commenced by Dr. Jamison, the former proprietor, and is continued by the present, Mr. John A. Tyler. The surface of the marl lies about four to seven feet below that of the low land bordering the swamp; and after removing this overlying mass, four or five feet depth of marl only was obtained, both rich and firm enough to be used for burning. Below this depth, the marl became much more loose and soft in texture, and of much darker color, as it was afterwards described to me by a person who had formerly superintended the excavations for lime-burning for several years. And from the very loose description thus obtained, I infer that the lower part which was thus left as useless, was rich in green-sand, and the whole mass very valuable and easily available for manure; which use, however, whether of the raw or the burnt material, no one thought of trying, during the long time that the bed has been worked. Some very small and altogether improper applications of lime scarcely deserve to be named as exceptions to the general neglect of the marl as manure.

On Cawcaw swamp, the marl has been formerly reached at Manuel Pooser's, (the highest known locality,) and at Wannamaker's a few miles lower; both near the swamp, and the marl lying low. And at both these places, the marl is overlaid by the south-eastern edge of the *infusorial bed*, which will be hereafter described.

On the South Edisto, I found marl in Barnwell, at Johnson's, (or now Binnaker's) bridge; and it has been since traced to one and a half miles above. Also at Walker's bridge, near the Colleton line, and again two miles above. Thin layers of the latter exposures are of very hard marl-stone. The greater mass of all these are sandy and poor, and of very different appearance from the great body of the Carolinian bed. It seems most likely that the original upper surface of the marl along the main course of this river, has been torn up by the force of a violent current, and while so suspended, mixed with sand also suspended, and then again deposited in the form of the poorer marl now presented, and forming but the upper part of the general and richer bed below, and which probably may be found by deep digging. The borders of the lower part of this river, and of the Four-Holes swamp, where they unite, formed part of the large area which the advanced season, and its certain danger to health, prevented my examining at any time after the subsiding of the high waters, which had rendered fruitless earlier attempts at examination.

Throughout the western and central parts of Colleton, and all of Beaufort, where I crossed these two large districts twice in different routes last March, no *true* marl exposure had been heard of, except the post-pliocene, or coast marl, the existence or character of which my visit first brought to light, and which will be described hereafter. There were, however, three different calcareous deposites which had been long known, and were recognized as marl, without doubt. On examination, two of these were found to be the small amount of refuse lime supposed to have been thrown away from indigo vats in ancient times; and the largest, and most noted, which was at a landing place in St. Helena, seemed to be the bottom of an old heap of lime, either burnt on

the spot, or brought there, and spoiled by a high tide, and abandoned and forgotten. These deposites, and the mistakes by their proprietors as to their character, would not deserve to be mentioned here, but to guard other persons, making supposed discoveries of marl (and also of lime-stone in the higher country,) to be less precipitate in coming to their conclusions. Sundry other deposites, mostly of the refuse lime of old indigo works, or of materials designed for such, I have since been called upon to visit, or to analyze specimens of, in other parts of the State. In every such case, an hour's work in digging and removing, and generally a few minutes, would have sufficed to show the very small quantity, if not the true character of these artificial deposites. Their quantity and extent, to be ascertained by digging and using the calcerous earth, will afford the proper and easy test of their character and value. And without this test any one may be deceived by a more superficial view of a few feet of exposure, and still more by a mere hand specimen.

But since interest and zeal on this subject have been awakened in these districts, several extensive and well determined bodies of good marl have been found within the region above-named, of which I can only venture to mention two, which have been sufficiently made known to me by accurate description, and the exhibition of sufficient specimens of the marls and their fossils. One is in Colleton, on Ashepoo River, three miles above sloop navigation, on the land of Frederic Fraser; and the marl of excellent quality. The other is on the land of Frederic G. Fraser, west of Huspa creek in Beaufort.

Marl of Little Salkehatchie and its Branches.

The high state of the water when I first visited this river, (and also the Great Salkehatchie,) prevented my making any useful search for marl personally; and my inquiries led to nothing, except that no thought had been given to the subject, and of course no interest or curiosity before excited. Subsequently, in passing near the head waters, I found a very poor marl thrown up at Dowling's mill-race, (near the head of Little Salkehatchie,) which at least indicates the presence of the great body, and gives hopes of the unchanged and rich marl being within reach below. And such rich marl is visible in a bold spring of marl-stone water which boils up in Lemon's swamp, a lower tributary of Little Salkehatchie.

Marl of the Savannah River and its Branches in Barnwell.

The continuation of the Great Carolinian bed, with its general richness and other characteristic features is found at the Boiling Spring, and various other places on the different branches of the Lower Three Runs, to near its outlet into the Savannah. And since my partial examination has excited interest, I am informed that marl has been found at Red Bluff, on the Savannah, and on King's creek, both near to Beaufort District. I discovered it abundantly exposed and easily to be worked, on the plantation of the Rev. Elliott Estes, on the Savannah, and above the mouth of the Lower Three Runs. High up on Tinker's Creek, one of the head branches of Upper Three Runs, I found marl in several contiguous places; but as seen, is too poor for use, because it is in a transition state to that of complete silicification of the shells, such as is often seen just above the upper or northern limits of the marl, and which singularly changed condition will hereafter be described.

No doubt that proper examinations will serve hereafter to discover many more localities of available and rich marl near the Savannah. Still, it must lie low, and therefore be comparatively difficult of access towards the upper limit, because of the existence of a remarkable and highly interesting geological feature that it is proper to mention, if only for its bearing on searches for the surface of the marl bed. On the Georgia side of the Savannah, the high-lands are of very unusual elevation, rising to 200 feet or more, and presenting river cliffs, made perpendicular by the washing of the river, of the height of near 100 feet. On the South-Carolina side, opposite, the lands are mostly of low swamp; or, if higher, are still of alluvial formation or subject to inundation by the highest freshets; and the high-lands, (not alluvial) lying back and next to the swamps, are much lower than those across the Savannah. It seems as if, in the general upheaving of the land from the bottom of the ancient ocean in which the marl had been long previously deposited and formed, that a dislocation was made here, the line of which furnished a passage and channel for the river; and that the present land of Georgia, with its underlying marl, was raised some 50 or 60 feet higher than the edge of the adjoining area, now forming part of the southern border of South-Carolina. Hence the marl on the Georgia side, which exposes a cliff of more than 70 feet, may be supposed to show the same alternations of strata, and of qualities, as could be found on the opposite shore by penetrating to 70 feet below the surface of the marl, which surface is at a depth as yet unknown below the surface of the soil. Therefore, to study the characters and alternations exposed to view on the Georgia side, is the readiest and as yet the only available mode of investigating the supposed character of the deeply buried and concealed lower part of the great body in South-Carolina. And besides this reason, and also the general interest of the subject, there is nearly as much of practical prospective utility and value to the agriculture of South-Carolina in the marl cliffs on the Georgia side of the Savannah, as if they were on the opposite bank. For in either case, the transportation of marl would necessarily be by water, and equally as cheap from one side of the river as the other. In the most extensive marling operations yet performed in this state, (though very recently commenced,) the marl from Shell Bluff is taken twelve miles against the current of the river, and landed on Silver Bluff, on the lower line of Edgefield District. It would be far more easy to transport the marl to double that distance down the course of the stream. Thus, from one locality, in Georgia, only, marl may be cheaply and profitably conveyed (as this one extensive trial has already fully proved,) to at least all the river lands of South-Carolina included within the distance of 36 miles along the river. And as there are other marl cliffs lower down, which I had not seen and know of only by loose report, the like advantage could be extended from them much further. For these several reasons, a more particular description of the remarkable and grand cliff of marl at Shell Bluff, will not be deemed out of place in this report.

The highest calcareous deposite is a stratum composed entirely of the gigantic oyster shells which stretch through both South-Carolina and Georgia. This stratum is here from 4 to 6 feet thick, and separated from the other and very different marl, lying below, by 10 feet of earth not calcareous, of which the upper and larger portion is coarse silicious sand, and the lower is the same sand interleaved with thin layers of clay. As it is presumed that

these shells, however worthy of notice, have no connexion with the inferior and great deposite, they will be dismissed from consideration for the present.

The thickness of the Great Carolinian bed, as there seen above water only, was accurately measured at the best point for that operation, where the cliff, for the whole height, was perpendicular, and even somewhat over-hanging. The height was 72½ feet. Doubtless the thickness below water is even more. At this place also, the lower strata (showing above water) were measured separately, and specimens of them taken; and the upper strata were measured in like manner, and sampled at another exposure; as all the strata of the cliff were not accessible at any one place. And if they had been so, the statement of proportions and kinds at one section would not precisely suit any other. For some of the strata, or varieties thin out, or even disappear entirely, and are substituted by the increased thickness of others, or of other varieties appearing elsewhere in the section.

NOS.	PROPORTION CARB. LIME PER CENT.	FEET.	
117.	89.	2	White and compact marl.
118.	52½	4	Darker.
119.	86	3	Harder.
120.	94	7	Hard; and some almost stony marl-stone. Full of hollow impressions of small shells—brownish color.
121.	82	4	Concrete mass of broken fragments of shells, pale purplish tint.
122.	60	2	Pale yellow, apparently poor, with a few casts of shells.
123.	51	16	White compact marl with pale green tint. No shells, except a few fragments of ostrea, undistinguishable.
124, 125.	81 } 70 }	10	Various thin strata, differing in appearance, but the lines of separation not very distinct, & all appearing rich. No. 124 selected as appearing richest, and No. 125 the poorest.
126, 127.	50 } 86 }	14	Coarse granular and firm marl, containing very few marks of shells, and none distinguishable. The two specimens, as the whole, seemed equal.
128.	58	2	Soft yellow marl, out of which flow many "lime-stone" springs.
129.	78	4	Below the water bearing stratum (No. 128.) as exposed at another place, by the higher level of the lower strata.

Besides these layers and kinds, there are sundry other varieties in different places, which either substitute some of these, or are interposed for a space. Among these may be mentioned as the most important for quantity, or distinguishable in appearance, the following:

(No. 130), Brownish ferruginous concrete of fragments of shells, compact, but not hard—80 per cent. (No. 131), Pale yellowish sand, soft or moderately loose, and apparently to the eye rather silicious—50. (132), Compact, hard, and close-grained dark marl-stone—84. White compact argillaceous marl, very like in appearance, one specimen, the upper, (No. 133), 87 per cent., and another, the lower, not differing much in appearance, (No. 134), only 48.

In a few places, and for a short extent, thin layers of dark brown silicious sand occur, quite distinct from the marl, and free from all calcareous matter.

Except the stratum of marl-stone, (No. 120), which is full of hollow impressions of small shells no longer remaining, there are very few shells, or even casts or impressions of shells, in all this great exposure of marl. A few of the *ostrea sellæformis*, and casts only of the *cardita plantcosta* are seen remaining, and sufficiently well preserved and well marked in character to be recognized.

The very great irregularity of level of the Santee marl, as before described, and also its broken and every-where shivered and fissured mass, indicate an irregular and violent upheaving force, even more than is exhibited on the Savannah. Thus, along the course of the Santee, from below Vance's Ferry, up to Half-way swamp, the upper surface of the marl on the Orangeburg side is at least 40 feet higher than any known opposite exposure in Sumter; and it may be safely inferred that the line of the great dislocations both on the Santee and the Savannah, became the passage-way of the waters of these rivers.

Marl and Marl-Stone of the Peedee Bed.

Though this formation is separated from the miocene marl (or middle tertiary,) in the geological series, or in regard to age, by the interval of two entire periods, or intervening successive formations, (the newer cretaceous and the eocene or lowest and oldest of the tertiary, both of which are here entirely wanting,) still the former two are so united in position, near the Peedee, that it would be difficult to describe either alone, without referring continually to the other. Therefore, in the description that will be given of the secondary or Peedee bed, the overlying and connected bed of miocene marl will be also embraced, so far as regards its position and visible thickness of the stratum; leaving its other characterstistics to be considered separately, as part of the whole miocene formation of the State.

It is the secondary formation in that vicinity only, to which I give the name of the *Peedee bed*. This peculiar formation is known as low on the Peedee river as Britton's ferry, at the line dividing Georgetown and Williamsburg Districts; though I could not see it there, when sought, because of the height of the river, (6 feet above low water,) at the time of my attempted examination. It may probably be traced still lower down the river. The surface of this bed rises as the river is ascended. At Williams' bluff, a little above Port's ferry, and 14 miles above Britton's, the marl-stone only was there seen, and was three feet above the water. On Gibson's land, next above, and stretching along that long bluff for a considerable distance, the secondary marl of dark gray color, was seen eight feet above the then height of the river, above which, for an additional height of several feet, is yellowish marl-stone, also secondary, which there presents a regular horizontal ledge or shelf. The softer marl below is there much poorer than generally higher up the river. Along a higher part of the river bank of the same plantation, the secondary marl disappears, or dips so low as not to be there visible above the water; the whole space, and 10 feet or more in height, being occupied by the miocene marl, which there first comes into view. At Godfrey's ferry above, the stratum of miocene was then more than 25 feet of visible thickness above the water, and no secondary marl to be seen beneath. At Giles' bluff, (Mr. Henry Davis' land,) the marl and marl-stone of the Peedee bed, in alternating layers, rose to 14 feet above the then height of water, having an addition of 12 feet thick-

ness of the yellow miocene marl super-imposed. At Witherspoon's bluff, 2 or 3 miles higher, the Peedee bed was again out of sight, and the miocene showing about 8 to 10 feet high. Proceeding still higher up the country, and near the river, the Peedee bed only is seen at sundry points of exposure. At Birch's ferry, 27 miles above Britton's, the Peedee bed was 10 to 12 feet above the river, and was exposed for 150 to 200 yards. The stratum of miocene marl had doubtless thinned out, and had come to nothing some miles below this place. The next exposure seen above, of the Peedee bed, was on Myers' land on the steep hill-side of a stream which empties into Jeffrey's creek, a branch of the Peedee river. There the soft marl and very hard marl-stone are of the like dark bluish gray color, as usual with this bed, and they alternate in distinct horizontal layers, varying from 9 to 24 inches thick—the marl being in the larger proportion. Here the whole thickness of the bed was seen, and found reduced to 10 feet; for its underlying stratum was seen exposed several feet deep. This is a black shale, (or very fine clay.) cutting as smooth as hard soap, and though apparently in a solid mass in its bed, is in thin layers, which easily separate and afterwards crumble in drying. It is not at all plastic, or yielding like clay. It shatters under the strokes of a digging implement, even when moist in its bed. The lower part here exposed has its thin layers alternated with much thinner layers of loose and open siliceous sand. This earth, of such marked and peculiar texture and character, is very abundant in this part of the country, and as high as Darlington Court House, and is vulgarly and improperly called "soap-stone." The secondary marl here lies immediately upon the shale, without any very distinct line of division. At Bigham's, alone below, some shale is seen above the marl, and the one seems to shade away gradually into the other. The Peedee bed of marl is also seen at various places on Will w creek, nearly to its source, which furnishes evidence of at least 10 miles width of the bed west of the Peedee. Its most nothern known exterior is on the land of J. A. Jolly, Esq., about a mile above the mouth of Jeffrey's creek, and not far distant from the river.

It had long been reported, and has been so published in agricultural papers, and remained without contradiction, that marl was abundant at Marr's Bluff, a well known public landing place and ferry on the Peedee, about 6 miles higher than the last named exposure. But upon examination, not a trace of marl was there seen, though 60 feet or more of perpendicular height is there exposed naked to view. A large proportion of this section consists of the same clay shale above described, which is the underlying stratum of the secondary marl, wherever the latter is found. This remarkable earth agrees, in its texture, smoothness of grain, and other sensible qualities, so nearly with the description of what is called marl in old English books, and according to vulgar and old established opinions derived from such erroneous authorities on this subject, that it is not strange that the shale at Marr's bluff should have so easily as well as falsely acquired the reputation of being excellent marl. Though there is not a particle of carbonate of lime in this thick stratum, I found minute quantities of sulphate of lime, (gypsum,) and also sulphate of alumina, (alum) in powder between some of the laminæ of the shale. This would indicate some source of sulphuric acid in the earth or in the water of the river; which is still more strongly evidenced at Giles' Bluff. Here, on the perpendicular face of the river cliff, of the secondary marl, in spots where sheltered from the rain, the surface is covered by a thin coat of

tufted moss, or lichen, growing on the marl; and this moss is delicately and beautifully frosted over by small crystals, which I found to consist principally of sulphate of lime. It was before stated in regard to the Santee marl, from its wasted appearance at the foot of the cliff, that probably the river water acting on it contained sulphate of iron.

It may not be without interest, or utility, to state that in the very thick exposure of black shale at Marr's bluff, the upper layers are purest and are very pure; and that, as descending, the intervening layers of loose sand, (as described above at Myers',) became more thick and abundant, and in parts of the section form the greater part. However, the shale still appears in layers of various depths, at irregular intervals to the height of the river—which was then about 8 feet above ordinary low water.

The height of the Peedee at the time of my examination of its banks in the spring, as in most other cases elsewhere, kept concealed a large part of the section, which was here the more desirable to be known, because of the existing uncertainty whether the hidden lower portion, at different places, consisted of either of the two kinds of marl, or of the shale below both. To be correctly informed in this respect, I again visited the Peedee, as early as possible after frost in autumn, and when the water was low, and commenced a trip by water for its more thorough examination. But the occurrence of bad weather, added to my suffering under ill health, forced me to abandon the attempt, and to entrust it to be made at a subsequent and more favorable time, by Col. J. N. Williams of Darlington, who obliged me, and served the public interest, by making this examination, in the manner that I directed, as far down as Godfrey's ferry. His examination was made at ordinary low water, about 8 feet lower than what I saw; and his report thereupon, received after the whole of the foregoing was written, enables me to state of what that lower 8 feet consists. He found the Peedee bed (secondary marl) at Birch's ferry to average 18 feet thick, for the entire length of that long bluff, and exposure. This rested on the usual underlying stratum of black shale, then exposed 2 feet above the water. At all the exposures below Birch's ferry to Godfrey's, he found marl down to the level of the water. This statement therefore adds from 6 to 8 feet of thickness of marl, which is accessible and available for use, whether of secondary or of miocene, to all that I had before seen, and had described in the foregoing pages.

The Peedee bed is of peculiar character, and very different in appearance from all the other formations in South-Carolina. It occurs in alternate layers of hard marl-stone and soft marl, sundry of which are to be seen in one section. Both these, wherever they under-lie the miocene, and also higher up than the latter extends, are of a dark bluish gray color; and each is of homogenous texture, the marl like an impure clay and the marl-stone like a compact and close-grained hard stone. Lower down the river than any miocene is seen, the upper marl-stone of the secondary or Peedee bed is yellowish. The marl is poor compared to most of those of the great Carolinian bed and to the adjacent miocene usually not more than from 30 to 40 per cent. The marl-stone, however, is rich, varying from 66 to 68, and the little that has been tried, burnt to white and excellent lime. The characteristic fossils, *belemnites* and *exogyra costata*, are not found diffused generally, but are very abundant at particular places, of which the bluff at Birch's Ferry is the best supplied. But this bed is so peculiar and uniform in appearance, that after it has been once identified by the presence of the above fossils, it can as well

be known even where they are altogether absent. The *belemnites* has a straight cylindrical body, sharp to a point at one end, and always broken and showing a hollow interior at the other. Its color is brown, and it is semi-transparent—very hard and brittle, and consists almost entirely of carbonate of lime. The specimens vary from 2 to 5 inches in length and from less than a quarter to nearly half an inch in diameter. The *extogyra costala* is a remarkable bivalve shell, of which one valve is very convex, thick, and ribbed lengthwise and rugged on the outside, and the other valve much smaller, and flat or a little concave. The largest specimens are about 5 inches in length. By the presence of either of these well-marked fossils elsewhere, the secondary formation, and probably also, if in this or the adjacent country, this particular Peedee bed, may be readily and certainly determined.

The banks of the Peedee river present the same remarkable geological feature that has been before mentioned of both the Santee and the Savannah rivers. The western bank is of considerable elevation, and at every bluff, within the limits named, marl is exposed of great but various depths. But the land on the eastern side of the Peedee is very low, opposite the whole region of marl described, and has very few bluffs on the river, and no marl has been heard of on that side.

The secondary formation extends to Black River, on which, and also on several of its eastern tributaries, I found either marl or marl-stone in the following places: At both the neighboring ferry-landings, called Brown's, formerly Avant's Mills, in map of Georgetown; on Stony Run near the preceding; on Black Mingo Creek, and on Indian Town Creek. The highest locality of marl-stone found on Black River was 10 to 15 miles below Kingstree. The then height of the river, and the want of any previous excavations, or present means for deeper inspection, prevented my making other than superficial observations. But from this it would seem that, in this deposite, both the softer and stony layers are poor. The underlying stratum of the highest marl-stone found, is a mere sand, slightly sprinkled with small bits of shells. Lime has been burnt of the detached upper stones on Black Mingo Creek, which fact would indicate a rich material. This deposite where seen highest up on Black River, and also on Stony Run, seems to be passing into silicified shell rock, such as will be described hereafter; and at a few miles below Kingstree, in Williamsburgh, and all above, northward, this change is complete, the shells, or their fragments being completely silicified, and no carbonate of lime remaining either in the shells or in the general mass.

But few of the fossils on Black River and its branches were well enough preserved to be plainly distinguishable. However, one valve of the *exogyra-costata*, which I found in the poor marl-stone at the highest known locality on Black River, identifies the formation with the secondary marl on the Peedee.

Miocene Marl.

The miocene or middle tertiary marl is as well marked, and distinguished by its fossils, as is any other of the subdivisions of the great formations; and there can be no question as to the marl lately described as overlying part of the Peedee bed belonging to the miocene subdivision, according to Mr. Lyell's arrangement. There are enough remaining shells, few as are the species, to establish this position; and many more of distinct casts or hollow impressions of such shells formerly present, but of which nothing but the impressions now remain. Still there is a peculiar and marked character of this particular body

of miocene marl, different from all others that I have had opportunities of observing. And such observations have been extensive; for as scarce as is the miocene in South-Carolina, compared to other kinds, in Virginia it constitutes perhaps nine-tenths of all the marl existing. Also, in Darlington district, separated as it seems from the marl on the Peedee, by a considerable space, I have lately seen the ordinary miocene marl, precisely similar to that of Virginia. The points of difference will be stated presently.

The principal positions and extent along the river, and great thickness of the Peedee miocene marl, were stated in the foregoing section in connection with the Peedee secondary marl. It is also found at some distance back from the river, on the hilly part of Mr. Henry Davis' land and elsewhere, in great quantity, and rising often to the surface of the earth. But beyond the limits named, I know of it no where except in one locality, where the existence of this marl is a remarkable and strange fact, but recently ascertained, or suspected. On Goose Creek, a few miles above its juncture with Cooper River, on the land of G. H. Smith Esq., and about twelve miles by land from Charleston, there is a small exposure of this kind of marl, rising from the level of the tide mark to 8 or 10 feet above. In a specimen of this body, sent to me to be tested, I found a small fragment only of a shell indicating the miocene, which was a strange and unaccountable appearance, inasmuch as this locality is surrounded on all sides by known exposures of the Great Carolinian bed, a different and older formation, and over which, through all its broad extent, no miocene had been found, or before suspected to exist. A journey of considerable length and greater difficulty was made to settle this interesting question; and though no excavation had been made which would have much aided my examination, and there was no opportunity to see either its extent or connexion with any other formation, the first glance was enough to show this to be miocene marl, and also to be precisely like the before known remarkable body overlying the Peedee bed. And both that on Goose creek and the very large exposures on the Peedee are alike presented in detached patches, which, however broad and thick, and precisely alike in character, are not connected, or forming a continuous stratum.

This peculiar marl was, like all others described in this report, formed originally by the gradual deposition of the shells of shell-fish, which formed all the calcareous matter, and more or less of the entire body; the remainder being earth brought and deposited by the sea, and thus filling up the interstices. But in this marl, nearly all the shells, and without exception all the white shells, have been dissolved and removed, leaving the matrix of earth full of the hollow moulds, showing where the shells had once been. Still, the matrix, which now forms nearly all the body of the marl, is itself rich in calcareous earth, probably because formed originally mostly of shells ground fine by the action of the waves. Only seven species of shells remain, or no more have I been able to find. All these are of the gray and very hard kinds, and of these few, three (all pectens) are believed to be new shells, or such as have not before been described by or known to any naturalist. The other shells, and also many more of the hollow and perfect casts of removed shells, abundantly serve to determine that this marl is miocene. But though the remaining species of shells are very few, the individual shells of one of them, (a new pecten,) are very numerous—serving alone to form a large proportion of the whole body of marl in some places on the Peedee for several feet in depth.

This particular miocene marl, though not very hard, and in the parts where

there are few or no shells abundantly soft, still has all its particles cemented together, so as to present something like the texture of a soft rock ; and which could be excavated by undermining, without any danger of the roof of the same falling. This character, added to the general decay and disappearance of the shells, and the difference of kind of half of the few remaining species from any other known miocene, all unite to induce my belief that these patches of miocene were deposited much earlier than the ordinary kind ; and that the former bears somewhat the same relation to the latter, (though more closely connected,) that the Great Carolinian bed does to the eocene, or lower tertiary.

The whole of this supposed older miocene is of yellowish, or yellowish brown color. It is dry, and easy to dig, except where hardened into marl-stone, as is the case in some of the upper parts, and in a horizontal layer. This conversion to stone has been produced by part of the carbonate of lime of the upper part having been dissolved by rain water. A small amount of carbonic acid is always brought down in rain, from the atmosphere to the earth ; which addition enables water to dissolve carbonate of lime, otherwise insoluble in water. This dissolved carbonate of lime, was carried down, through the porous marl, until it reached a closer stratum below, or made one by the evaporation of the water and deposition of the lime. These strata of marl-stone, when rich enough, may be burnt to lime ; and the remaining marl and larger portion of the body, may be easily dug and used as manure without any other preparation.

Near Darlington Court House is found the miocene marl, such as is common in lower Virginia and in the adjacent part of North-Carolina. This is principally of earth, for the most part silicious and loose, in which are imbedded numerous shells, of various kinds, generally entire, and their size and shape well preserved. Indeed, they generally are so hard, and many of large size also, that it is difficult for persons unacquainted practically with marling, to believe that such shells can serve well for manure, without some preparatory process to break them to pieces, or perhaps to reduce them to powder. However, experience has amply shewn that such expense need not be incurred.

This marl has only yet been seen at three places near Darlington C. H. ; one on the land of Col. John F. Ervin, and another on that of Mr. James Gibson, both on streams flowing into Swift Creek, and from 1 to 2 miles from the Court House. The third is on Black Creek, John Fountain's land, and 5 miles south-east from the Court House. But, from recent report of the shells found, it is inferred that the same kind of marl is exposed at various places along Lynch's Creek, (which I have not yet been able to visit,) and also near Black Creek, 6 miles or more below Fountain's, on the land of R. Rogers; which would indicate the continuation of the same stratum throughout at least all the space between these different localities. This marl is richer than the similar miocene of Virginia. At Col. J. F. Ervin's recently opened pit, the bed was dug through at my request, and was found to be 9 feet thick, and resting upon the great bed of black shale which underlies the Peedee bed, and stretches from the upper termination of that bed through the interval vacant of marl, to this separate deposite. In Black Creek and every deep stream, between, this shale forms the bottom ; and it is reached in digging wells, so as to show that it is generally continuous throughout this part of the country.

The Post-pliocene Marl of the Sea-coast.

The general dip towards the east and south of the great marl stratum, as observed and stated in relation to the basins of the Ashley and Cooper rivers, and the surface of the marl being beneath low tide mark higher up the rivers than Charleston, left no ground to suppose that marl could be found exposed naturally still nearer the sea shore. There had not been seen, nor heard of, any other and more recent formation of marl in South-Carolina, and none was suspected to exist. It was under these impressions that I first visited the sea-islands, and not to look for marl, or with the slightest expectation of meeting with it. But while engaged last winter in examining the other abundent resources for calcareous manuring, in the beds of recent oyster shells, and of more ancient heaps of the same left by the aboriginal inhabitants, I most unexpectedly found a deposite of marl, though of a different formation and kind from any that I had before seen here or elsewhere, and which had never before been noticed, though probably seen by every resident on the island of Edisto, where the exposure was first observed. In passing over the bridge on the main road from the village of Eddingsville on the sea shore, an appearance on the margin of the creek, similar to the common blue miocene marl of Virginia, caught my eye. Upon examination, it was found to be indeed such a marl, in general appearance; but with this difference, that the shells contained, though fossil, seemed to be identical in kind with those of animals now living in the close adjacent ocean, of which the shells are to be seen cast up on the sea beach. From the formation being discovered in a tide creek of South Edisto River, and within a few miles of its outlet into the Atlantic ocean, it might be perhaps supposed that the shells were its product, and cast up by the waves of the present ocean. But though the formation in question is manifestly recent in comparison to all other known marls, still it is very ancient compared to such as is now forming in the bottom of the Atlantic, or may possibly be formed of the like in future time on the shore by the dead shells thrown up by present action of the waves. For not only are the existing bounds of the ocean some miles distant from the first discovered locality of this formation, but the bed of marl is also overlaid by the still later deposite of marsh soil of several feet in thickness, and elsewhere, as subsequently seen, by firm sandy earth. Therefore, it is evident that however new may be this deposite, and as it certainly is in reference to the great geological series of successive formations of marl, or of fossil remains, it is older than both the marshes and the high lands of the islands which rest upon it. This marl is unquestionably of the most recent formation of all which have yet been deposited on the bottom of the ocean, and subsequently upheaved so as to be raised above the surface level of the waters.

The shells of this marl first found near the bridge, (or at least so far as then visible,) are all of small size, or in fragments. The earth intermixed is mostly silicious, and of bluish tint. The mass moderately compact, so as to permit its being dug out in solid lumps, but unusually easy to dig and to crumble. When pointed out and exhibited to residents of the island, it was recognized by several, as similar to what they had seen in other adjacent creeks, emptying, as this does, into the South Edisto river, and from one of these creeks, in the land of Mr. James Seabrook, specimens were subsequently produced, shewing a similar general appearance and like formation, yet different in particular characters. In this, the shells were nearly decomposed, and the marl was much richer in carbonate of lime, and also more compact. Previously I

had found it elsewhere in another creek in the neighborhood, of still another description, the shells being much larger, more perfect, and the intermixed earth less compact. This seemed to be a lower part of the bed than the other kinds.

Further examinations enabled me to ascertain the presence of this marl at Distant Island, the land of Mr. Joseph Hazel, which is adjoining Lady's Island, and nearly south from the town of Beaufort, and about four miles distant; and also on Mr. McKee's plantation, in Lady's Island, and about three miles east of Beaufort. To each of these previously unnoticed localities, I directed the attention of individuals by exhibiting the specimens from Edisto, and describing the level and situations at which the marl was likely to be found. By such indications furnished to Mr. Hazel, he found, in the first day, that he had the marl exposed naked and stretching along his beach for several hundred yards. And when I forthwith accompanied him to see this interesting locality, we found further that it extended under the whole beach, concealed from view by merely a thin covering of 8 or 10 inches of beach sand. The lower part, first seen, was similar to the lowest found in Edisto Island, many of the shells being large. The higher part found under the marl, was formed of shells nearly all small, and, though perfect in form, very rotten and easy to crumble. This deposite is at a place where the water has gained upon the land; and Mr. Hazel remembers when the present beach and the place of the deposite of marl were covered by firm high land, such as now borders it, of 8 feet elevation above high-water. This alone would prove that the deposite is very ancient compared to the existing condition of both the land and water. Since then, Mr. Hazel has found the like marl on other parts of his land, and several other deposites have been found elsewhere by other persons near the coast, of which the most extensive and important is in John's Island, which underlies Doctor's swamp for 5 miles in length. It was found there and traced by Mr. Sams. Having heard from Professor Lewis Gibbes, of Charleston, that he had found such shells, and so placed as to certainly identify the deposite with such as I had discovered and seen as above described, I requested of him a written description and list of the shells, of which he had carefully noted the species; he has furnished both, in a letter dated Nov. 25th, 1843, of which the portion on this subject will be copied below.

"The city of Charleston rests upon a bed of sand of an average thickness of 15 feet, colored by iron, of a yellow more or less deep, in some places almost white, and in others of an ochrey yellow or brown. The grains composing this sand are almost uniform in size, about the one hundredth part of an inch in diameter, and mixed with but a small quantity of clayey or calcareous matter. Underlying this bed is a stratum of shells about 5 feet thick, in some places not more than 3, and differently colored in different places; under the city it is blue, in other places nearly the color of the bed of sand above it. From this stratum proceeded the shells in the following list.* They all belong to species now existing on our coast, and consequently shew that the stratum in which they are found, as well as the bed of sand above them, belong to the post pliocene of Lyell. There is but one shell in my cabinet not yet determined or recognized as a coast shell. It may perhaps however exist elsewhere along the coast of the U. S.; for Dr. Ravenel informed me some time since, of a curious fact, namely, that among shells found in excavations made at the Rail Road establishment on the Neck, he recognized several Gulf of Mexico shells, shells not found at present on our own coast. The ordinary wells of the city are sunk in the bed of sand, and the fire wells penetrate the bed of shells beneath.

"This bed of sand is exposed in several places around the city, as at Haddrell's Point, (where it may be seen from the harbor,) and at several of the "bluffs" on Asaley and Cooper rivers. At low water, the stratum of shells is exposed in some places, and I examined it

[* The list will be made part of the more general list of shells from all the formations, which be inserted at a subsequent part of this Report. E. R.]

under these circumstances in Town creek on Ashley river. In the City I examined it in a few places when they were making the excavations for the fire wells, and from C. Fraser, Esq., I received shells taken from other excavations, corner of King and Tradd-streets. From Mr. J. Wilson I received specimens of the same stratum from his plantation on John's Island. The precise extent of the formation I do not know."

Mr. Edward Frost, one of the representatives of Charleston, has since informed me (Dec. 2nd) that he has seen and examined this same deposite, on the side sand extending to the bottom of a creek of Ashley river immediately opposite the city.

The post-pliocene or latest formed marl, wherever yet observed in South Carolina, (unless that under and near Charleston be an exception) lies between the extremes of high and low tide marks, and generally presents but a thin bed, rarely more than three feet in thickness. The shells are of such animals as now live; and mostly if not entirely belong to the neighboring ocean waters. Though generally entire, the shells are enough decayed for manure. And though the stratum is thin, yet the ease with which this marl may be worked makes it a very valuable deposite to be used for manure.

Oyster Beds and Indian Heaps of Oyster and other Shells.

But even if the post-pliocene marl had no existence, the coast plantations would have most abundant and very cheap materials for calcareous manures in the inexhaustible quantities of the shells, of oysters living and dead, with which all the salt creeks and shallow bays of the sea abound, and which may be obtained in any desired quantities, and be reduced to a proper state of division for manure easily by crushing, as well as by burning to lime. These shells, forming what are called the "rackoon oyster" beds on the mud flats, are of small size, thin, and easy to break, and to pulverize. The lower oyster shells, which were the first formed of the bed, are partly or wholly buried in the mud, the hinges downward as they grew, and a later growth attached to the opening or more elevated parts of the older; and so on, with successive growths, until the accretion has risen to from 3 to 5 feet high above ordinary low tides, and covers completely large spaces of mud, without any vacant intervals being left. Still, though the shells and living oysters thus form vast connected masses, they are so slightly attached to each other by their adhering extremities, both laterally and vertically, that they may be broken apart and taken up with the greatest ease, to load vessels alongside. No supply can be cheaper that is burdened with any expense of distant transportation; and the supply is continually increasing, and would be inexhaustible, even if the demand and the consumption were as great as they ought to be for the coast plantations, and including all the tide rice lands which may not have the advantage of still cheaper marl at hand.

But besides the supplies of oyster shells thus offered so profusely by their natural growth, there are extensive accumulations of the same and other sea shells already made on almost every plantation along the sea coast. These shells were gradually collected around the cabins of the aboriginal inhabitants, as the shell-fish were consumed for food. And as they were left, the heaps have been suffered to remain upon and to encumber the cultivated fields to this day. I heard of but two individuals who had even spread the heaps on the surrounding land to abate the nuisance of their accumulation on particular spots, and the damage to the hoes and to tillage, and also to production. And there have been more cases of removal of the heaps of shells, at much cost of labor, by carting them into deep hollows and tide creeks, to get rid of them.

Yet the mere spreading them thinly would be a certain and valuable, and also the cheapest possible manuring. And the great fertilizing effect, even without spreading, is obvious to the eye in very many cases on the sea islands, where the heaps had been so small as not to be too much of an incumbrance on the land, and obstruction to the tillage and growth of crops.

On other parts of the coast, (as near Oakly Inlet, Georgetown) there are similar heaps, and of large size, almost exclusively of clam shells. The greater hardness of these would probably make requisite the burning them to lime for manure. But for that use, they offer a cheap and excellent material, and a large supply.

MINOR CALCAREOUS DEPOSITES.

There are some other beds of calcareous deposites and shells, which, though in very limited quantities, deserve consideration; and which, from their isolated position or peculiar character, cannot be arranged under any one of the preceding heads. Of these several deposites, the most marked in character, and the only one sufficiently abundant to be put to use for manure, is the

Bed of Gigantic Oyster Shells.

This singular and very remarkable deposite I have seen exposed in four different and remote localities, including that at Shell Bluff, just across the Savannah in Ga., and which was incidentally referred to at page 22. The next most northern exposure to this is on a branch of the Lower Three Runs, above, and also at the Roaring Spring. A third place where I found the fragments of those peculiar shells on the surface of the earth, and which could not be then examined deeper, was on Tinker's Creek, a branch of Upper Three Runs; and the fourth was first discovered in the digging of the northern section of the Santee Canal, the lower excavation of which crossed a bed of these shells, which is now covered by the water of the canal. Whether these far separate exposed points are in one or in different beds, or whether or indeed the shells belong to but one or to two species of extinct oysters, may be doubted. All the shells are of oysters, and of enormous size. They are of two varieties or different shapes, and which Conrad deems different species; which, however, though quite different in appearance, are not more so than are the living oysters now to be found in different and neighboring places of the same river, and according to the abundance or scarcity of their food in their respective positions, owing to their being either much crowded, or lying thinly scattered. One kind of these ancient shells, (termed by Conrad *Ostrea Caroliniana,)* is very broad compared to its length. A single valve of the largest which I found at the Santee Canal, though manifestly much reduced in size at the edges, measured 8¼ inches in length, and 6¾ in width, and weighed 2 lbs. 10 oz. The other kind *(Ostrea longirostra*, Con.*)* is much longer, and very narrow in proportion. One of the largest of these which I collected at Shell Bluff, was 13¼ inches long, (with the curve of the shell) though it must have lost an inch at the opening end, and not more than 2¾ inches wide. The beak alone, (or the former and existing hinge part,) of some of these shells, of which only fragments remained, was near or quite 6 inches in length.*

* Bartram, who visited this Bluff, describes shells much larger than the above sizes, or any that I could find. His words are as follows: "The shells are of incredible magni-

These two varieties of shells are not found intermixed, but either at separate elevations in the stratum or at separate localities. At the Santee Canal, all the specimens I could find (by digging in the bank originally made by excavating the canal) were of the broad kind. At Shell Bluff, the upper part of the stratum consists altogether of the long and narrow shells; and at the intermediate localities the shells were so much broken, and mostly under water, that their precise original shape was doubtful. But if the long beak, or hinge, serves to determine the long kind, such were found on the Lower Three Runs. I incline to the belief that these two varieties belong to one species.

The only place where the profile and depth of the stratum is exposed is at Shell Bluff. It is there seen in the upper part of the perpendicular face of the cliff, above the marl of the Great Carolinian bed, and there separated from it by an intervening body of from 4 to 10 feet thickness of first coarse loose sand, and then the like sand alternated by sundry very thin layers of clay, all of which intervening body is without any shells, or marine remains or any calcareous matter. This complete separation should forbid the belief that the deposite of gigantic oyster shells belongs to the same geological formation as the Great Carolinian bed below. The stratum of these shells at Shell Bluff is from 4 to 6 feet or more thick. They lie as closely to each other as they well can be, and are held together by the former vacancies having been filled by a cement of shells, fragments and earth. The whole mass is very rich in calcareous matter, and would serve well to furnish materials for lime. But the remains are too hard, and the fragments generally two large and solid, to be used as manure without being burnt to lime.

Deposite of recent shells upheaved.

At the Laurel Hill Bluff on the Waccamaw River, there is a deposite of recent sea shells, imbedded in coarse and loose sand. The mass is exposed in the lower 8 feet (above high tide) of the washed and steep bluff, and presents quite such an appearance as may be supposed would exist in the upper sands of the bottom of the ocean near the shore. The shells are mostly of the *gnathodon cuneata*, some recent oysters, and a few smaller recent sea shells, common to the present coast. This formation, though a matter of curious interest, is of no practical value, because of the small quantity and also poor quality of the body.

Miocene deposite under part of the present Ocean.

On the ocean beach, near Oakly Inlet, Georgetown District, I found many shells in such excellent preservation, that from that circumstance, as well as their having been evidently thrown up by the waves, they would have been supposed recent, or the product of the existing ocean. But, from examination of the kinds, these shells were known to be of the miocene era, and of course are of fossil origin. Among these shells are *Venus Rileyi*, *Venus alveata*, *Corbula inequale*, *Arca limosa*, and a variety of *Ostrea Virginiana*. These shells, and the many masses of marl-stone seen scattered on the same beach, and which had been in like manner thrown up by the waves, must have formed part of a sub-marine bed of miocene marl, which still exists and perhaps has always remained under the sea; and the rare and excellent state of

tude, generally 15 to 20 inches in length, from 6 to 8 wide, and 2 to 4 in thickness, and their hollows sufficient to receive an ordinary man's foot." Bartram, though seeing this locality, probably relied on report for the sizes of these shells.

preservation of the shells may be owing to their having never been exposed to air, or to any changes of wetness and dryness.

It is probable that parts of this curious deposite of miocene exist elsewhere deeply buried along the coast, or under the sea, from the following fact: A very large and unusually perfect shark's tooth (as usually called,) weighing 11 oz. 3 drs., was lately presented to me by Dr. J. Bachman, which had been drawn up by an anchor from the bottom of Charleston outer harbor, in water 45 feet deep, off Fort Sumter. The tooth is precisely similar to those of large size found in the miocene marl of Virginia; and its being partly encrusted with recent madrepore, and having also sea weed growing to it, attest its subsequent position in the water of the existing sea.

ANALYSES OF MARLS AND MARL-STONES OF S. C.

The specimens, of which the contents of carbonate of lime are to be stated below, were collected during the course of my examinations of the marl beds, and with a few exceptions, were selected by myself. Parts of all these specimens were reserved for a cabinet in the State House, the filling and arrangement of which will be completed soon after the presentation of this report. It was not designed to make either a mineralogical or conchological collection, for neither of which had I the time or the necessary scientific knowledge; but simply a collection of all the various marls, lime-stones, and other calcareous formations of the State, together with some of the characterestic fossils of each formation, having such fossils.

The specimens are arranged in the cabinet according to the respective formations or divisions to which they belong, as stated in this report; and by the labels, are indicated the particular as well as general locality, and generally also, the proprietor of each marl; and by reference to the following list, the strength of each specimen can be readily known. The shells and casts of shells which are placed with some of the specimens of each formation, or division of the South Carolinian marls, are by no means a full collection; but are enough in number, as well as of the most characteristic kinds, to clearly distinguish each particular kind of marl.

I. *Marls, &c. of the Great Carolinian Bed.*

From the borders of Ashley River and its tributaries.

1. From John S. Brisbane's landing, 9 miles above Charleston, taken from the surface on the beach, between high and low tide mark, contained of carbonate of lime, per cent. - - - 64
2. From the same, taken from the bottom of the river 26 feet below low tide, - - - - - - - - 75
3. Lumps of stony hardness, full of impressions of shells, found in great quantity in that neighborhood a few feet above the marl, 6
4. Marl from O'Neale's landing, - - - - 76
5. From river bank at Drayton Hall, - - - - 63
6. " Bee's Ferry, - - - - - - 50
7. " Magnolia, - - - - - - 75
8. " Greer's Landing, (near Middleton Place,) - - 52
9. " Pringle's, - - - - - - 75
10. " Cattell's Bluff, Clement's land, greenish tint, - - 52
11. " Another part of Clement's land, white, - - 78

12. From Cohen's land, - - - - - 62
13. " John A. Ramsay's, - - - - - 67
14. " Cedar Grove, I. M. Dwight's, - - - 76
15. " Oak Forest, - - - - - 36
16. " Wassamasaw swamp, (head source of Ashley,) - 72
17. " Indian Fields No. 1, (light brown,) - - - 47
18. " do. " 2, - - - - 50
19. " 45 feet beneath the water in outer part of Charleston Harbor, near Fort Sumter, after removing all the recent shells adhering, or enclosed by recent boring shell-fish (See p. 13,) 81½

The following are specimens obtained in boring (in 1824) in the city of Charleston, from the different depths stated, (see p. 13, 14.)

*19. From the depths of 120 feet below the surface, per cent. 65
20. " do. 135 - - - - - 56
21. " do. 160 - - - - - 69
22. " do. 162 - - - - - 44
23. " do. 180 - - - - - 59
24. " do. 200 - - - - - 54½
25. " do. 225 - - - - - 60½
26. " do. 227 - - - - - 58½
27. " do. 230 - - - - - 55
28. " do. 258 - - - - - 58
29. " do. 270 - - - - - 66
30. " do. 274 - - - - - 79
31. " do. 282 - - - - - 79
32. " do. 309 - - - - - 74

Marls, &c. from the borders and neighborhood of Cooper River.

33. From the Grove, Dr. Edmund Ravenel's, soft and granular, per cent., - - - - - - 52
34. " Mulberry, Millikin's, supposed (by the eye) average quality, 60
35. " " supposed richest, - - 76
36. " " supposed poorest, - - 42
37. " Lewisfield, Simons', - - - - 84
38. " Point Comfort, R. W. Roper's, - - - 79
39. " Steep Bluff, - - - - - 80
40. " Rectory, (in the road) - - - - 80
41. " Dr. Barker's, clayey marl, upper part of stratum, - 43
42. " Dr. Benj. Huger's, (marl-stone,) - - - 95
43. " Monk's Corner road, near Moss Grove, - - 80
44. " do. near Broughton's Swamp, (peculiar marl, see page 15) - - - - - 46
45. " Col. James Ferguson's, similar to last, - - 58
46. " do. nodules like chalk, in last, (see page 15) 96
47. " H. W. Ravenel's, near Santee Canal, on head waters of Cooper, ordinary kind, - - - - 95
48. " Isaac Porcher, jr., 5 feet under a swamp leading to Cooper, 67
49. " do. another specimen, lower, - 81
50. " Philip Porcher's, - - - - - 86
51. " Frederick Porcher's, marl-stone, - - - 92
52. " Somerset, Wm. Cain's, ordinary marl, - - 87

53. From Deveaux's old mill-pond, 5 miles north of Pineville, 87
54. " Robert Mazyck's, near Santee Canal, besides a large propor-
55. tion of green sand, contained of carbonate of lime, - - - - 25
56. " do. overlying earth of the last, much green sand, and of carb. lime, - - - 17
57. " do. white marl-stone under all the green marl, 90
58. " Goose Creek, Brodie's land, (brownish,) - - 66
59. " do. Wm. Kelly's (brownish,) - - 68
60. " do. do. (yellowish,) - - 78

Marls, &c., from Santee river, and its neighborhood.

61. From Ball's Dam, Dr. J. S. Palmer's, Charleston Dist., carbonate of lime, per. cent. - - - - - 91
62. " Col. S. J. Palmer's (landing of old Jamestown,) with considerable green-sand, - - - - - 66
63. " Dr. Robert Gourdin's, Lenud's ferry, Georgetown Dist. 93
64. " do. marl-stone, lower stratum - 97
65. " Lequiex's, Williamsburgh, marl, - - - 91½
66. " Glass' do. - - - - - 94
67. " Eutaw, Wm. Sinkler's, near mansion, Charleston Dist. 94
68. " do. within deep sink, near Eutaw Spring, - 88
69. " do. marl-stone, protruding above the surface of the battle field, - - - - - - 92
70. " Dawshee cove, lower part, - - - - 95
71. " James Gaillard's, marl-stone, - - - 93
72. " Rocks Creek, near mill, soft marl, - - - 94
73. " upper stratum, - - - 95
74. " do. surface, marl-stone, - - - 93
75. " do. soft marl, with also a notable proportion of green sand, - - - - - - 94
76. " Below and near Nelson's ferry, - - - 83
77. " Vance's ferry, Orangeburgh, upper layer, taken 25 feet above and back from the river, - - 86
78. " do. lowest above the river (or 6 feet above low water,) - - - - 90
79. " do. marl-stone, layer between the two last, - 92
80. " Avinger's, 25 feet above the river, marl, - - 84
81. " A. Felder's.* - - - - - 94
82. " Keating Simons', softer layer under the over-hanging shelf of marl-stone, and near surface of river, 96
83. " do. inland, and top of stratum, - 82
84. " Cavehall, Dr. Cheves', - - . - 86
85. " do. marl-stone in the cavern, - - - 80
86. " Hale's mill, upper layer, Orangeburgh, (containing no green sand,) - - - - - - 84½
87. " Hales' mill, lower layer, with about 25 per cent. of green sand, (by the eye,) and carb. lime, - - - 51
88. " a branch of Stout's Creek, green sand about 20, and carb. lime, (highest known exposure near the Santee,) 35

*This has been used largely for burning lime for sale.

89. From under layer of last, marl-stone, - - - 64
90. " Potato Creek, Sumter, Nelson's, marl, - - 91
91. " Heatly Hall, (on Half-way Swamp, Orangeburgh,) - 90
92. " Pinckney's mill-pond, - - - - 41
93. " Pinckney's mill-dam, - - - - 69
94. " beneath low water in Scott's lake, Sumter, - - 84
95. " F. Dantzler's, Charleston Dist. - - - 75½

Marls, &c., of Edisto river and its tributaries.

96. From Slater's land, 1½ miles above Johnson's (or Binnaker's) bridge, Barnwell, - - - - - 36
97. " Johnson's bridge, near surface and yellowish, - 38
98. " do. near surface, and bluish, - - 36
99. " do. 8 feet deep, - - - 31
100. " Walker's (or Stokes') bridge, soft and sandy, - 31
101. do. marl-stone, - - - - 87
102. On Four-holes swamp, near head, from Zimmerman's, and about 5 of green sand, - - - 86
103. do. John A. Tyler's, (formerly Dr. Jamison's,) marl, or softer part,* 93
do. do. marl-stone,* - 94
104. On Cawcaw swamp, Wannamaker's land, - - - 62
105. do. M. Pooser's (highest exposure found,) 26

Marls, &c., of Savannah river and its tributaries in Barnwell.

106. On a branch of Lower Three Runs, near Boiling spring, Col. Hay's, - - - - - - per. cent. 74
107. From a spring half a mile lower, - - - - 62
108. On main stream of Lower Three Runs, W. Holly's low ground, 64
109. do. another specimen, - - - 62
110. Thin soapy layer, forming the upper surface of the marl, and found in different parts of the bed of the creek, - - - 22
111. From Gillett's mill, Gen. Erwin's, firmer parts, - - 64
112. " do. softest part, (granular,) - - 46
113. " Rev. Elliott Estes' land, on Savannah river, (above Lower Three Runs.) - - - 92
114. " do. marl-stone, - - - 90
115. " Major J. G. Brown's, Lower Three Runs, upper part, 50½
116. " do. 10 feet below surface, 32
117 to 134, 17 specimens of different parts of the cliff at Shell bluff, before reported at page 23.

Of Little Salkehatchie and its branches.

135. From Dowling's Mill,† - - - - - 7
136. " Cedar Spring, on Lemon Swamp, (Miller's land,) - 73
137. *On Ashepoo river*, from Frederick Fraser's, - - 92
138. *On Huspa Creek*, from F. G. Fraser, upper part, - - 16

*This has been used largely for burning lime for sale.

†This was a part detached from the upper surface, in excavating for the mill site, and was not worth notice, except as indicating that marl may be found probably much better, lower in the bed.

139. do. do. lower part, very compact and smooth grained, like hard fullers' earth, - - - 93

II. *Marl and Marl-stone of Peedee bed.*

Throughout this, the soft marl, which is generally rather poor, and the very hard and compact marl-stone, which is generally rich, are presented in alternate layers.

140. Marl, dark bluish gray, from bluff at Birch's ferry, carb. lime, per. cent. - - - - - - 36
141. do. at Birch's ferry, 5 feet from bottom of the bed, 33
142. do. do. 10 feet - - - 51
143. Marl-stone, do. 12 feet - - - 66
144. Marl, Clay wall, (J. A. Jolly's,) above mouth of Jeffrey's creek, surface, - - - - - - 24
145. do. Willow creek, Gordon's, - - - - 45
146. Marl-stone, do. - - - - 77
147. Marl, Bigham's, on stage road, supposed average of his digging, 32
148. do. Leggett's, upper part, - - - - 57
149. do. Giles' Bluff, Henry Davis', - - - - 42
150. do. do. next to low-water mark, - 14
151. Marlstone, do. - - - - - 86
152. do. Myers' land, - - - - - 84
153. do. do. (another specimen,) - - 76
154. do. (pale yellow) Gibson's bluff, upper layer, - 82
155. Marl, bluish gray, do. lower - - 10
156. Black river, marl-stone ledge, at Avant's (or Brown's) upper ferry, 72
157. do. soft black earth underlaying the last, only - 2
158. Stony Run, Georgetown, marl-stone, - - - 55

III. *Miocene Marls, &c.*

159. From Giles' bluff, Peedee, (overlying secondary) yellow marl-stone, 78
160. " H. Davis' land, back from above, yellow soft marl, - 60
161. " do. another place, - - - 64
162. " do. another - - - - 66
163. " Godfrey's ferry, - - - - - 69
164. " do. harder layer, - - - 89
165. " Gibson's land, lower stratum in cavern, on Peedee, - 81
166. " do. back, near spring, - - - 74
167. " Witherspoon's bluff, (above Giles') 13 feet above low water, 62
168. " do. 6 feet above, - 74
169. " Goose creek, near Cooper river, G. H. Smith's land, - 82
170. " do. another part of same exposure, - - 80
171. " Branch of Swift creek, near Darlington C. H., J. F. Ervins, blue, taken 3 feet below surface of stratum, 64
172. " do. do. at 8 feet, - - 69
173. " do. James Gibson's, yellow, - 63
174. " do. do. another specimen, 64
175. " Black creek, 5 miles S. E. from Darlington C. H., John Fountain's land, yellowish, - - - - - 57

IV. *Post-Pliocene, or coast marl.*

176. From under Doctor's swamp, John's Island, blue and loose, 41

177.	" Store creek, Edisto Island, - - - -	18
178.	" do. another specimen, - - -	27
179.	" James Seabrook's, Edisto Island, - - -	58
180.	" Jos. Hazel's, Distant Island, near Beaufort, - -	47

Any other marls, which may be visited and examined during the short remaining time of my service after submitting this report, will be analyzed hereafter, and the descriptions and contents made the subject of a supplemental report.

CASTS OF SHELLS IN INFUSORIAL CLAY; AND SILICIFIED SHELLS AND SHELL ROCK.

In proceeding towards the northern limits or last found exposures of the marl, first of the Peedee bed (secondary) and next of the Great Carolinian bed, and in searching outside of but near to the northern boundaries of the marls, and at many distant points, I often reached either one or both of two very remarkable and extensive belts, both of which may be deemed, from the characters of their few known fossils, as parts of the same geological formation as the adjacent great calcareous beds; and therefore should be considered in connexion. Still the chemical composition of these belts are entirely different from the marl, and they have no agricultural value whatever.

At Wannamaker's old pit, on the Cawcaw swamp, a few miles north of Orangeburgh, C. H., where marl formerly was burnt for lime, I found the earth about to be described lying immediately over and within two feet of perpendicular distance from the upper surface of the ordinary marl of the Great Carolinian bed. The same stratum was also found over-lying the marl at Manuel Pooser's old pit, in the same neighborhood, which is the highest or most northern exposure of marl found on Cawcaw Swamp. Also, the same belt is seen, without any marl beneath, crossing the old public road (to Columbia) about 4 or 5 miles above Orangeburgh C. H. It there crosses about midway of a long hill, the stratum being perhaps 20 feet thick, and having the ordinary very red clay subsoil of that region both above and below. This stratum of earth appears so like to the neighboring marl, in color, texture, and in being full of apparent shells, that an experienced eye might be at first deceived, and would pronounce it to be marl; and such was the general and undisputed belief of those persons who had given any attention even to this very obvious great exposure. Yet there is not a shell remaining, of the many which formerly were present, nor the least trace of the carbonate of lime, of which the shells were entirely composed. The earth is a very compact silicious clay, hard, but not of stony fracture, of a pale dingy yellow tint. The bed contains numerous hollow casts of various species of shells, as perfect and as beautiful as if they were well executed works of art. Every minute mark on the former shell is perfectly retained, but reversed in form, in the hollow cast; and the surfaces often appear as polished and shining as do recent and perfect shells. And it would seem that if these moulds could but be filled by the penetration of any fluid which should in after time become solidified, that such substance, after breaking and removing the mould, would be a perfect copy of the original shell. The supposition of the possibility of such a process of nature having been executed elsewhere will be submitted presently, in regard to another belt of fossil remains.

This earth is not only remarkable for its numerous and beautiful impres-

sions of shells, preserving perfectly the form of every part impressed, but still more for its animal origin, if it may be so called, in another respect, which will now be stated.

My friend Mr. M. Tuomey had, during last year, extended the previous discoveries by other investigators, in Europe and the United States, of the infusorial formation, to a new region, (near Petersburg, Va.) and has since found this singular deposite there to be 60 feet thick, of the fossil remains or the shells of animalcules so small that they would have been invisible when alive, as are now the fossil remains, without the aid of a good microscope. On the suggestion and at the request of Mr. Tuomey, I collected and sent to him for investigation such earth and rocks as were suspected to be of infusorial origin; and his success in the search has been far beyond my expectation. Besides other very extensive infusorial beds of some-what different character in other respects, and which will be presently described, the earth of this whole belt of clay casts has been found, by Mr. Tuomey's examinations of my specimens, to be principally and throughout composed of the silicified shells and remains of invisible animalcules. The earth which filled the former shells of fish, as well as the general mass enclosing them, are alike composed in this manner.

This body of "infusorial" clay was first seen on Stout's Creek near the Santee in Orangeburgh. The exposure was pointed out to me at the foot of the hill near Warley's store. The casts of shells are there mostly very small, and though of many species, none could be determined. Here this earth has been long ago used for some purposes of masonry. Easily as it may be dug when moist in its bed, it becomes very hard on drying. And blocks may be easily shaped and smoothed at first, which serve when dry as a hard building stone, which neither cracks nor crumbles, nor admits moisture. This material was used many years ago for the entire chimney of Warley's store, and also for ground pedestals for the columns of the piazza of the mansion of Col. Edward Richardson. Both these are protected from the weather only by a thin coat of lime white-wash, and they remain in perfect preservation.

From this place it is 15 miles or more to each of the three other exposures before mentioned. And even when not over-lying the marl, the most distant of the known parts of this particular kind of infusorial clay is not above 3 miles from known exposures of marl of the Great Carolinian bed.

Throughout the exposures already named, this infusorial bed has such identity of character, in color, texture, and other qualities obvious to the senses, that no observer would question that all belonged to the same deposite or original formation. But I have now to trace it through a far broader extent of territory, and in which there is so much variation of sensible qualities, that it needs resort to the geological features, to establish that all belong to one great deposite of fossil remains of infusorial animalcules.

Across the Santee from this part of Orangeburgh, and lying under the "sand hills," about, and to some 10 miles below Manchester in Sumter, there is found in great quantity, exposed in every deep ravine and digging, for miles together, the deposite which there and elsewhere is generally known under the name of "fuller's earth." This name is however not correctly applied to the Sumter earth. It is a very hard and compact dark gray clay, or rather a soft aluminous stone. The grain is extremely fine and close, and homogeneous, without cracks or fissures. It is soft enough to be cut without great difficulty, in ditching, or other works, to a smooth and even surface; but is so

hard as to resist all the subsequent action of flowing and washing water, as would the hardest rock. In the ditches and natural beds of streams, it forms cascades as permanent as if of granite. But as firm and imperishable as is this earth, when kept either under water, or free from water, when exposed to alternations of wet and dry, the masses soon split and break down in small and curiously shaped fragments; the planes of the new surfaces, or fissures thus separating, being much and irregularly curved, and sometimes approaching to spherical.

Hollow casts of shells, such as are described above, are found in this part of the deposite; but they are comparatively few in number, and were seen only in the upper part of the stratum. This upper part, as seen under the sand hills of Sumter, (and especially as best exposed at and near Col. John Manning's country seat,) has a very unequal surface, as if formerly shaped by the powerful denuding action of a current. Above it, was 3 or 4 feet thickness of loose and coarse sandy clay, on which were here and there small patches of *silicified shell rock*, such as will be presently described particularly, and which is abundant a little farther down the course of the river, on the stream of Dyson's cotton factory, and elsewhere in Sumter. It is merely referred to in this passage, and in advance of its full consideration, to mark its lying *above* the stratum called "fuller's earth." This latter earth shows, in a deep cut of the road through the sand hills, full 30 feet thickness from the top, and no bottom is there exposed. In a very deep and noted ravine, about two miles from Manchester, and 5 above the last named locality, the perpendicular and naked sides of which expose the strata for a great depth, this stratum of fuller's earth appears much higher, and is underlaid with many and thin strata, of various clays and sands, ochre, and dark colored shale, and, at the lowest visible part, the foundation was of coarse silicious sand. The fuller's earth here is softer, or more of clayey and yielding texture, than generally in Sumter. The specimen taken there was lost by accident, and therefore there was no subsequent examination of its fossil or infusorial character. But no doubt was then entertained as to its being the prolongation of the general stratum of "fuller's earth." And of the ordinary and great body, the subsequent microscopic examinations made of my specimens proved it to be part of the great deposite of infusorial remains, and doubtless part of the infusorial stratum of Orangeburgh.

The greatest sub-division of the infusorial stratum in Sumter is well known, and, more than for every thing else, because of the use made of the earth, pounded and made wet, to take out grease spots, for which purpose it serves well, and is used and known extensively, by its vulgar and improper name of "fuller's earth" thence deduced. The same deposite I saw low down in Charleston District, near the Santee, in a valley some few miles above Dr. John S. Palmer's plantation. And from that neighborhood I obtained a specimen, which when broken exposed a perfect and beautiful hollow cast of a shell.

But before seeing any of these places, or the earth from them, my attention had been directed to a very peculiar formation elsewhere, which also had long attracted much of general observation and remark, under the prevailing and erroneous belief that the stone in question is a very extensive deposite of "petrified wood." It is in fact the same as the "fuller's earth" of Sumter and of Charleston Districts, and, as since also proved, of the like formation by animalcules, of whose remains this stone is in like manner principally composed.

It was this so called "petrified wood" that I first saw and examined on the Ashepoo River, (at and below the ferry,) on Huspa Creek, and Coosawhatchie River; and it is to be found almost every where in the neighboring parts of Colleton and Beaufort Districts. The stratum (or perhaps several separated strata of the same stone,) is very thin, often but 4 inches thickness, or even less. The close and smooth grained "fuller's earth" of Sumter is here changed to a very hard but brittle aluminous stone, which is very similar to that called *chert* by mineralogists. It is easily decomposed by both air and water, first becoming light colored and soft, and next these softer portions successively being washed away by the water of rain or of streams. When so operated on for a length of time, as is the case with almost every piece seen in the water courses, the hard unaltered interior shows, in its grain and dark color, some resemblance to those of heart-wood; and the sudden change, at a precise line, to a whitish color, caused by the decomposing action of air, appears still more like what was formerly sap-wood. Further, the outside, wasting away most in the softer streaks and leaving the harder points protruding, offers a strong resemblance to the rough bark and smaller knots of live-oak.

This latter and extensive though thin layer had earliest attracted my observation, as it is indeed a subject of curiosity to the least observant. And the examination of this part preceded that of the other parts of the great infusorial stratum, as described above, and led to the proofs that all belong to the same great formation, and are connected with and overlying the calcareous part of the Great Carolinian Bed, wherever that bed has not run out, and has no existence, as is the case under the most northern exposure of the infusorial stratum in Orangeburgh and Sumter.

I shall now proceed to the description of the other and before mentioned belt, of silicified shells, or the rock formed by the process of shells being converted to silex. I first found the evidences of this curious and strange natural process on Black River and several of its tributary streams, crossing the general direction of their courses, and along the line of the upper or northern visible boundary of the Peedee Bed, or secondary marl. Shells and their fragments were seen lying above marl-stone, completely changed to silex, and no portion of their original calcareous constitution remaining. The silicified shells here were very imperfect, and the species not distinguished; but the curious change they had undergone was not the less certain. It seemed hereabout as if the change was yet in progress, or the bed in a transition state from calcareous to silicious. For the marl and marl-stone are poor just below the appearance of any completely silicified shells; and poor calcareous rock was found at different exposures up Black River to within some 6 or 7 miles of Kingstree; after which, as seen at the bridge two miles below Kingstree, shell-rock altogether silicified is taken out of the river. Higher up, it becomes a true buhr-stone, and is quarried and worked for mill-stones, for which it is an excellent material. The traces of the former shells are few and faint; but abundantly distinguishable, so as to show the origin of the silicious rock. The mixture of remaining calcareous matter, with more of the substituted silicious, presenting a transition state, I also found on Tinker's Creek, in Barnwell.

But it is near to and (as I presume) in connexion with the Great Carolinian Bed that the belt of silicified shells presents the most perfect condition and the most interesting subject for observation and study. In Orangeburgh, (at Warley's hill,) and in Sumter, as before stated, small parts of silicified shell-

rock are to be found over-lying the infusorial clay stratum—as the latter is elsewhere seen over-lying the calcareous bed. But for much the greater space known, the belt of silicified shells is seen alone, and northward of both the former. Taken alone, in Orangeburgh, where it is seen in greatest perfection, this formation stretches parallel to and northward of the infusorial belt, whlie the latter is seen and was found in different places, 6 or 7 miles from the marl, and from near the Santee to the South Edisto river. In Sumter, it is exposed in many places above (or north of) Half-way-swamp, but known nowhere below. This appearance is of a rock soft and crumbly in some places, but of great hardness and closeness generally, formed as much of shells as are the newest marls which show the most perfect and numerous shells. The matrix, in which the shells are imbedded, is altogether silicious, as are the shells, and the whole mass of rock. The shells, formerly so numerous that the whole mass must have been at some remote time a very rich calcareous marl, have, by some strange natural process, had every particle of their original calcareous substance removed, and substituted in every minute particular, by pure silicious matter, which is there not only of flinty hardness, but appears to be crystallyzed, and transparent beneath the surface. If we could suppose the perfect and empty hollow moulds of shells described above as in the adjacent infusorial clay belt, to be filled by silex in a dissolved and fluid state, and the solvent fluid then gradually to evaporate, or be absorbed, leaving precipitated its silex in solid form—and this to be repeated until the moulds were entirely filled—the supposition might explain the manner, though not the causes of the change, either in the total removal of the calcareous matter, or the supplying of the substituted silex. But whatever may have been the manner or cause of the change, the effect is perfect and most admirable. The silicified shells are very numerous, and of many species. Though as hard and as brittle as flint, they exhibit every slight marking of the original shells; and every minute prickle, or edge, in the substituted silex, has the sharpness and finished outlines of the original shell when enclosing the living animal. These silicified shells are far more perfectly preserved than any real (or calcareous) fossil shells known, owing to the completeness of the change of substance, and the greater hardness of the crystallized silex than the carbonate of lime, even in the freshest and hardest condition of the former shells. Indeed, except in their entire change of material and substance, and being altogether silicious instead of altogether calcareous, the best specimens from this belt appear to the eye as shells perfect in all respects; so absolutely perfect in form, that, but for the loss of color, they might be supposed by a close observer to have been but recently obtained from the ocean. Among the most beautiful and delicate I obtained, and which are different from all that my own searches furnished perfect, were a *pholas* and a *cytherea* found and presented to me by Mrs. David M. McCord; and a *pyrula* found by Major J. Stroman, which also I owe to his kindness. These are believed to be heretofore unknown, as are many others of the silicified shells. But there are a few of these, and also casts of other shells in the infusorial clay stratum, which are known also in the upper and neighboring parts of the Great Carolinian Bed, so as to prove the geological connexion of all the three beds. The silicified shell rock is highest (and of course the latest made deposite) in the series—the infusorial stratum next—and the great calcareous bed is the lowest of the three, where existing under either.

The silicified shells, rock, and each of every different appearance of the

infusorial clays or rocks above described, have all been mistaken for marl, or calcareous formations.

LISTS OF SOME OF THE CHARACTERISTIC SHELLS BELONGING TO EACH OF THE DIFFERENT FORMATIONS OF LOWER SOUTH CAROLINA.

Remarks.

Some of my objections to concurring in the now received geological arrangement of the most important of the marl formations of South Carolina, or the Great Carolina bed, were stated in the early part of this report. It is not for me to attempt to throw light on this subject in any other mode than as has been done, in diligently collecting fossils, and truly presenting them according to the *precise* localities from which they were obtained. Care and accuracy in the latter respect are the more especially required, because great mistakes have been already committed, and promulgated through previous and more *scientific* publications. And further, I have no information that any person has before found the fossils of the Ashley, or even suspected the fact, that for the much greater number, they are different from those of the Santee and of the Cooper; as appears not only in the few here named, but in many others (casts) undetermined, though well preserved. To enable those investigators who possess the necessary knowledge to draw correct conclusions, I have here presented, with their particular as well as general localities, such shells as have been already known and described; and also such as I suppose new or heretofore undescribed and unknown. Still there remain many casts of shells, which are believed to be new, but which cannot be determined for want of any shells of the same kind. In other cases, where casts only were to be found of particular shells, they served as well for identification, because the shells were also well known, as found elsewhere.

There may be, and probably are some mistakes as to the species in the following lists of fossil sheels; though whenever a doubt was entertained, it is expressed. But there is no mis-statement, nor any ground for error left, as to *localities*. I gathered most of the shells in person, and for the few for which I am indebted to other persons, I can as well vouch for their localities. In this point lies the chief value of this list, and it is a value of the more importance because so large a proportion of loose, indefinite or entirely deceptious localities have been heretofore given in the little published incidentally on the fossils of South Carolina. In the manner in which the following list is made, giving always *exact* localities, and generally those where the several fossils are the most abundant, any mistakes which may have been made can be easily detected by subsequent examinations of the places named; and all that is correct will be of material aid to more thorough investigations and scientific writers on the fossils and formations of South Carolina.

The shells of the part of the *miocene* lying upon the secondary or Peedee bed present a remarkable difference from those of all other beds of *miocene* which I have before observed. Although the individual shells are numerous, and well preserved, and to be seen through beds for miles in extent, I could find only the few species named in the list below, and of these, three are new, or before unknown. Still there are enough casts of other shells, and admirably preserved, to identify the *miocene*, even if no shells had remained. These remaining shells are all of the very hard and brown or dark gray kinds; and to their greater hardness their preservation is to be ascribed. Every white shell had disappeared, leaving generally its hollow mould in the matrix of marl.

The *miocene* marl extending into Darlington and Sumter, differs from the above, and contains numerous shells mostly of the species common in the blue *miocene* marls of Virginia; and some others rare there, if ever found. As I had but little opportunity to examine them in the beds, in a late and hasty visit, (in November,) the shells named in the list are not offered to exhibit the complete number of species, but merely some of the more common kinds, so as to distinguish the kind of marl.

The shells of the *post-miocene* marl beds are believed to be precisely like those of the animals now living in the neighboring parts of the ocean, as are all in the following list, prepared and furnished by Prof. Lewis R. Gibbes, of Charleston, and which was contained in his letter, of which part was copied on page 31. These names will be enough to identify the formation; and the most complete list would be (as I believe) but a list of the recent coast shells.

Shells of the Peedee Bed, or Marl of secondary formation.

Belemnites Americana,	*Morton*,	Birch's ferry, Peedee River, Marion.
Exogyra costata,	*Say*,	do.
Anomia argentaria,	*Mor.*	Davis' Bluff, (lower strata.)
Turritella vertebroides,	*Mor.*	Gordon's, Willow creek.
Trigonia ——?		Peedee river.

Shells of the Great Carolinian Bed.

Balanus peregrinus,	*Mor.*	Greer's landing, Ashley river.
Panopœa elongata,	*Conrad*,	do.
Anomia rugosa,	*Con.*‡‡	do.
Mytilus ——?		P. Clements, do.
Trochus giganteus, new,		John A, Ramsay's land.
Lunulites Lyelli,	*Con.*	Near Eutaw spring, Santee river.
Pecten membranosus,	*Mor.*	do.
Ostrea sellæformis,	*Con.*	Dawshee cove, below Eutaw, and thence up the river in great abundance.
Ostrea panda,	*Mor.*	Rocks creek mill, below Eutaw creek, lying lower in the bed than the O. sellæformis, at Deveaux's old mill pond; and Heatly Hall on Half way swamp, Orangeburgh.
Terebratula Lachryma,	*Mor.*	Near Lenuds' ferry, lower Santee.
Lutraria petrosa,	*Con.*	At and about Vance's ferry, upper layer.
Cypræa lapidosa,	*Con.*	Hale's mill, Orangeburgh, in lower and green sand marl, near Santee.
Nucleolites crucifer,	*Mor.*	do.
Cardita planicosta,	*Lamarck*,	do. (one cast only; and casts found at Shell Bluff.)
Trochus leprosus,	*Mor.*	Mulberry, Cooper river.
Conus gyratus,	*Mor.*	do.
Gryphæa mutabilis?	*Mor.*	Sportsman's Retreat. Cooper, (found and given to me by Dr. Cordes,) and also, (or gryphœa convexa?) in green-sand marl at R. Mazyck's.

†Found and given to me by Major J. Stroman.
* " by Col. D. J. McCord.

*The shells marked with a star before the name are also in the calcareous bed, so named above.

‡This shell which is the most abundant and perfectly preserved of all found in this bed on Ashley river, is new, or as yet undescribed. But after my specimens had been collected, I learned that Mr. Conrad had one in his collection, and that he designed for the shell the above name. I have therefore adopted it, and given to him the credit, in advance of his future publication.

Scutella Lyelli.	*Mor.*	Erwin's mill, Barnwell.
Scutella crustuloides,	*Mor.*	Ro. Mazyck's (green-sand marl,) near Santee canal.
Scutella Caroliniana,	*Ravenel,*	The Grove, Dr. Edmund Ravenel's, on Cooper.
Scutella macraphora,	*Rav.*	do.
Pinna —— ?		Stokes' Bridge, Edisto river.

Silicified shells and casts, of the belts stretching along-side and north-west of the Great Carolinian Bed, and deemed to be the upper and newer part of the same formation.

*Cardita planicosta,	*Lam.*	silicified shell, Gates' quarry, St. Mathews, Orangeburgh.
Cardita alticosta,	*Con.*	do. do.
Crassatella alœformis,	*Con.*	do. do.
Turritella Mortoni,	*Con.*	do. do.
Pyrula Edistonia,†	new,	do. J. Stroman's mill, near S. Edisto river.
Pholas Tuomeyi,‡	new,	do, Col. D. M. McCord's, St. Mathews.
Cytherea Maccordia,	new,	do. do. found and presented to me by Mrs. McCord.
Arca —— ?		do. do.
*Lutraria petrosa,	*Con.*	hollow-cast in infusosial clay, old stage road, about 4 miles north of Orangeburgh C. H.
*Conus gyratus,	*Mor.*	do.
Pinna —— ?		Orangeburgh.

Shells of the Miocene Marl, in part lying upon the Peedee Bed, (secondary,) and in part, on Goose creek, on the Great Carolinian Bed.

Pecten Pedeense,†	new,	H. Davis' bluff, Marion, Peedee river.
Pecten translucens,‡	new,	do.
Pecten Marionis,‡	new,	do.
Pecten Humphreysii ?		Goose creek, near Cooper river.
Plicatula marginata,	*Say,*	do.
Ostrea Virginiana,	*Gmel.*	
Fusus quadricostatus,	*Say,*	H. Davis, Marion, on Peedee.
Balanus proteus.		do.

The hollow casts are numerous, of which the following are a few of the species:

Chama congregata,	*Con.*	Godfrey's ferry, Marion.
Panopœa reflexa,	*Con.*	Witherspoon's bluff.
Cardium laqueatum,	*Con.*	do.
Oliva literata,	*Lam.*	Goose creek.

The following are but a few of the shells seen in the bed near Darlington C. H. which seem generally to agree in kinds, appearance, &c. with those of the ordinary *miocene* blue marl in Virginia.

Venus Rileyi,	Ervin's, near Darlington C. H.
Chama corticosa,	do.
Mactra modicella, (numerous,)	do.
Fusus prialis,	do.

Shells thrown up by the waves from submarine miocene bed.

*Venus Rileyi,	*Con.*	Sea shore, Oakly Inlet, Georgetown.

*The shells marked thus are also in a previous part of the lists.
†Very numerous in this deposite along the Peedee, and known to me no where else.
‡Found by Mr. Henry Davis, Sen. of Marion.

Venus alveata,	*Con.*	do.
Ostrea Virginiana,	(variety,)	do.
Corbula inequale,	*Con.*	do.
Arca limosa,	*Say,*	do.

*Shells of the Post-Pliocene or coast marl.**

Natica duplicata,	Arca incongrua,
Nassa obsoleta,	" pexata,
" vibex,	" ponderosa,
Cerithium dislocatum,	Cardium maculatum,
Pyrula carica,	Donax variabilis,
Oliva Sayana,	Tellina alternata,
" mutica,	Lucina divaricata,
Ovula acicularis,	Venus mercenaria,
Fissurella attenuata,	Cytherea concentrica,
Ostrea virginica,	Mactra lateralis,
Pinna seminuda,	Lutraria canaliculata.
Balanus ovularis?	Scutellum quinqueforme?

OBSERVATIONS ON THE ACTION OF CALCAREOUS MANURES AND THEIR PRACTICAL APPLICATION AND EFFECTS.

Previous to the commencement of my examination of the marls of South Carolina, there had been but very few attempts to profit by their application as manure. It would be both a needless and ungrateful task to inquire into the causes of this strange and general neglect of such wide-spread and easily available resources for fertility and riches—and of disregard and ignorance of truths generally known and acted upon in other regions far less blessed in these resources, and in the capability of profiting by their use, than lower South Carolina. It is enough here to state that such was the general neglect of calcareous manures, and general want of efficient information as to their value. Many individuals, indeed, had made very small and mostly improper applications of marl, and a few of lime, and which were as loose and inaccurate as experiments, as they were ill-directed to obtain the best results as manure. And a few individuals presented more marked and meritorious exceptions, in having within the last few years made much larger applications, and having reaped more or less appreciable and admitted profits therefrom. Among these, the oldest or the largest operators, and, as they deemed themselves, also successful marlers, besides those already mentioned, were Mr. Darby of Orangeburgh, Dr. J. S. Palmer and Col. S. J. Palmer of Charleston district, Dr. Robert Gourdin of Georgetown district, and Gen. James H. Hammond, of Silver Bluff, Barnwell. Reports of the applications of the four last named gentlemen have been recently published,† and their favorable results stated; and the several papers will be annexed to this report. But the total amount of these, added to all other applications of marl and lime made in South Carolina previously to 1843, it is believed, fell short of 500 acres. It would furnish an interesting and most useful statistical document, if the legislature would hereafter require the extent of each planter's applications of marl and lime, for every successive year, to be ascertained and recorded by the tax-collectors; and, a few years hence, also the then and thereafter estimated increased pro-

*All these are from the bed under and near Charleston, and are those referred to at page 31.

†Gen. Hammond's first, in Farmer's Register, for December 1842, and the others, in Southern Agriculturist, for June 1843.

duct of the improvements thereby made. Such statements, continued, and published regularly year after year, would exhibit an amount of newly directed labor, and of newly created agricultural wealth, beyond any present conception of the effects; and the exhibition would stimulate the further exertion and increase, more than any other possible mode of conveying instruction, or of urging the propriety and profit of using calcareous manures. Nearly all of the few applications of marl (or of lime) which have heretofore been made, have failed of early or satisfactory effect, or for so long as observed for effects, because of the improper mode of application; which was, as usual with putrescent manures, by burying the marl under the "list," and thereby avoiding, and indeed *preventing* all intermixture of the manure with the soil, which is essential to its operation. In addition to this error, the application was almost invariably made to land long before under continued tillage. In other words, the marl was applied as if its effects were *direct*, and like those of putrescent and alimentary manures of transitory benefit. Of course no such effects were obtained; and the other and real effects were impaired and postponed until they were no longer looked for; and therefore they often were produced without being observed, and always without either the results, or the impediments to results, being duly appreciated.

It would be here out of place and of propriety to swell this report by presenting at length and in detail the theory of either the action, or full and minute directions for the practical application, of calcareous manures. And still less is this course needed, as in previous publications I have presented such views to the public at length; and moreover, have distributed gratuitously through this State, more than five hundred of copies of the most important of the "Essays on Calcareous manures."

To these publications, I will therefore beg leave merely to make general reference, in this work, which will serve to supply deficiences whenever more extension of the subject is requisite than is permitted in the following concise observations.

Considering the great variations and degrees of fertility of cultivated soils, and the important bearing of such differences on the profits of the cultivators, it is strange that so little attention has been given to the causes, or of care to avoid the worst and obtain the best effects. Every proprietor knows, that the profit of cultivation is much greater on rich than on poor ground. But very few have estimated *how much* greater is the profit; and nowhere, within the sphere of my observation, are the prices of lands properly graduated, in proportion to their fertility and true productive value. If properly estimated, it would be manifest that poor land, for cultivation, if to remain poor, would be dear as a gift, and its cultivation the most costly of all. Yet, the greater number of cultivators of such soils, are content to remain in that condition, without making an effort, and scarcely indulging a hope of improving their fields and their profits.

It is not the less remarkable, that the more sanguine and enterprizing cultivators, who aim and hope to improve, seldom inquire into the causes and manner of the operation designed, and therefore, most naturally, seldom succeed in their design. To apply the ordinary putrescent manure, is generally the sole means attempted or thought of; and if on poor and bad soils, in the race between exhaustion and new fertilization, the latter is invariably left far behind.

It is a universally acknowledged truth, that what is needed to make soil

most productive, are such ingredients as will supply, in sufficient abundance, the *food of plants.* Growing plants draw from the soil by their roots, and are nourished by the dissolved parts of nearly all putrescent matters, either vegetable or animal, or mixtures of both. The ordinary manures are precisely such substances; and sooner or later, by their gradual decomposition, are converted almost entirely to the food of plants, and if judiciously applied, are consumed by, and help to sustain, the growing crops.

But it is not enough, by a great deal, that manures serving to form food for plants shall be given to the soil. There are other conditions necessary for their profitable and best effects; and the most important of these conditions is, that the soil shall be so constituted as to preserve the putrescent matters from waste and profitless dissipation, and to give them wholly for the support and growth of plants. This condition is furnished by nature, in well constituted soils only, which present the most productive and durable lands under tillage. Without this constitution, all the supplies of putrescent manures which can be given to a farm, will be of little profit; and if derived from its own resources only, will be utterly insufficient to preserve, and still less to increase, the yearly measure of productiveness of the land.

To learn the causes of the difference of soils in their power of receiving fertilization, it is necessary, and it will be sufficient, to go back to first principles, and trace soils from their formation, and their most simple conditions.

All soils, for their essential parts, are composed of the three important earths, silica, alumina and lime, (the latter combined, usually and at first with carbonic acid, forming carbonate of lime) and with an addition to such compound soil of putrescent matter, of either animal or vegetable origin. Each of all these ingredients, in some proportion, is indispensable to every soil—or it would be barren if either were entirely wanting, no matter how abundant might be all of the others. The absolute necessity for the presence of each substance, will be seen by the consideration of their qualities and powers.

Silica, or silex, in its pure state, forms rock crystal. Ordinary sand furnishes it nearly pure, and enough so to show its utter unfitness to retain putrescent manures; or, even while such manures are passing away, for such a mixture to make a soil capable of sustaining plants. The hardness of the grains of sand, forbid their absorption of all moisture; and their loose and open state, permits all fluids to pass through and to escape rapidly, either by sinking, when abundant, or by evaporation, when scarce. The latter mode of waste is much increased by the great heat of such sands, received from the sun. Thus, with the changes of the weather, sands would be in rapid and violent alterations, drenched thoroughly and washed by rains, and dried by the sun and wind; any putrescent matter present, would, by these changes, be rapidly carried through all the stages of fermentation and decomposition, and go to waste, because there would be no property whatever in the sand, to combine with or to retain the results of fermentation. A pure sand would, necessarily, soon lose every particle of putrescent matter; and the nearer any soil approaches to a pure sand, the more nearly would it approach such a result.

Alumina, or argil, is the pure matter of clay, or that which, when united with more or less of silicious sand, forms clay, and gives to the mixture its adhesiveness, plastic quality, and close texture. It is clay we have to consider; for perfectly pure argil or alumina is never known, either as soil or

subsoil. A clay containing much alumina, is difficult to become either wet or dry from the opposite condition. When very wet, it is a sticky mortar, and when quite dry, is almost as hard as stone. It forms the most intractable soil under tillage, and the most forbidding to the growth of plants. Putrescent manures, or their soluble results, cannot penetrate a close clay—or if artificially enclosed, are kept therein imprisoned and inert, and comparatively useless to the crop. There is but little chemical attraction or combining power, between clay and putrescent matters, even in the chemist's operations, designed most to favor their combination; and as nature and cultivation can only operate much less perfectly to this end, there are scarcely any means for the little combining power of clay to act at all. Thus, as of sands, though in a different mode, pure or stiff clays have no power to receive manures, or to retain and yield them for the proper consumption of growing plants.

Thus, if pure silicious sand, or pure and very stiff clay, alone formed the earthy parts of a soil, no supply of putrescent manure could be either durable or effective in any important degree, and certainly not profitable for the application.

If the sand and clay were mixed in due proportions, then the soil would be greatly mended in texture and in relation to moisture. But still there would be no chemical attraction for, or power of combining with and retaining, putrescent manures. And therefore, such a mixed or medium soil, though exhibiting less of the opposite defects of almost pure sand or pure clay, would be nearly as barren, and quite as incapable of being durably enriched, as either. And when soils are constitituted of any of the grades of the three classes above referred to, or even with any slight and insufficient admixtures of other and necessary ingredients, it is not at all strange that they should be incurably sterile. It would, indeed, be strange and unaccountable, were it otherwise. Still, the far greater number of natural soils in the Southern Atlantic States, approach nearly to one or the other of these three classes; and though having enough of other ingredients to prevent absolute barrenness, have not enough to permit them to be much or profitably enriched by putrescent manures—and not at all beyond their natural degree of productiveness, however low that degree may have been.

It is the presence of the third ingredient first named, lime, which serves to remedy the defects of all the others, and to make useful the peculiar qualities (all of which are essential to soil) of the silicious sand, the argil, and the putrescent and alimentary matters of the soil. And though the natural quantity of lime is generally very small, and much too small, in this region especially, there is some little in every soil that is capable of maturing a plant of any kind. Small as may be the quantity, it is essential to the formation and perfection of every plant; and if there were not a particle of lime in any soil, it would not be capable of maturing a seed, or of supporting even a blade of grass. And as but a very small proportion will serve to give its best operation to soil, there is sufficient inducement and means almost every where, for man to supply to the soil what nature has withheld, in sufficient quantity.

In the form of combination in which nature generally offers lime, that is, the carbonate, and probably in every other form of combination subsequently taken in soil, it has a strong chemical attraction for soluble putrescent matters, vegetable and animal, and a power of combining with them, forming

compounds which cannot be decomposed by air, water, or heat, and which, therefore, cannot go to waste, but which are perfectly decomposable by the powers of growing vegetation, and therefore may be profitably and entirely used as food for plants. Herein is the great secret of the benefit of calcareous manures. The combining with and fixing in soils putrescent matters, is then a great and most beneficial operation, and of which all other earths, (unless magnesia be, as I presume it is, an exception,) are entirely destitute.

We need go no farther to show that calcareous earth in soil is all important. Still it has several other very valuable operations in increasing the productiveness of the soil, which would require too much time to be more than barely touched upon here. Some of these other modes of operation are as follows:

1. In neutralizing the acid principle of soil, which is generally present in all naturally poor soils, and which is poisonous to all cultivated and valuable crops. The total removal of this poisonous quality of soils is an immediate and the most obvious effect of the application of calcareous manures.

2. In the power of altering the texture and absorbency of soils. The admixture of calcareous manures with soil, serves in an important degree to moderate the previous opposite defects of being either too open and light, from excess of sand, or of being too close and tenacious, from excess of clay; and also of being either too little or too much retentive of moisture.

3. By the alteration of constitution in soils, produced by calcareous manures, all products are rendered more perfect, and are ripened earlier. The latter effect is especially important to the late cotton in S. Carolina, over and above all increase of fertility, and of general bulk of product.

4. Some lime being essential to the formation of every plant, it may therefore be considered a specific and alimentary manure for every crop. Still this *direct* operation is perhaps the least of the benefits of lime. Some plants, however, of which clover is one, require so much of this ingredient, that they can scarcely live on ordinary soils.

5. Another operation of calcareous manures, and which is very important also in agricultural and pecuniary value, as well as for other considerations, is that of restraining or preventing the production of malaria, or the gaseous products of putrefaction of vegetable matter, injurious to health. No effect yet claimed for the operation of calcareous manures was at first heard with more incredulity than this; yet the short experience of 12 or 15 years only has been enough to remove almost every doubt on this subject in lower Virginia, where marl has been most extensively applied.

6. Finally, by furnishing to any soils which had been previously very deficient therein, an ingredient in calcareous earth, essential to their good and perfect constitution, all the functions of the soils and of plants growing thereon, are made more perfect, and invigorated; and every source of injury to the crops, whether from soil, season, depredations of insects, or other diseases to which may be alike exposed the marled and unmarled parts of the same field, will be much less hurtful (if even perceptible in effect,) on the former than on the latter. The calcareous manuring does not prevent or

even lessen these causes of diseases and death, but enables the plants, by their greater vigor, to withstand and to out-grow the inflictions, and thus renders them comparatively harmless.*

If the preceding views be sound, the manifest deduction from them is, that *all lands which are not already calcareous*, or sufficiently supplied with lime by nature, *require to be made so.* And relying upon my former and very general observations and examinations of soils elsewhere, as well as a fewer but sufficient number recently made in S. Carolina, I may venture to assert that there are scarcely any natural soils, if indeed a single one, in all that extensive region, which has *carbonate of lime* as an ingredient, or constituent part. And though all soils (as before stated) must contain lime in some form of combination, as I infer with vegetable acids, still in nearly all the upland soils of this great region, and especially those on which pine forms the principal and most vigorous growth, the proportion of such vegetable salts of lime is much too small, and the addition of more lime or carbonate of lime is greatly needed, and would be highly beneficial and justifiable, where the material may be had cheaply enough. There are, indeed, some other soils which received more lime originally from natural supply, and which still show, and will always show, the superior fertility and durability thereby conferred on them. Among such soils are those of Dawshee and Eutaw on the Santee, and many other smaller bodies of similar valuable upland, elsewhere; and such are the numerous rich alluvial soils deposited by river floods, or of swamps over-lying marl, or otherwise naturally limed originally. But even these lands, the best provided by nature with the essential ingredient, lime, have not enough of it in any form of combination, and not a particle in the form of *carbonate* of lime—which form is presented by marl, and by quick lime after a short time also, and in which form it would be found in natural soils, if calcareous, and abundantly furnished with lime. Though so few have been the practical applications of calcareous manures and designed experiments in this state, the results of many accidental and chance-made experiments have been observed, which go fully to prove the great and durable improvement made by lime on the richest alluvial rice lands.

Deeming, then, that calcareous manures will benefit nearly if not all known soils in S. Carolina, and increase their production of all crops, the next questions are, how far the means are available, at not too great cost, and what measure of increased production of crops may be counted on from the application of calcareous manures. These questions being inseparable, will be answered together, generally and concisely, and without giving reasons or proofs which would occupy too much space here, and for which, as before stated, I refer to preceding publications.†

The benefit, or increased product of crops, to be expected from *proper* ap-

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* See all these positions argued and established in Chap. 8, and elsewhere in Essay on Calcareous Manures.

† In addition to the numerous statements, both of general operation and particular results of marl and lime, given in the essay on calcareous manures, and also in various parts of the Farmer's Register, a number of special answers to particular and comprehensive queries on this subject, may be advantageously referred to in vols. 8 and 9 of the last named publication A concise digest of these answers, on the most important points, arranged in tabular form for easy reference, will be added to this section of the report.

plications of marl, if estimated by the numerous known and unquestioned facts of results in Virginia, may be expected to range (according as circumstances may be more or less favourable to the action,) from 20 to 50 per cent. increase on the first crop; and to increase thereafter in each successive crop, until a permanent maximum product is reached of 100 to 300 per cent. upon the product previous to the marling. And the increased products would be much larger at first, and also in after time, (as is the case in Virginia,) but for the general plan of continual and exhausting tillage in S. Carolina The improvement is permanent, so made. Whatever is thus gained, will never be lost under a proper course of culture, and that not required to be more mild than due considerations of profit ought to dictate under any circumstances. And though additional dressings of marl or lime will be needed in after time, it will not be because any of the early effect of the prior application has been lost, or is even diminished, but because another and new increase of production may be then added to the first.

But all my arguments for and exhortations to commence and prosecute heartily this greatest and most profitable mode of fertilization, avail nothing as yet on the minds of most persons, because of their unbelief of the promised effects, as to their own lands and to S. Carolina. And this is not merely the result of ignorance on the subject, (which always is incredulous,) but has better or more plausible grounds, in the facts that most of the few trials of marl which have been made in the State, have been reported to produce either very little effect the first year, or none at all. Perhaps if made acquainted with all the circumstances and facts of each such case of reported failure, partial or total, I might be able to explain the causes. But, though I have done this, and even to the satisfaction of the unsuccessful and before despairing experimenter, in many particular cases, it is obvious that all the facts cannot be generally obtained, and if they were, that this report would not offer a place for such extended comments on such trivial matters. But it is not necessary for me to contest any of such asserted failures. I may go farther, and admit, (as is believed indeed to be the fact,) that before the beginning of 1843 there was but one person in the State who had found enough benefit in his first year's marling to proceed forthwith boldly and with increased confidence, zeal and energy, on the second year. And this distinguished exception, of very large operations, (Gov. Hammond's, now extended to 1200 acres,) commenced no farther back than for the crop of 1842; and the increased products, even in this case, though fully satisfactory to the proprietor, were not half equal to what would have been realized on land in proper condition to receive calcareous manures. Further, of the numerous experiments made this year, after the commencement of my duties and in consequence of them, of the greater number whose results I have heard, the benefits have been either very small, or as reported in some cases, not even perceptible. Can the opponents of marling desire more full admissions than these? And yet they all serve but to illustrate what I have continually striven to impress, that without vegetable matter to combine with, calcareous manures will be of but little value. But, on the other hand, I have heard of no trial of marl on land in proper condition, that is, recently and sufficiently rested, and thereby provided with vegetable matter, in which the effect has not been very great in the first crop. And three or four such results only would be enough to explain the cause, and ought to prevent all

inferences unfavorable to marling, if from a hundred failures of early effort under reverse circumstances. I will cite a few of such experiments.

John A. Ramsay, Esq., on Ashley river, like many other persons, has this year marled land long under incessant annual tillage, and with but little benefit to this year's crop. But he also tried a marked space on land recently cleared, and which had produced but one crop, in 1842. The marling was too light. Still he believed the increase on the marled space to be at least 100 per cent.; and so it appeared to me, when seeing the land as late as Nov. 25th, long after all the cotton had been gathered and the stalks dead. The other result is even more sriking, because more accurately observed. Henry Davis, Esq., on Peedee, applied last spring to a marked acre, also of new ground of the second year, 300 bushels of marl containing 60 per cent of carbonate of lime. At my request he carefully weighed the product separately, and also that of an adjoining acre, equal to the other but for the difference of marling. The season was very unfavorable and the whole crop of cotton bad. The product of the marled acre was 592 lbs. of seed cotton, and of the unmarled, 336 lbs. These rates of increase are such as I have been accustomed to obtain, on lands having sufficient previous rest, and receiving for manure all their growth, and that only while at rest. And such increased products will continue still to increase for 10 or 15 years of proper culture.

The application of marl or lime to alluvial rice lands, I had early and earnestly recommended, though on theoretical grounds alone, having then no knowledge of any actual application. J. M. Dwight, Esq., upon that advice, applied marl last spring to a small marked portion of his newly embanked rice ground on Ashley river. In addition to hearing the remarkable benefit stated by several persons, I recently saw the remaining stubble of the crop. Never was superiority of growth more manifest. But it should be admitted that the great benefit of this marling seemed to consist in resisting the evil action of salt in the land, which greatly injured, and in parts totally destroyed the rice elsewhere. Previously, I had gathered information of several different applications of lime to rice grounds; one only recently, which produced great effect on the first crop—and the other applications of ancient date, some of them made by accident; but all producing good and long continued effects. Col. Pinckney Allston told me of two spots in rice fields near Georgetown, on which the lime used for indigo vats had been thrown, (as was inferred,) on which he had always seen a remarkable superiority in the growth of rice, and which continues undiminished. As indigo culture ceased on these lands at least 60 years ago, this chance-made lining must be at least 60 years old; and probably the land has produced a rice crop every year since, and certainly without any other manure.

When estimating the profits of application of putrescent manures of very quick but transitory effect, (as of cotton seed, for example,) the increased and early products ought to return both the principal and interest of the out-lay, as well as a fair profit thereon, or the planter will have gained nothing by the investment or application. But in calculating the profits of marling and liming, the increased products being permanent, the average annual returns should be counted but as the interest and profit of the principal thus permanently invested. Hence, while cotton seed as manure (supposed not generally to act longer than the first year,) to be really profitable, ought to yield, in the first crop, at least 110 or 120 per cent, on the total cost of the

manuring, and stable manure at least 70 per cent, a greater profit would be reaped from marl or lime, were the first, or even the average annual increased nett products only 12 or 15 per cent, on the first total cost. And when, instead of such small increase, there is found, as most commonly after a few years, a permanent increase of 100 to 200 per cent. on the previous product, and perhaps 50 to 100 per cent. on the entire cost of the manuring, the superiority of returns over those of all putrescent and transient manures, used alone, is so great as almost to forbid comparison.

Considering, then, the increased nett and average annual products from marling and liming, as permanent interest or profit upon the cost of the manuring, (if accomplished by a course of judicious general culture and management,) it is for each planter to estimate and compare his probable returns, with the necessary expense of his particular outlay. The gross returns from the application of calcareous manures may not vary greatly, and indeed, will be very regular and uniform, under equal circumstances. But the expenses will be very different, according to the difference of easy or difficult access to the manure. Very many planters in this State, and upon a very extended field of operations, may marl so cheaply, that their clear profits therefrom may be more than 100 per cent. per annum, on the outlay, for all future time. And if content with as little as 12 per cent. of permanent nett annual interest, (which is, perhaps, double the interest of their agricultural capital in general,) there are very few planters in South Carolina, so remote from marl or lime, that they may not resort to this mode of improvement.

Where the marl is naturally exposed on the plantations on which it is to be applied, and is as easy to be worked as on most lands where so exposed, the labor of marling in South Carolina would cost much less than on any lands of as great extent I have known elsewhere. Add to this abundance of marl, and to its easy access, its far greater richness than the ordinary marls of Virginia, and the general expense of an equally effective dressing will, in the former country, scarcely equal one-third of the ordinary expense in the latter.

So far as to the plantations having within their bounds, rich and easily accessible marl. In regard to others less favored in position, the proprietors might profit by transporting to them rich marl, more than one hundred miles by navigable water, or ten miles, at least, by land carriage. Unslacked quick-lime, whether from shells or marl, or lime-stone, might well pay much heavier costs of transportation.

In the much larger portion of the lands of the marl region, though the marl may not be visible, it would probably be reached somewhere, on every plantation, at a depth of from twelve to thirty feet. And even if as deep as thirty feet below the surface, still, if veins of spring water can be excluded, the accumulation kept drawn off without too much labor, then it would be cheaper to draw up marl from below this depth, and even as low as sixty feet, than to cart it three miles. The texture of the great Carolinian bed is so firm, and the thickness of the bed so great, that an excavation may safely be made in it, widening as it descends, so as to be in form like an inverted cone or funnel, of which the narrow pipe would represent the cylindrical well, dug through the overlying earth, expanded to a conical shape below, in the body of the marl. If no considerable veins of water should flow into such an excavation, it might be safely stretched to any desired depth

and proportional breadth; and the marl (and the water) be easily drawn out by horse power or steam engines, in the manner used for raising coal.

It might be inferred, perhaps, by some, that the great number of wells which have been dug to obtain water in the marl region, and the very few cases in which any have reached and made known the presence of the marl, would render it unlikely that it can be generally penetrated by other wells. But in opposition to such inferences, let it be observed, that where the bed of marl is not broken and shivered, (as on and near the lower Santee,) it is nearly level, and almost impervious to water; and having, usually, only open sandy earth above, the marl, necessarily, must be the great, and, indeed, only water-bearing stratum of this region. The rain-water, or that brought in veins from remote sources, sinks through the open sands, until stopped by the impervious marl—on and above which, for perhaps some five or six feet, the lower sand is saturated by water. As soon as a well is sunk to this lower part of the soil, a sufficient supply of water is reached, and enough depth for a reservoir is obtained, without digging as low as the marl. Thus, though the appearance of water might always truly indicate the marl being within six feet, still, the marl might never be reached and exposed to view. But in truth, it may have been reached, and portions of marl scraped off and brought up from the bottom, in the digging or cleaning of hundreds of wells, and yet no notice taken of the fact. On the plantation of an intelligent and good planter, (who was then anxious to obtain marl, and who since is zealously and successfully using it,) I found marl that had been brought up from two of his wells, and had been long lying along side, on the surface, scarcely observed, and its character unsuspected. If the occurrence of water cannot be avoided, before reaching the marl, (which may be ascertained by the use of the auger,) then perhaps the water may be avoided either by digging pits in alluvial swamps of close soil, which is rarely traversed by veins of springs, or otherwise at the edge of the high land, below or away from where the springs burst out and flow off on either side.

Full and sufficient directions for the practical operations of marling and liming would occupy too much space to be included here, and such directions are the less needed, as they may be found by the general reference for details already named. A few of the most important points only will be here stated, which may be more especially required to be known by new beginners at marling in this State, and under the peculiar existing circumstances.

The peculiar richness of the marl of the great Carolinian bed causes it to be generally more hard than the much poorer marls mostly used elsewhere. However, the difficulties of excavation are not thereby much increased; and considering the quality as well as quantity, the marl may be worked and applied much more cheaply than softer and poorer marls, presented in thinner beds, elsewhere. It will be found easy enough to break up and reduce the large lumps, as dug and while yet moist. If broken, (by striking with the hammer-end of the grubbing hoe,)so that none remain larger than the fist, much the greater quantity will be pulverized, and as much of the whole in a fine state as the land can use before the larger lumps come to pieces, which will take place in a year or two. I here refer to *marl*, or what is soft enough to be dug and cut by grubbing-hoes or picks. If lay-

ers or lumps of *stony* hardness occur in any considerable quantity, they should be let alone, or reserved to be burnt into lime, if rich enough.

In applying marl to the soil, it should be done so as to have the marl and soil as well and thoroughly intermixed as possible. To this end, the application should always be broad-cast—never in or under the rows or hills of the plants cultivated. As there can be no waste of the manure by exposure, it may be put on at any time, or in any condition of the ground, as may be most convenient. The more of vegetable or other putrescent matter is in the soil the more marl will it require, and the more may be profitably applied. Consequently, on land recently at rest, and receiving its own growth for its improvement, or land which is designed to be afterwards so treated, more marl may be applied, and any quantity will be more beneficial, than on land before and afterwards continually under exhausting cultivation. According to the various conditions of land, and degrees of strength of the most abundant (which are the richest) marls of South Carolina, the amount of safe and proper marlings may vary between 100 and 200 bushels to the acre.

All firm marl and marl-stone as rich as 85 per cent. or richer, may be profitably burnt to lime, for manure or for cement. And though this has been done in several places, and for a long time, (principally to supply lime for the preparation of indigo—never for manure—) and though the lime was sold readily, and at very high prices, still the business was conducted so badly, that but little profit was made, and it has now almost ceased. The marl lime, burnt at Jamison's kilm on Four Holes swamp, sold at the kilm at 25 and 31 1–4 cents the slaked bushel, equal to 50 and 62 1–2 cents for the *unslaked*, (as 1 bushel when slaked swells to 2,) which is the way it should be always counted. This material, being so much more porous and soft, may be both quarried and burnt much more easily than compact and hard lime-stone. Yet lime of the latter (as will hereafter be shown) may be burnt for 8 cents, or less, and therefore we may infer that lime from marl or marl-stone may be furnished for 5 or 6 cents the bushel.

And if the lime-stone of the higher districts, as well as the marl-stone or hard marl of the low country, was occasionally burnt, and the lime sold as low as it could then be well afforded, there would be no part of the country too far off to profit more or less by the use of lime as manure.

PREFACE.

In 1840, for the purpose of presenting the fullest proof, in facts and opinions derived from the experience of practical men, of the operation and effects of marl, I published sundry circular queries, and also directed copies specially to many known individuals. The general and blameable remissness in this respect which marks the whole agricultural class, and the unwillingness to write any facts for publication, prevented my obtaining answers from more, including myself as one of the number, than 22 marling farmers. Than these, no others would have been better witnesses for their respectability, and their opportunities of judging, so far as their experience and observations extended back. But there were very many others who failed to answer, who had either longer or larger experience of marling, or had obtained more important benefits therefrom, than the greater number whose answers were given, and which answers, even if standing alone, offer such full and conclusive proof of the certain effects and great profits of marling.

The much more extended answers of these 22 individuals, as heretofore published in the *Farmers' Register*, for the more important points of their testimony, will be here condensed in the following tabular form, to which some general statements and remarks will be added. The places left blank in the table, were either not answered at all, because of uncertainty, or so generally and in such extended terms as not to permit being brought into this digested and concise form.

It is proper to state, in advance, that though the system of cropping on nearly all these lands before marling was more or less exhausting, still to give some degree of rest from tillage crops was universal. And that after marling, as required by the known necessity for such procedure, the course of culture was always made more lenient, and grazing was generally forbidden, in part or wholly, during the intervening years of rest from cropping. The most general rotation of the country, and of most of these persons previous to marling, was the "three-shift" with grazing; that is, first year, Corn; second, Wheat, or Oats in part, where the land was not too poor for either, and grazing after harvest; and third, close grazing of the natural growth of grass and weeds. This exhausting rotation was generally and immediately changed after marling, by the entire prohibition of grazing; and afterwards partially or wholly, by having Clover, as a manure crop, in the year of rest. In a few other cases the *milder* four-shift rotation was used, which merely had another year of rest added to the above; and in fewer cases, and but in part, the *severer* four-shift, in which a second crop of Wheat was taken instead of the second year of rest and Clover, or three grain crops and one of Clover (as manure) in four years.

It should also be stated that it was an error with most of these persons, as with most others, to marl too heavily. Some of them, in this manner, injured more or less land, perhaps all in Prince George county. And generally more neat profit would have been derived from lighter applications.

Further: the wood-land remaining to be cleared, and such as was by new clearings added to these farms was nearly all poor, and if not marled, after a few crops being taken, would have been poorer than the previous average of older land. And for this reason, very few if any of the new clearings taken throughout, would have served, without being marled, to increase the former general average product per acre.

Corn and Wheat have been the sole great market crops of these lands, with the exception of Cotton for a few years only, and which crop is now abandoned.

TABULAR STATEMENT

OF MARLING OPERATIONS AND SUPPOSED RESULTS, ON TWENTY-TWO FARMS OF VIRGINIA, BROUGHT UP TO 1840. EXTRACTED AND C

Referred to at Page 58 of the Report of the Agricultural Survey of South-Carolina

FARMS.		Regular Marling.	Quantity of Arable Land.		Quantity of Land Marled by 1840.	General strength of Marl per cent. in Carb. of Lime.	Usual quantities applied.	Rotation or course of cropping, and whether exhausting, merely preservative of the then productive power, or meliorating (if without the addition of Marl).	
			Acres.						
NO.	PROPRIETORS.		Before Marling.	Added since.			Bushels.	Before Marling.	After Marling.
	Prince George County.								
1	James B. Cocke,	1820–1	450	250	575	45	280 to 350,	Preservative; three-shift rotation, without grazing,	Meliorating. Same with Clover, and afterwards the mild four-shift rotation,
2	John B. Bland,	1826	150	250	376	26 (*a*) to 30,	300 on old, 400 on new,	Unusually exhausting; then rented land,	Meliorating. Three shifts with Clover, not grazed,
3	Edw. A. Marks,	1827	170	100	230	45 to 50, (*b*)	400 to 1830—300 since,	Preservative; three shifts and no grazing,	Preservative, or meliorating generally. Three shifts without grazing; partly severer tillage,
4	John H. Marks,	1827	400	50	300	45 to 50, (*b*). (Same pits),	400 to 1830—300 since,	Exhausting,	Barely preservative,
5	H. H. Cocke,	1827	—	—	500 to 600	25 to 60,	200 on poorer, 300 on richer,	Very exhausting; three shifts and grazing,	Preservative, three shifts and no grazing—more recently Clover,
6	Elgia Russell,	1827	50	142	150	25 to 50,	200 on old, 400 on new clearings,	Very exhausting,	Exhausting; three shifts and rest only recent, in last few years,
7	Theoderick Bland,	1830	350	12	200	50 to 60,	350,	Very exhausting,	Meliorating; three shifts, Clover and no grazing,
8	Edmund Wilkins,	1834–5	263	170	214	42,	180 on poorest, 320 on best,	Very exhausting,	Barely preservative; three shifts and but little grazing,
9	Wm. Wilkins,	1833	60	40	70	45 to 52,	300,	Exhausting,	Meliorating, three shifts with Clover,
10	Rd. M. Harrison,	1834	200	—	125	50,	250 to 300,	Exhausting; three shifts and grazing,	very slight grazing, Meliorating,
11	Coggins' Point Farm,	1818	540	197	670	30 to 61; average 40, (*a*)	500 to 600 formerly—since 300 to 400,	Meliorating—after early and great previous exhaustion; the mild four-shift rotation, without grazing,	Meliorating—mild 4-shift, with Clover recently. Latterly, some grazing, and also severer cropping,
	King William County.								
12	Wm. S. Fontaine,	1835	400	200	550	57, (*a*)	450 to clayey—200 to sandy land,	Very exhausting; two shifts (1st, Corn; 2d, Wheat, or Oats, and grazed,)	Meliorating, three shifts, with Clover, not grazed,
13	Thomas Robinson,	1834	200	20	210	57,	150 to 200,	Exhausting; three shifts and grazing,	Meliorating; three shifts, and not grazed,
14	Thomas Carter,	1827	800	400	810	Rich,	600 at first, then 300,	Exhausting; three shifts and grazing,	
	Surry County.								
15	Bolling Jones,	1834	—	—	241	50 to 60 carb. of lime, and some green-sand,	250 to 300,	Exhausting,	Meliorating,
16	Wm. C. Jones,	1836	—	—	210	65,	150 to 250,	Exhausting,	Meliorating,
17	P. T. Spratley,	1834	300	—	200	45 to 50,	250 to 500,	Meliorating; three shifts without grazing,	Meliorating; three shifts with Clover,
	James City County.								
18	H. B. M. Richardson,	1829	85	17	100	Rich,	150 to 350,	Exhausting,	Exhausting for some years—since meliorating,
	Pasquankey River low lands and green-sand marls. (*c*)								
19	Wm. F. Wickham,	1820	1000	20	900	10 carb. of lime, and 8 to 22 of green-sand, (*a*)	800 generally,	Exhausting; three shifts and grazing,	Four shifts. First, Corn; second, Wheat; third, Clover; and fourth Wheat,
20	Edmund F. Wickham,	1824	515	40	425	(Same as above),	600,	Same as above,	Same as the above,
21	Corbin Braxton,	1834	500	50	400	45 carb. of lime, and 20 to 30 green-sand,	200 to 300,	Meliorating,	Meliorating,
22	Carter Braxton,	1837	750	—	350	18 1–2 to 36 carb. of lime: 8 1–2 to 20 green-sand, (*a*)	250 to 300,	Meliorating,	Meliorating,

TEMENT

EXTRACTED AND CONDENSED FROM THE MORE EXTENDED REPORTS IN THE FARMERS' REGISTER.

ral Survey of South-Carolina.

ng, merely preservative at the addition of Marl).	Increase per cent. of first Crops after Marling.	Present rate (1840) of increase on previous Product.	Average Product of Corn per Acre. Bushels.		Average Crops of Wheat. Bushels.		Present value of increased average product of Crops per Acre.	Present increased average annual value of gross products of the Farm.
ter Marling.			Before Marling.	In 1840.	Before Marling.	Recently and to 1840.		
Same with Clover, and mild four-shift rota-	About 100 per cent.,	Oldest, 200 to 300,	7,	27,	150 to 200,	600 to 900,	$10,	$3000.
Three shifts with Clo-	Nearly 100 on better land; less on poorest,	Increased invariably; least on poorest land,	10,	30,	4 bushels per acre,	8 to 10 per acre,	$6 66,	$1800.
or meliorating general- shifts without grazing; tillage,	Mostly 100; on poorest much less,	150,	10,	22,	121 actual average,	500,	$6 66,	$1020.
ive,	80,	Small addition,	10 generally, 30 on 40 acres,	25,	350,	700,	$6 66,	$2000.
three shifts and no recently Clover,	100 and less,	Continued addition evident,						
ree shifts and rest last few years,	100 on old land; 30 or 35 on new,	Gradual increase,	10,	20,	150,	350,	$3,	$426.
ree shifts, Clover and	30 on rich neutral soil; 75 on acid soil,	300 to 400,	13 1-2,	35,	800, (c)	2500, (c)	$9 50,	$1100.
ive; three shifts and g,	30 to 40 on best land; 100 and more on poorer,	Perhaps 50 addition,	5,	15,	3 per acre,	8 per acre,	$3 50,	$736.
ree shifts with Clover, ing,	100,	Much increased,	5 to 7 1-2,	25,				
	50,	100,	10,	20,	300,	600,	$3 50,	$166
mild 4-shift, with Clo- Latterly, some graz- severer cropping,	50 on new land; 80 to 120 on old and acid sandy land, much less on clays,	200 to 400 on acid, and less on neutral soils,	10 to 12,	25 to 27,	637 actual average for 6 yrs.	1800, (d)	$8,	$3200.
three shifts, with Clo- d,	10 to 20 on poor stiff clay; 50 to 60 on sandy soil,	Increased considerably,	8,	20,	300,	7 to 800,	$7,	$1700.
three shifts, and not	25,	125,	5,	20,			$8 50,	$700.
			15 to 17 1-2,	30 to 35,				Doubled.
	25 to 100,	Increased steadily,	9,	19 1-2	No Wheat cultivated.			
	50 to 60; on acid land, 100,	Increased.						
ree shifts with Clover,	50,	100 or more,	6 to 8,	20,	Full 50 per cent. general increase.			
or some years—since	50 to 100,	Increased,	10,	25,	60,	100.		
First, Corn; second, Clover; and fourth	Slight "except on Cotton, where immediate and great benefit,"	Continually increasing since,	15 to 20,	30 to 40,	Doubled.			
ve,	Slight,	Increased constantly	15 to 17 1-2,	30 to 35,	Doubled.		$8 60,	$2600.
	100 to 200,	More,	15 to 20,	40,	More than doubled,			$2.000 on Corn alone.
	50 to 100,		15,	30,	Doubtful,			

EXPLANATORY NOTES.

(*a. a.*) The strength of the marls thus marked, determined by specimens carefully selected, and analyzed by myself.

(*b. b.*) The strength inferred by comparison with others of the neighborhood, of similar appearance and known quality. All others estimated by the suppositions of the several proprietors. Such estimates, whether made by guess, or by applying correct analyses of *particular specimens* to general operations, very frequently err in making the average of the marl seem richer than is true.

(*c. c.*) In No. 7, the estimate of Wheat product was for only the crop of 115 acres—there being no more fit to put in Wheat before marling.

(*d.*) No. 11 was marled by the reporter, and held by him until the end of 1838; since then, partly owned and entirely occupied and managed by his eldest son. The above estimate of the average productive power of this farm in Wheat (stated in 1840) was much too low; as the crops actually produced in that and the subsequent years were as follows: 1942 bushels in 1840; 2175 in 1841; 3377 in 1842; and 1725 in 1843. It should be stated however that the last crop (1843) was on the best Wheat land offered in the course of the rotation; and further, that the season for Wheat was the best ever known. It is probable that most of the foregoing estimates of the productive powers of farms in Wheat were also too low; and for the same cause of error, that is, the occurrence of a series of bad Wheat crops for some years preceding 1840.

(*e.*) Much the greater proportion of land of the preceding 18 farms (excepting No. 7, and of each one,) was *acid* soil, of inferior quality and mostly sandy. The following four farms were naturally rich and *neutral* soil, such as shows but little immediate benefit from calcareous manures. These would have shown much less, but for the large proportion of green-sand with the Pamunkey marls.

To the facts appearing in the foregoing Table, it should be added that all the 22 individuals, in their full replies to distinct and particular questions, concurred in the opinion, that the increased productive power already given by marl will be permanent, and that they had no expectation or fear of any further deminution thereof. They also all maintain that putrescent manures are much more efficacious and profitable on marled land than they were on the same before marling—either because of greater early effect, more durability, or both together. Further, nearly all these individuals, (and all who could properly offer opinions thereupon,) declared from their experience and observation their entire concurrence in the supposed manner of action of marl, and the actual results stated to be obtainable, as both had been set forth at large in the "Essay on Calcareous Manures."

E. R.

The Primitive Limestone Belt.

It has long been known, that limestone of excellent quality was exposed at the Limestone Springs, in Spartanburg; and at later times, sundry other exposures have been found, and the limestone has been quarried in several places, for the reduction of ore at the neighboring iron furnaces; and also was burned to lime, to supply, at a very high price, the very small demand for lime, for cement and other mechanical purposes. It is but lately that the number of natural exposures of limestone ascertained, have made it seem probable, not only that the limestone forms a continuous and connected narrow belt across the State, but further, that the limestone may be successfully sought in many other places than it has yet been seen in its apparent course.

Extending from the nearest similar exposure in North Carolina, this stripe of limestone enters South Carolina in York, a little west of King's Mountain, and is first seen on one of the upper forks of King's Creek. Thence it is seen exposed in almost every valley in the course of the line, and at distances apart, from a few hundred yards to two miles. On the following plantations are presented exposures in York; commencing near the North Carolina line, first on Hamright's land, and thence, in order, on the lands of Etter, Whesant, Wilson, Bird, Harden, W. Black, Hauser, the King's Mountain Iron Company, (two localities,) and the South Carolina Iron Company, on Broad river, and just above their iron works. Next, across Broad river, and in Spartanburg, on the lands of Stacey, the South Carolina Company, (two places,) Limestone Springs, Otterson and Watkins; and on Thompson's plantation, on Pacolet river, about 2 miles below the Hurricane Shoals. The last named exposure only was artificial, it having been reached in the digging of a well; and this is the extreme limit of the limestone in Spartanburg yet known, though the Pacolet Springs and Cedar Springs, both further on, are of limestone water, which would indicate the stone to be there accessible, if dug for.

Throughout this line, there prevails a general uniformity of the appearance and character of the limestone. It is seen protruding above the surface of the earth only in bottoms, and only in a few and but slightly elevated masses, before excavations are made, which have generally shewn the stone to rise much higher and abruptly in the neighboring hill sides, and abundant in accessible and available quality. Though seen only in the valleys, still it is not because the limestone preserves any thing like an equal elevation. On the contrary, the limestone at one exposure between King's Mountain and Broad river, (though in a valley,) is fully 350 feet perpendicular, higher than elsewhere, in another deeper valley within a few miles.* The stratification of the limestone is seen generally greatly inclined, and very different in degree, and also in direction. It is in some places almost vertical, and at others, though rarely, nearly horizontal. The color is generally blueish gray. At the Limestone Springs, part is white. The stone is mostly nearly free from any admixtures worth consideration,

* This fact is known from the running and levelling of one of the experimental lines of survey, for the designed (and fortunately abortive,) Cincinnatti and Charleston Rail Road.

as effecting the quality—unless perhaps it be of magnesia, of which the proportion has not yet been determined; and if known, it is a disputed point, whether its presence detracts any value from lime, either for cement or for manure. The formation is primitive; it has the ordinary hardness and texture of compact limestone. The grain is sometimes close, and the fracture dull—but in others, highly and beautifully crystalline.

Proceeding in the same course, and after a wide interval of about 36 miles, in which no limestone has yet been found, the next exposures known are in Laurens district, on the south side of the south fork of Raiburn's Creek, and are seen from one and a quarter to one and three quarter miles above the junction of that with the north fork. There are several different exposures within the limits of half a mile along the course of the creek, and indicating a visible width of the limestone belt, at this place, of several hundred yards. This is on the land of Mr. J. Garlington, and 9 miles from Laurensville, in a direction south of west. The existence of limestone here has not been long known. A kiln has been erected within the past year, and the business of burning lime for sale commenced.

The next known exposure was made accidentally some years ago, by the digging of a well, on the highest ridge land, south of and next to Reedy river, and about 5 miles from the last named locality. At 64 feet deep, a peculiar rock was reached, and quarried by blasting, and excavated and drawn up for some considerable depth. It was not then suspected to be limestone, but is now known to be such, by comparison with the neighboring limestone very recently discovered. These are, first, on Waite's and Clardy's lands, along a branch of Walnut creek, which is a mill stream, emptying into the Saluda, and about 1 1-2 to 2 miles from that river; and next on Barmore's land, about half a mile from the Saluda, and about a mile above Pinson's ford across that river, and rather more above the mouth of Turkey Creek,—and which last exposure is the extreme south-western limit of this range of limestone, so far as yet traced in South Carolina.*

The limestone quarried on Raiburn's creek, exhibits great difference of quality. A part is so impure that it makes a very poor lime, and is no longer burnt, since its character has been ascertained by that costly mode of trial. There is, however, an abundance, of good quality—a pale blue crystalline stone, with very little of any foreign matter intermixed. But the stone exposed on Waite's and Clardy's lands and on Barmore's, is very pure, and indeed is, so far as seen, a beautiful white crystalline marble. The natural exposures at the latter place, are seen not more than 40 yards in extent; at the former, for more than 100 yards, and where highest, the limestone is seen 10 feet above the bottom in which it rises, which height is much greater than was exposed naturally at Garlington's, and at other

* The following statement will serve as evidence of the slight value as yet attached to limestone, even at nearly the exposure most advanced towards a country and a market destitute of lime, and therefore in the most valuable position to command purchasers. When examining the limestone on Clardy's land, (which is in fact a beautiful crystallyzed white marble, as well as bein - excellent limestone, for cement and manure,) I heard that the small tract of land containing it was then advertised for sale at public auction, for the purpose of division among heirs. It has since been sold; and in compliance with my request, a gentleman of the neighborhood has written to inform me of the result, in the following words: "The land brought a small fraction over $4 per acre. Attention was particularly directed to the limestone on it; but the land did not bring a cent more on that account."

places, where excavations for quarrying have shown the stone to rise high and to be abundant and easy of access.

The course of the line of limestone, as marked on the annexed map of the State, proceeding from the north, is, first, nearly south-west, and becoming more southerly in Laurens, and approaching its southern known extreme. The whole line forms a gentle and nearly regular curve. If future investigations should prove that the two remote parts of the limestone do not belong to the same range, (as supposed above,) but to two distinct and separate ranges, then the southern continuation of the Spartanburg limestone would probably pass somewhere under Greenville and Anderson districts, and the northern extension of the Laurens limestone through Union, and perhaps Chester. In either case, the Laurens range must, if continued, pass under Abbeville. And if persons who are intimately acquainted with the features of the ground, would carefully search for the limestone in the course of the lines designated above, and especially in places near the farthest extended known exposures, it is probable that in a short time there would be discovered twice as many exposures, and much more than double the extent of lime now known. With the necessary local knowledge, the examiner should proceed in the supposed line of direction, and examine the rocks showing in every deep valley, and especially crossing the beds of rivers and smaller streams. The touching with acid is much the easiest, and also the surest mode of distinguishing limestone from all other hard rocks.

There is another narrow belt of limestone, extending from Habersham in Georgia, and exposed in Pickens district, near the out-let of Brasstown creek, into the Toogoloo, (or main branch of the Savannah,) and also, about 12 miles distant, near to and north of the Chauga river. Taking these two points as indicating the course of the line, it is nearly north-east and south-west; or something like parallel to the supposed general course of the lower range of limestone, and also, to that of the Blue Ridge mountains. Some lime has been burnt of the Pickens stone, but very little use made of it for any purpose; for which neglect the high price offers a sufficient, though not the only operating cause.

Even though the limestone of the upper districts should not be exposed and found available in more places than it is now known, still it offers immense benefit to the agriculture of the surrounding country. But to reach this end, and to produce any important benefit to the sellers as well as to the buyers of lime, two new conditions must exist, which will mutually sustain and give value to each other. These are, a greatly reduced price for the lime, and a greatly increased demand and consumption. While the lime sells, as now, from 25 cents to 40 cents the bushel, there will never be enough consumption to make the business of burning lime worth much. But if it sold at 10 cents, which price, a constant and certain and large demand would make abundantly profitable, the lime would be conveyed for manure, 20 miles by land-carriage, and much further by aid of the intersecting navigable rivers—making a business of great profit to both sellers and buyers, and of great and permanent improvement to a large space of territory.

These statements vary so much from existing prices and prevailing opinions in South Carolina, that it is proper to accompany them with some evidence—which will be done as concisely as the occasion requires. The

facts which will be adduced, are such as have been hastily gathered, where but few authorities and sources of information could be referred to, and therefore, as proof, they probably are not the most full. Nevertheless, they will be ample for my purpose. Professor Low, (in his Elements of Agriculture,) states the price of lime, (unslaked, as is always understood, when not stated otherwise,) in the borders of England and Scotland, to be three pence sterling the bushel, or about 6 cents. The only statement of price in France I have seen, is in the excellent and elaborate treatise of Harrenfratz.* It is there mentioned incidentally, that at Barres the price was 8 to 10 *sous*, which is about as many cents. In that country, fuel is enormously dear. In Ireland, as I have learned severally from two very intelligent and observant gentlemen from that country, the price of lime is 6 pence per barrel, (of 4 bushels,) and the charge for burning the stone brought to the kiln is 2 1-2 pence the barrel. The latest European authority that I have, is in Johnson's Farmer's Encyclopedia, just published in this country, which states so low a price for lime, that I prefer to quote the whole passage. The author says, (in the article "Lime.") "The price of fuel, and readiness of access to the limestone or chalk, of necessity, governs the price of lime; in some districts of the north [of England] it is made by the farmers for not more than one penny to three half pence the bushel." In Lancaster, Pa., lime is sold at the kilns at 12 1-2 cents, where fuel is high. Excellent lime is brought in large quantities, slaked, and the vessels loaded in bulk, from the Schuylkill and the Hudson, to James river in Virginia, and sold to the farmers by the cargo, and upon previous contract, at 9, 8, and even as low as 7 cents the bushel—the last named price being for a very large contract, within my knowledge, recently made. As stone lime, if good, gains at least 100 per cent in bulk by being slaked, and converted from compact stone to impalpable powder, these prices for slacked lime should be doubled, for the proper mode of estimate; and which shows that lime may be and is continually brought from 5 or 600 miles, and by sea, and sold at prices equivalent to 16 and even as low as 14 cents the bushel. Now, even if we had no facts nearer home than these, it would be manifest that lime may be burnt as easily in South Carolina as elsewhere, and sold cheaper than the highest of these prices, and not much dearer than the lowest. For if labor be higher here than in Europe, and more labor be required for removing earth and blasting, on the other hand fuel is much cheaper, and (as yet) so is the land containing the lime-stone. But I have more satisfactory proof, in estimates and facts obtained in regard to the very lime under consideration. At the Limestone Springs, in Spartanburg, where the stone was first discovered, and has been longest and most largely burned for sale, the business is conducted, as every where else that it has been attempted, with very little knowledge of the process, or economy of means. The kiln is badly constructed, and there is great waste of fuel, and of heat, and of time in burning, as well as labor in blasting the stone in the quarry. Every part of the labor was hired and paid for at fixed rates; and thus the occupant, Mr. J. C. Janney, knew precisely the cost of every charge of the kiln; and of all which, at my request, and for this purpose, he made the following accurate estimate and statement of actual expenses,

* *Traite Theoretique et Pratique de l'Art de Calciner la Pierre Calcaire.*

for the burning of 600 bushels of lime, which is the quantity contained by the kiln :

" Quarrying or raising limestone (or blasting, breaking, and heaping,) say 28 loads, of 3,200lbs, at 45 cents the load,	$12 60
Hauling stone to the kiln (about 100 yards or less),	5 00
Filling kiln and burning, (2 men for 5 days, at $1 each),	10 00
Paid for cutting wood, 22 cords, (or price of wood ready cut),	10 90
Hauling the wood,	6 60
	$45 10."

Which is equal to 7 1–2 cents the bushel for the 600 bushels of lime, unslaked. Every expense is charged except the rent of quarry and kiln, which could not be determined ; but which, in large operations, would together scarcely make half a cent more, or raise the cost to 8 cents. Thus, if selling at 10 cents, at the kiln, and with certain and full demand, a nett profit of 25 per cent. would be cleared, even on this very inefficient and very costly mode of operations. And if a proper kiln were constructed, so as to save the fuel, the heat, the time and the labor, that are now wasted, and the quarrying were done in the best manner suitable for a large business, there can be little doubt that the above stated expenses might be greatly reduced.

Among other valuable services for which I am indebted to the knowledge and kind aid of Mr. M. Tuomey, he visited and examined the lime-kilns in Philadelphia on the Schuylkill, at my instance, and prepared accurate drawings and descriptions of the best kinds there in use, which, together with all the statistics of the business, as there conducted, showing the amount of labor, expenses, and prices, &c., will be here annexed, for the benefit of any person who may desire to commence the business of lime-burning in South Carolina, in a proper manner for economy and profit—than which a more profitable business can scarcely be undertaken, even if with a view of selling lime, and for other than agricultural uses.

" The best site for a kiln will be a hill side convenient to the lime-stone quarry, or marl deposit. In such a situation, besides the facility afforded for charging the kiln, the expense of masonry will be much reduced, as little more than a breast wall will be required. This wall should present a portion of a reversed arch, the convex part being towards the fire. This form evidently offers the greatest resistance to the expansive force of the heat from the kiln. The interior of the kiln must be lined with some fire-proof material; some varieties of sand-stone and talcose rock, where they can be procured, will furnish good substitutes for fire-brick.

" The only difficulty to be apprehended in burning hard marl with wood, is that when the burning proceeds to a certain point the stones composing the arch are apt to crumble and fall in. The most compact masses should therefore in all cases be selected for the construction of the arch.

" Minute directions will scarcely be necessary, as prudence will dictate to every man on commencing the business of lime-burning, that an experienced hand be employed, even at an additional expense, at least until the ordinary hands have acquired sufficient experience.

" The stone used at the kilns in Philadelphia is the refuse from the quarries at Norristown ; it is boated down the river a distance of 17 miles, and delivered at the kilns at 85 cents per ton—which quantity, when burned, furnishes 15 bushels of [unslaked] lime. The small coal used in the perpetual kilns costs $2 a ton—a ton being sufficient to burn 100 bushels of lime. Where wood is used, 15 cords of oak-wood (which is bought at $3 per cord) will burn 1,000 bushels. Two men are employed at a kiln at $1 each a day. The time required to burn a charge of 1,000 bushels varies from 48 to 60 hours.

" The cost of burning, &c., 1,000 bushels, deduced from these data, will stand thus:

Lime-stone, 66 6–10ths tons, at 85 cents,	$56 61
Oak-wood, 15 cords at $3,	45 00
Hire of 2 hands, 4 days at $1 each,	8 00
Cost of burning 1,000 bushels,	$109 61

Nearly 11 cents per bushel.

" Cost of burning in the perpetual kilns, where coal is used:

Lime-stone, 66 6–10ths tons at 85 cents,	$56 61
Coal, 10 tons at $2,	20 00
Hire of 2 hands, 2 days at $1 each,	4 00
Cost of burning 1,000 bushels,	$80 61

Or nearly 8 cents a bushel.

" Prices of lime delivered at the kilns:

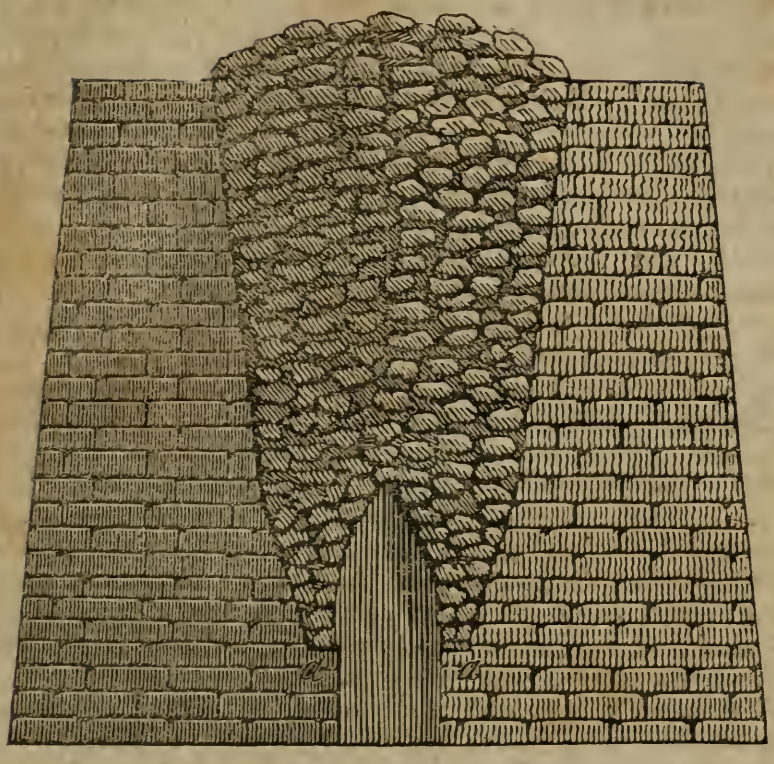
Wood-burned lime per bushel,	18 cents.
Coal-burned lime per bushel,	13 cents.
Slaked lime and ashes,	6 cents.

" The wood-burned lime is preferred by bricklayerers and plasters, though for agricultural purposes it possesses no superiority over the coal-burned.

FIGURE 1.

Scale—One-eighth of an inch to a foot.

FIGURE 2.



" Fig. 1 represents a front elevation of a kiln in which wood is used as fuel. *C*, an iron door which is closed excepting while wood is thrown in during the burning. The opening, or eye of the kiln, as it is called, is closed with loose stones, leaving the vent *b* and the space at *a* open. At *a* the wood is thrown in.

" Fig. 2 shows a vertical section of the kiln filled and ready for firing. The arch is commenced with small stones on the offset *a a*, each course projecting over the preceding one, until they meet at top. This part of the operation of filling requires some skill.

" The arch requires the largest stones, which should be reserved for the purpose. It is common to heap the stones above the level of the top of the kiln, as represented in the figure. The charge for this kiln is about 1,000 bushels.

" On the top and back of the kiln an opening like a door is left for the convenience of filling, and also for taking out the lime when burned. During the operation of burning the opening is of course closed."

It was not designed in the foregoing directions to indicate the best plan for the construction of a kiln, nor the cheapest mode of burning; but the best and cheapest known in actual operation, where the business is conducted well and on a large scale. There are doubtless more perfect plans of kilns, though more expensive and difficult to construct, which may be referred to, if desired, in various scientific works. Neither was it deemed necessary to describe and figure the perpetual kiln, which is doubtless the best for very large operations, and where coal is the fuel, (or charcoal,) but for which wood will not serve, as is believed by the Schuylkill lime-burners. But compare these *actual* operations and expenses at the Philadelphia kilns, with what is done and with what may be done in South Carolina, and it will be obvious that lime may be burnt here much cheaper, from limestone, and still more so from marl, and marl-stone, because of the greater

cheapness of the materials, of fuel, and of labor, than these estimates exhibit in regard to Philadelphia.

To offer directions for the practical application of quick-lime would be still more difficult, and is even less called for at this time and in this report, than in regard to marl. A few general observations, however, will be hazarded, and the principal and essential rules stated briefly, for the convenience of those persons who are totally unacquainted with the subject, and may not have ready access to more full instructions in other publications.

The quantities of quick-lime applied have varied greatly in different countries; and this wide variance seems to have grown more out of the difference of cheapness or dearness of the lime, than from any sound reasoning, or experience, or in accordance to calculations of profit. Doubtless a heavy dressing, if not so heavy as to do harm to crop or land, must produce more effect and increase to the acre, than a light dressing. But the abatement of such increased product in lighter limings, is by no means in proportion to the lessening of the dressings applied. And indeed it seems that the lighter the applications to the acre, the greater the effect, for the quantity of lime applied. Thus, the good results experienced from unusually light dressings, have served of late years to reduce the general amount of liming to the acre, while the whole quantity applied has been increasing rapidly every year, wherever the practice has been commenced. The lime used formerly on James River in Virginia, was obtained altogether by the farmers buying and burning oyster shells; and they then usually applied to the acre 72 bushels of burnt shells, (which required 100 bushels raw, to produce,) and which would expand to about 120 or 125 of slaked lime. But Mr. Wm. B. Harrison, on James River, who has limed about 1,500 acres, in this manner principally, and with great success and profit, has since told me that he would have profited much more for his expense if applying at first only half the quantity to the acre, and, of course, spreading his annual amount of lime over double the space. The extent of annual liming has been greatly increased lately on the lands bordering on James River, and destitute of marl, because of the additional and new supply of slaked stone-lime, brought by vessels laden in bulk, from the Schuylkill in Pennsylvania, and Hudson in New York. This slaked lime is generally applied at the rate of 40 bushels only to the acre, equal to 20 bushels of unslaked, or less, when the lime-stone is very pure; and this quantity is deemed by the most judicious limers as sufficient for one application, and it is found to yield satisfactory results and good profits. In a part of France, La Sarthe, it is the established practice to give not quite 12 bushels of lime to the acre, but to repeat it with every commencement of the rotation, which is of three years. This is equal to giving rather less than 4 bushels of lime a year. This mode of repetition is there deemed the best, and the results are at any rate satisfactory. Now, according to my views, with land so treated, a time will arrive when no more lime will be needed, and the then maximum product of the land will never thereafter be reduced. But putting all this theoretical expectation aside, and supposing that, for all future time, 4 bushels of lime, costing 10 cents the bushel, shall be annually given, how small would be the cost, compared to the ordinary products and profits derived from liming! Still, it will be a very great mistake to expect from such light applications the same results as from more heavy dressings.

In whatever manner or quantity quick-lime is applied to land, it is all-im-

portant that it shall be equally distributed over all the surface. Its condition, of being in the smallest possible state of division, and every particle of the impalpable powder being separate and acting, is the cause why a quantity of lime so much smaller than of marl will show appreciable early effects. But if the quick-lime be suffered to get wet in mass, before being completely separated and mingled with the soil, it forms a mortar, and unites and hardens in lumps; which condition, no matter how small the lumps, is a return to something like the former state of lime-stone. These lumps will not be entirely reduced for a long time; and will therefore produce but slight early effect as manure.

To make sure of the equal diffusion of the lime, and with greater ease, it should be given to land already ploughed for some tillage crop, as corn or cotton. If previously slaked, a measured quantity (say a peck, or half a bushel,) should be deposited in the middle of a marked square, of such size as will serve to give to each acre the quantity of lime designed. The lime should be spread as speedily as possible after being thus dropped, carefully and equally, and each heap over its allotted and marked space. And as soon as enough ground is so spread, square harrows, each with 20 or more straight and sharp tines or teeth, should be driven over the land, once or oftener, so as to well mix the lime and surface soil. The lime is then safe; and the subsequent tillage of the crop will mix it thoroughly with the soil, and to sufficient depth.

When the lime is received before being slaked, as is usual, and ought to be preferred, the heaps of burnt shells (or lime-stone) ought to be put out as above directed, of sizes and at distances determined by the quantity desired to the acre. As fast as the unslaked lime is thus deposited, each heap is well covered over by enough of the surrounding ploughed soil, drawn over it by a broad hoe; which is easily and quickly done. This covering of earth, by its moisture in the dryest weather, soon causes the lime to slake; and will serve also to protect the lime from the heaviest fall of rain, which otherwise would convert it first to mortar, and next to stone. As soon as the heaps are slaked, and the earth is in good order for working, the heaps are to be chopped down, the lime and soil which composed them thus well mixed, and then the whole heap spread over its designated space. Then the harrowing follows as in the previous case, though less of it will be required.

Where very small quantities of lime have been found most effectual, they have been given as part of compost heaps, of which the remaining and much larger portion is of any rich soil, peat, or swamp and pond mud, or wood's leaves or litter. This general plan is that of La Sarthe in France, before adverted to, and also general in Normandy, and in Belgium, and which Puvis, the author whose "Essay on Lime" furnishes the facts, deems the best mode of application. He says—"There is first made a bed of earth, mould, or turf, [peat,] of a foot or thereabout in thickness. The clods are chopped down, and then is spread over a layer of unslaked lime, of a hectolitre [2 7–8 bushels] for 20 cubic feet of earth. Upon this lime, there is placed another layer of earth, equal in thickness to the first, then a second layer of lime; and then the heap is finished by a third layer of earth." As soon as the lime is fully slaked, by the moisture of the earth, "the heap is cut down, and well mixed; and this operation is repeated afterwards before using the manure, which is delayed as long as possible, because the power of the effect on the soil is increased with the age of the

compost, and especially if it has been made with earth containing much vegetable mould."* It may not be unnecessary to state that there should not any animal excrement be permitted to enter the compost heap, as such highly putrescent matter would be damaged by the co ntact and decomposing action of caustic lime.

I have had no personal or experimental knowlege of the effects of this practice; nor had I heard of any one having followed the directions of the French author and the recommendation of his translator until this year and in this State. When in Sumter I was informed that Mr. Peter Mellett, a judicious planter not long since deceased, having read the article above quoted from, determined to try the plan. Though not far distant from the rich marl and marl-stone at and near Vance's ferry, it was not then known that there were the cheapest sources of supply; and knowing of no better mode, he thereafter bought northern lime in Charleston, at such price as it happened to bear whenever his cotton was wagoned to market, (generally from $1 25 to $1 50 the cask of about 3 bushels); and as return loads, the lime was thus brought to him by 90 miles land-carriage, including the expensive ferriage over the Santee. With it, he formed compost heaps, as above described, but of which the other materials were principally, if not entirely, of leaves and wood-land scrapings. He applied this to his cotton land for every crop, which was every year, in such quantities as gave only 2 1–2 bushels of lime to each acre. This course he continued, to such extent as his return loads of lime served for, until his death, 8 years after his commencement, and throughout he was well satisfied with his results, and the manifest and great improvement produced. The death of Mr. Mellett, and there being no person particularly acquainted with his experiments, prevented my obtaining more precise information; and perhaps even what is stated may be incorrect in the minor particulars. But whatever may be wanting in details, there is no doubt entertained among those persons residing in that neighborhood, of there having been very great improvement of both crop and land thereby produced, and of good profit made, even on this extravagant and unnecessary cost of lime. Col. James Richardson, who was acquainted with all these general facts, was so well satisfied with the results that he has followed the example to some extent, and is prepared to proceed; and though at unusual cost for lime, still at less than the preceding operations of his neighbor. He will procure marl-stone from across the river, and then wagon it 8 miles from the nearest accessible landing place to his plantation, there to be burnt and then mixed in compost heaps.

I should have been very far from recommending such small doses of lime, and for promising any appreciable effects from them; and still further from recommending the obtaining lime at such enorm ous cost, in either price or carriage. But the facts are the more interesting, on these very grounds, and much more so because of their having occurred in South Carolina, and where they may be examined into strictly, and their truth and value tested.

Whatever may have been the cost of this experiment of Mr. Mellett's, it is believed by some of his most intelligent and respectable neighbors that in

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* See Puvis' s "Essay on Lime," translated in Farmers' Register, vol. III, commencing page 359.

8 years he had thus raised land to the product of 1,000lbs. of seed cotton to the acre, which before was so excessively poor that it was supposed not capable of producing more than 100lbs. Even when admitting this reported fact, it may be objected, that it was not the lime, but the vegetable matter of the compost, which produced the much greater part of this wonderful increase. Unquestionably it was not the lime; for if it had been used in as small quantity alone, it would have produced no such benefit, and probably no perceptible effect in one year. But still it was the lime that enabled the vegetable part of the compost so to act and so to endure. For it is the general practice of the lower districts to apply vegetable compost, without lime, but with the addition of some rich animal admixture, and no such durability of effect, or extent of increase of crop, has been so produced. And such applications cease to act and are exhausted after one or two crops; and even though renewed (as is common on some lands,) every crop, never shows effects continually and greatly increasing for eight years, as did Mr. Mellett's compost. In my opinion, in his case the great benefit produced was neither by the lime nor the vegetable matter, as such; but by the new substance (probably *humate of lime*), formed by the chemical combination of the lime with a portion of the vegetable matter.

According to the French author above quoted, and also to English authority, experience has shown that the older the compost, the better it acts as manure. This is a strong practical proof of the correctness of my opinion just expressed. For a considerable length of time can give no more strength nor activity to either the lime or the vegetable matter; but it can, and it is necessary for that purpose, more effectually combine the two, and form a new manure better than either or both the combining materials.

On the Inland and River Swamp Lands, and their Drainage and Embankment.

Next to the use of calcareous manures, the most important of the neglected sources of agricultural wealth in South Carolina, is the drainage of the rich, and now pestilential swamps which are so numerous and extensive throughout all the lower, and part of the middle country. Indeed, though the former subject of neglect heretofore is the more important and inexcusable, because of the ease and certainty of the means of improvement which it offers—drainage of the swamp lands would not be less important and valuable if effected. For the productive and pecuniary profit to be thereby gained, great as it would be, is not to be compared in value with the blessing of improved health, which would be another and sure consequence of proper and general drainage, in addition to all the prevention of disease to be also gained by general marling and liming.

It seems to be a prevailing opinion in this country, that the thorough reclaiming of the great swamps is impossible, because of the great quantity of water to be discharged. To enable this question to be settled decisively, in advance of all actual operations of draining and embanking, would require thorough examinations and views by one possessing the knowldege

not only of these practical operations of agriculture, and of the nature and value of different swamp and alluvial soils for cultivation, but also of profound and varied attainments in several departments of science; and with all these means brought to bear on the object of investigation, there would be further required years of great physical labor, and endurance of exposure, and risk of health, and even of life. In comparison with such proper grounds for pronouncing authoritatively on the practicability and profit of reclaiming the swamps in general, such slight and chance-made observations and inferences as mine have necessarily been, deserve not to be named. A very general view, obtained thus imperfectly, however, will be here submitted.

Where there is as much natural fall or grade of descent from the water as is seen generally in the inland swamps of this State, and where the head-waters and most remote sources of supply fall within the limits of the State, and of the general plan of reclaiming, there can scarcely be ground for doubt that proper and easily practicable drains would serve, certainly and cheaply, compared to the value of the object, to drain the before inundated swamps. A canal in the lowest ground, having a properly directed course, even if but 10 feet wide and 5 feet deep, if always operating, would gradually and regularly draw off the waters, which, obstructed as they now are, may flood many thousands of acres. And there are but few, if indeed any, of the larger inland swamps, of which a main canal of double this width, at most, would not serve to remove the surplus, and heretofore, injurious waters; and perhaps at the same time, furnish good navigation in times of most abundant water, if not always. And as previously adverted to, another important advantage in many swamps, would be, that the main canals would reach the marl below, and serve to furnish it by the excavation needed for drainage.

Nor is it left for mere theory or reasoning, in advance of facts, to sustain this general position. Very many of these inland swamps, (now all returned to more than their original state,) have been formerly drained and were kept in excellent condition under rice culture. And though that is not *dry* culture, and requires not the keeping the land always drained, it can scarcely be doubted that entire and complete drainage, for corn or cotton, may be even more certainly effected, than the alternating draining and flooding necessary for rice culture. For, in the former, the object would be, by deep and always open ditches, to get rid of the surplus water as fast as possible, and to keep the level of the water at all times as much as possible below that of the soil. Whereas, for rice culture, in addition to the means to be kept ready for discharging the water, there must be also the means of commanding it for flooding the land deeply and frequently. The latter object and practice is in conflict with the general principles and effective means for the most thorough drainage, and for dry culture; and therefore the latter conditions would be more easily and certainly attainable, than those necessary for rice-culture.

The fact that very many of the large inland swamps were formerly drained, and produced abundant rice crops, and that they have been since abandoned, would seem proof that the making or maintaining the drainage was opposed by insuperable natural obstacles. The obstacles were, indeed, great, and they finally compelled all opposing efforts of industry to yield to them, in despair. The main obstacles, however, were not natural,

but legal and political. To construct and maintain a great and long extended line of drainage, requires one general or uniform plan, and the direction by one will and effort; or, otherwise, the wills and efforts of the many proprietors to be combined as perfectly as if but of one individual. While landed estates were so large that one man, or so few as could well combine their efforts, could embrace an entire scheme of extensive drainage, then such operations could be, and were in many cases, effected. But when the general division of estates increased greatly the number of proprietors, and reduced to almost nothing the interest of some of them in these great works of drainage, some such persons would naturally neglect to perform their part of the labor of maintenance, and next abandon it entirely; and this, by the injury produced, would cause others to be equally neglectful, and ultimately the whole of such great and valuable works were rendered useless, and became more than ever nuisances in all respects.

There is another and very important class of swamp lands, of which the general and profitable improvement and culture are by most persons considered even more hopeless than of the swamps last referred to. These are the great swamps which border the larger rivers, as the Peedee, Santee and Savannah, which have their sources far without the boundaries of South Carolina, and bring down floods accumulated upon immense areas about their distant head waters. It is true, that to contend with and to restrain such floods, is a far more difficult undertaking than to open the lesser streams and to drain the swamps on their borders. But the object is of enormous value; and even if not made perfectly and at all times secure, may be partially effected, and enough so for great profit to the proprietors, and great benefit to the State in general, provided a proper plan could be devised by law, to which each particular work of embanking on the same river should be made to conform; so that instead of the construction of one individual operating to counteract the purpose of another, and of all, each construction, as completed, shall aid all others, and all the separate undertakings together compose one great work, and operate to produce one great object, by similar and concurrent action. But to enable any such proper scheme of embankment to be effected, either in part by one or a few adjoining proprietors, or for a much larger extent of swamp lands, the aid of legislation will be essential. This aid may be at first given only so far as to forbid any proprietors by their constructions counteracting or obstructing such general plan for embankment and drainage as the law shall have adopted and required to be conformed to in all private works. And when the value of the great object shall be well enough understood, and the object generally desired, legislation may go farther, and require and compel combined action of proprietors in cases *manifestly* to their profit and benefit, as well as for the public good. Such aid of the law, in compelling joint action of proprietors of river swamps, on a general and prescribed plan of embankment and drainage, is given by the code of Louisiana, and has been found to operate most beneficially for every private as well as public interest. Without the adoption of this legal policy, the most fertile and now the most valuable lands of Louisiana would have remained forever in their former condition of worthless and pestilential morass. And without the aid of similar legal policy, the great swamp lands of South Carolina, whether on the great rivers or the smaller streams, will also forever retain their present almost worthless and decidedly injurious character.

Cursory view of the state of Agriculture, in the lower and middle parts of South Carolina, and of the changes and improvements therein most required.

The report of the beginning of an agricultural survey of any region, would exhibit a strange deficiency, if omitting all notice of the general characters of soil and of culture, of errors of management, and of the most important and essential requisites for improving the condition and increasing the profits of agriculture. Still, I approach the treating of such subjects, however slightly, with the reluctant diffidence which ought to accompany such admitted and great deficiency of knowledge of details, on my part, and of opportunities for ascertaining them, which must be counted on in one so recently an entire stranger to the country in question. My necessary want of opportunity for full information, while it admonishes me to limit my present remarks within narrow bounds, will, I trust, serve to excuse the meagreness of this portion of the report, and also, any misconception of facts, or errors of deduction, which may, nevertheless, appear.

The lower districts of South Carolina present a general similarity of surface, soils, and of culture, together with many particular and local differences on each of all these points. The surface of the land is mostly level, and of no great elevation above the tide on other navigable rivers. The highland soil is generally sandy, yet, in many places, stiff; and still more often than of the latter case, is the subsoil stiff and impervious to the surplus rain water (or nearly so,) even when the soil is sandy and open. And either naturally, or from exhausting tillage, most of the cultivated lands are poor. There are numerous swamps, large or small, intersecting the uplands; and though of the highest order of fertility, and capable of being drained with certainty, and with ease compared to the value of the object, these swamps remain almost universally in the state of worthless morass, and nuisances in every respect. Besides these "inland" swamp lands, or such as are above the influence of tide, there are immense tracts of salt tide marshes, made no use of except for grazing, and a much smaller extent of fresh-water marshes. The latter class, though much less in quantity on every river than either the salt marshes or the swamp margins above tide, furnishes nearly all the rice lands of South Carolina, and the annual products of that valuable crop, which are almost incredible, from the very small space which serves to yield such an amount. As more full and particular observations will be elsewhere presented in regard to rice lands and rice culture, and as swamp lands, in general, have been under consideration, no more will be added here on these heads; and the further remarks will have reference to uplands only, and their culture.

Since indigo ceased to be the general and great market crop of South Carolina, cotton has become the almost universal market crop, in highland, in all South Carolina, except the range of elevated and hilly districts nearest the mountains. So little of wheat, oats or rye, is made in the lower country, that they scarcely deserve to be mentioned as parts of general culture. The soil or climate, or both, are deemed, (and correctly,) unfavorabe to all these small-grain crops. Corn, with field peas and sweet potatoes, constitute the other great subjects of tillage in this region, of next importance to cotton. But of these "provision crops," nothing is raised for market, or for other than consumption on the plantations producing them. And very

many of the cotton planters, (and also rice planters) buy more or less of their provisions every year, from importations of corn from Virginia and North Carolina; and in some cases, buy hay from New England. The supplies of pork are still more generally bought from Kentucky and other Western States. And as the country is thus partially supplied with such provisions from abroad, it must be readily inferred, (as is the fact,) that the population of the city of Charleston depend almost entirely on foreign supplies, for corn, hay and pork. Northern and (in some cases) European hay, is even carried up to supply Augusta and Columbia, along rivers which flow through swamps covered with natural grass, so rank and luxuriant as to be almost impenetrable. Indeed, some of the greatest objections to the land and air of lower South Carolina, (their humidity) serve to render the production of grass the more certain; and few countries possess greater natural facilities, or which are more improvable by industry, for producing in abundance, grass, hay and live-stock, and their products of meat, milk and butter, all of which are now so deplorably deficient.

It is a common opinion, that the cultivation of rice and cotton is much more profitable than that of corn and other provisions, and that those planters having good lands for the former, can better afford to raise them, and buy provisions in part, or corn, sometimes, entirely. This opinion seems to me erronious, almost without exception. It seems next to impossible, that there can exist any where, a truly thriving agricultural class, which, as a regular system, buys, instead of raising, the necessary and most important articles of food. Such a system, pursued by the proprietors of rich rice and cotton lands, may indeed present large incomes of money for crops sold; and it may minister to encourage great luxury and expenditure. But it will be apt also to induce a pinching measure of the plain and solid comforts, and even in respect to necessary wants, and a scant provision of proper supplies of aliment to man and beast, and also to the land. A thorough reform on this head, to be produced by the sufficient diminution of each individual's rice and cotton culture, and substitution of extended corn, and other provision culture, and grass and stock raising in general, is essential to the permanent, solid, and agricultural prosperity of the State.

Besides the error of practice, which grows out of the former state of demand and supply, principally, there are other errors of cultivation, simply, which would be faults, without regard to the balance of demand and supply. Of these the two most important have been already treated of, and need no more to be enlarged upon, viz. the heretofore general neglect of the use of the abundant calcareous manures, and the general neglect of draining inland and river swamps—which latter neglect, I will only here remark, is the more surprising, inasmuch as it is exhibited in the same region, and often in the same neighborhood, where there is the most extensive, elaborate, and perfect system of embankment, drainage and culture, exhibited in the rice culture of the tide-swamp lands.

Some other of the more important and general defects of agriculture, in the lower and middle districts especially, will now be mentioned; and first, the frequent and continual cropping of the fields, without the intervention of rest, or of meliorating crops which enable the fields to be manured by their own growth.

In maintaining the benefit and necessity of *resting* arable land from the continued bearing of exhausting crops, I do not mean that land becomes

weary of producing, and requires a cessation of all such efforts, so as to have its powers re-created, as a tired and over-worked animal needs a temporary cessation of all muscular exertion. I do not know that this absurd doctrine was ever maintained by any one; and if it has been, it must have been by those who, like others who have argued against resting land, in this sense, were not practical, but mere theoretical and closet agriculturists.

Land has an unceasing tendency to produce as much vegetation as it has power, under existing circumstances, to bear; and if not cultivated, will always so produce of such weeds as there may be seeds or roots of in the soil. And what I mean and advocate as "resting," is not the cessation of production, (even if that were possible) but the temporary intermission of the more exhaustiug crops, and substitution of some others less exhausting in their growth, and rendered absolutely meliorating or enriching to the land, by being suffered, either wholly or partly, to die and remain on the gronnd, and thus to serve as manure. All vegetable products, if removed entirely from the land producing them, must be exhausting, though in various degress; and all, if suffered to remain there, must be more or less improving to the fertility of the soil. But there is great difference in different plants as to the comparative amounts which they draw from the land in growing; and also in what they give to it by their death and decay on the place where they grow. And it is by judiciously choosing among different kinds of plants, and using for meliorating or manuring crops, those which will give most to the land for the least expense, that the cultivator will most improve his land and his nett profits, by what I call the giving rest to his fields from continued exhaustion.

If plants drew all their sustenance from the soil, and (as a necessary consequence) by their death and decay gave back to the land no more than they previously drew from it to sustain their growth, then no such entire process of growth and decay could increase the fertility of the soil, and it would require the return of the whole of every vegetable crop or product to the land, to keep it barely stationary in productive power, and prevent absolute diminution and finally entire destruction of fertility. But all growing plants derive more or less of their food and support (and always in large proportion, though very unequal in different plants,) from the inexhaustible supplies offered by the atmosphere. If then the crop is removed, so much of its bulk as was derived from the atmosphere has been obtained without injury to the soil—which has suffered only the usually much smaller loss of what was drawn from the earth. And if *all* the growth be given back to the land, then the improvement exceeds the previous draught by the whole amount of the much larger bulk and manuring value derived from the atmosphere. But for the abundance of this beautiful provision of nature, most soils would be exhausted by a few years of ordinary tillage; and the impoverishment so produced could never be remedied, except by an almost impossible supply of putrescent manure from foreign sources.

Much the larger part of the bulk and weight of every vegetable is probably thus derived from the atmosphere. Still, crops vary greatly in their exhausting powers, if removed from the land, and also in their manuring values and powers, if suffered to remain and decay there. As a general rule, the broad leaved plants, and especially all of the pea tribe, draw the most largely from the atmosphere, and the least in comparison from the land; and hence all these plants are the most improving as *resting* or manuring crops. On the other hand, the narrow leaved and grain-bearing

plants, (as corn, wheat, rye, &c.) draw the least from the atmosphere compared to the amount they draw from the soil, and therefore are the most destructive of fertility when entirely removed, and would be the least improving, even if suffered to remain, in whole or in part, for manure.

According to the general principles here set forth, when a field is suffered to rest a year, and cover itself with a growth of natural and volunteer weeds, all of which die and decay on the ground, the clear gain to the land, of newly created productive power, is just as much as the weeds drew from the atmosphere. Such a manuring crop, on land much worn and poor, will indeed be but light. But its great recommendation is that it costs nothing to produce it, either for seed or labor; and on a very large scale, and for lands greatly exhausted, the manuring by the natural growth of weeds is the chiefest and most efficient mode of obtaining and applying vegetable manures. On such lands, artificial and far more generous manuring crops, as field peas and red clover, would not produce enough to pay for the cost of the labor and seed necessary to be given. And even if the natural growth were but small in comparison to these latter, its product is all clear gain.

But on land already in good productive condition, or after being raised to that condition, and capable of yielding good crops, it would be much more economical to subject nature to art, and to compel the land to produce the most fertilizing, and also cleansing, manuring crops, such as field peas, or red clover, where the latter can be well grown; and it may be expected to grow well wherever the land has been well marled or limed. For the superior value of such crops over natural weeds, both as manure and for the purpose of cleansing the land of weeds and of insects, is much more than will compensate for the requisite and greater cost. And though such rest, under meliorating crops, is a necessary and profitable practice for all lands, it is not necessary in the same measure. For the richer that land is made by proper and sufficiently mild treatment at first, the less *time* for rest will it subsequently need, in proportion to its time under exhausting crops. For one year under good peas or clover, may serve to give to the land in good productive condition as much manure as will sustain it under three or four succeeding and more or less exhausting crops. Whereas, on the same land before being so improved, and while in its most exhausted state, two years of rest and of natural growth to one of exhausting tillage, might have been necessary for the first steps towards resuscitation.

Thus in regard to resting exhausted lands, to such extent as will not make the field too foul with perennial weeds and shrubs, it should not be considered (as it is usually) that the proprietor is losing any thing by the intermission of an annual crop. He is merely delaying the making a scanty draught from the field, and also avoiding the necessary labor for that purpose, to obtain still more of product, with less average labor, at future times. He who thus allows time and its own growth to his poor field, is lending (in the nett value of what he might obtain from an exhausting crop,) a sum at an enormous rate of interest, which he will receive with his principal, but a year or two later than the earliest payment he could have extorted.

Such is the benefit of the *rest* which I advocate, and of which *rest* there is scarcely any given on the greater number of plantations in South Carolina, until by continued tillage the land is so reduced as to compel its being "turned out" of culture for years together, and perhaps until it throws up a

second growth of pines, and is again cut down and cleared for tillage. And in this way the most incessant and exhausting planter is compelled at last to give more years of rest to his fields, than he who gives rest the most frequently and regularly. For the long term of rest consequent upon the wearing out and turning out of the field, if divided into single years, and distributed properly among the years of production, would have served to keep the land up to its maximum of fertility for a century, or for ever.

When advocating the more general resort to rest for the fields, I have been constantly met by the question "Will not manuring serve without, and in place of, rest to land?" Certainly it will, so far as giving nutriment to the soil and to its subsequent crops, and *so far as sufficient manuring shall be given.* But the latter condition is limited on ordinary plantations. All the ordinary resources for manure offered by the offal of market crops, and the leaves of extensive wood-land besides, with all the labor to be used in converting these materials to manure that any existing plantation force can bestow, would not serve to supply as much prepared putrescent manure as would be necessary to maintain unimpaired, and still more to increase, the productive power of the fields or plantation wholly under continued and exhausting crops. And though this might be done, under the different circumstances of extraordinary resources for manuring, and of extra labor devoted to manuring, still it would be cheaper to permit nature to aid the general operation and result, by adding something of her rich and inexhaustible supplies of manure from the atmosphere; or, in other words, to let the fields in part manure themselves.

This subject is closely connected wth that of rotation of crops, which will be now also brought into view. In general there is even less regard paid to rotation of crops than to the resting of land. The large crops of South Carolina, which occupy entire fields of upland, are only cotton and corn. Next in extent and importance, in the lower districts, are sweet potatoes and field peas, (always raised among the corn.) Except in the highest districts, the other crops, as oats, wheat, grasses, &c. are so few and small in extent as to scarcely deserve mentioning as parts of general culture, and as forming by their partial interposition any thing like a system of rotation. Whether intermediate rest be allowed to the land or not, the crop of cotton generally succeeds cotton, and corn succeeds corn—each being kept on land deemed the most suitable, as on the sea islands. Or if, as practised elsewhere in some cases, one of these two crops succeeds the other on the same field, still their tillage is so much alike, that the condition of the field is not materially changed by such change and succession of crops.

Various reasons or theories have been advanced for that necessity for rotation or change of crops, which has been established by the practical experience of all well cultivated countries, and nearly by all good practical and experienced individual cultivators. And these theories, whether fanciful and false, or however plausible, are incapable of being proved, and have by their contradictory doctrines weakened rather than sustained the general proposition of the propriety and necessity for rotation. Without asserting or opposing any of the views referred to, I will present others of more practical character, and more open to examination, which to my mind sufficiently establish the general doctrine of the necessity of rotation of crops, and also indicate the general rules which should direct the kinds of rotation to be adopted under all different conditions of agriculture.

The old and long prevalent theory was, that each particular crop requires, and more or less exhausts by its growth, its specific food in the soil; therefore, that another kind of crop can best follow, to take up also its specific and yet still remaining and abundant food. A more recent and now more prevalent theory is, that each plant rejects, and from its circulation exudes by its roots, some matters unfit for its nutriment, and which it had taken up from the soil; and that this excrementitious matter, though rejected by, and useless or injurious to, the particular crop so rejecting it, is good food for other crops or kinds of plants; and hence, by changing crops, putrescent matters which would be useless or perhaps hurtful to the previous crop, become good nutriment for other crops. Whether there is any truth in either or both of these or any other reasons heretofore given for rotation, such other reasons as I shall here offer will not be the less solid and important.

The particular condition of soil produced by the tillage or the growth of one kind of crop, is suited as a preparation for some other kind, and is as unsuited to some others. Hence, if considerations of profit direct that two certain crops shall be raised on a large scale, and the cultivation of the one serves well to prepare the land to receive the other, then it is important that they should in that order succeed each other. Thus, if corn, and oats sown broad-cast, were regularly raised, and without rest, and no other large crops, there would be great advantage found in alternating them, rather than to keep each on its own field year after year. For if alternated, the clean tillage for the corn would prepare well for the oats, which has no cleansing tillage; and the cover of vegetable matter (annual weeds and natural grass,) succeeding the oats, would, as a partial manuring, be beneficial to the succeeding corn, and would not hurt its growth by producing foulness, as the necessary tillage process of the corn would destroy and keep down the growth of all annual weeds. And these reasons for such alternation would be sufficiently cogent, even if corn would grow after corn, and oats after oats (with proper preparation,) as well as if succeeding different kinds of plants. This rotation is not by any means referred to as one approved, but merely for illustration.

Again—all crops suffer from different plagues of insects, and from diseases, which, if they could be properly investigated, would probably be found to proceed from unobserved or invisible insects. The great number or minute sizes of most of the injurious insects, make it impossible to destroy them by direct means, and thus relieve the crops suffering under their inflictions. The only effectual means is to prevent the great increase of such insects *by changing, and as completely as possible, the condition of the land from that in which they best thrive, to another altogether unsuitable to their natural habits and wants.* And such changes, so far as they can be produced by man, are best effected by such successions of crops and difference of culture and cover, as will most completely change for a time the condition as well as the products of the soil. Some kinds of insects require, from their natural habits, not only such peculiar vegetable food as is suitable for their sustenance, but also, dry air, exposure to sun, and a naked and open soil, for them to penetrate easily for their own shelter, or to bury their eggs and raise successive progenies. Such conditions are furnished by corn, cotton, and indeed every other upland culture of the lower districts, and therefore, the insects to which they are favorable must be kept alive from year to year, even if the crops be changed, and thrive

and increase whenever the crop furnishing them suitable food is on the ground, and the more so, the longer that crop may continue to be raised year after year in succession. Other tribes of distructive insects require a close soil, and the shade and shelter and moisture of a completely covering grass or other broadcast crop, as well as their suitable food to be furnished by some of the growing plants. And the continuance of such condition of things, without some intervening and violent change of crop and condition, will cause the propagation and continued existence of so many of such insects, that the next cultivated crop, in its young state, may be utterly destroyed by them. Thus, (for illustration) the clover manuring crop serves in Virginia to furnish the best possible condition to shelter and sustain myriads of the destructive cut worm ; and if the land be ploughed in early spring, and corn planted, one or several successive plantings and young growths of the corn may be destroyed by the remaining and ravenous cut-worms, before they change to another and harmless state, (that of the chrysalis,) preparatory to becoming winged, and propagating new broods for the next season, and for which they require grass land.

Yet, by merely and completely changing the condition of the soil, these insects may be rendered comparatively harmless, or be completely gotten rid of for a particular space or time. If the clover be ploughed under early in winter, and the subverted soil exposed to the winter's cold, the eggs of the cut-worm, which were deposited in the earth, will be mostly destroyed. This is an example of greatly changed condition. But a much more complete and effectual remedy is found when the clover is ploughed under in August and September, to prepare for wheat, by which a shaded and moist condition of the soil, covered completely by a green and broad-cast crop, is suddenly and completely changed to a naked surface of soil, open and loose for 6 or 8 inches deep, and dried and heated by the sun. Such a condition would prevent the parent moths of the cut-worm from choosing such an unfriendly place to deposit their eggs ; or if the eggs had been before deposited there, or the worms already hatched and eating, the great exposure and change of condition would effectually destroy them. And if any should still survive all this treatment, and also the additional exposure to the winter's cold, the crop of wheat still would not furnish the proper food for the worms, and they would therefore necessarily perish without doing more injury. And either because wheat does not offer proper sustenance to these and other insects destructive to corn, and sustained by green clover, or because all such insects have been destroyed by the previously sudden and complete change of condition of the soil, it is certain that the wheat following such process of burying clover under the subverted and bare soil, is more free from depredating insects, from disease, from weeds, and is of very far more vigorous and productive growth, than if following corn, or any grain crop, and having the cleanest and best possible preparation of tillage.

These facts, though foreign to the present agriculture of South-Carolina, will serve for the purpose of illustrating my general views of the benefits of rotation of crops. Were I as familiar with or experienced in the usual course of tillage in this State, as to its peculiar great crops, it is probable that many and as striking illustrations might be taken from the actual condition of things here. Something of this I shall proceed to add, though with more diffidence ; because never having cultivated any one crop on the

same ground in long continuation, (except cotton for a few years,) I have no personal experience thereupon, and must rely for my facts altogether on the information of others.

The *rust* of the growing cotton is one of the most general and most destructive diseases to which that crop is subject. Sundry causes are alleged for this disease, some or all of which may truly be auxiliary or even inducing causes to the main one, which (according to my general position before stated), I take to be the depredations of myriads of very minute insects, to which the green cotton plant furnishes their best if not their peculiar food. Other circumstances, of weather or soil, at different times, may serve to increase or check, or even prevent, the depredations of these insects; but the circumstances which increase their injurious effects could not operate, unless the insects were present. And it may be presumed that they would not be present, or be very few in number, if the preceding crop had not been cotton, but some other crop on which these insects could not live. In confirmation, I understand that cotton is rarely attacked by rust, when it does not immediately succeed cotton. The other diseases of this crop may be ascribed to other tribes of insects; and the means of prevention, either partial or effectual, would be also a change of the continued succession of cotton, and the intervention of a condition of the soil as unlike as possible to that under cotton culture.

Corn seems to need change of soil less than any other of the great crops; and the many cases of success with which it has been raised for many years in succession on the same fertile field, have been triumphantly adduced by the opposers of rotation, as a certain and manifest proof that a change of crop is not necessary. Even if this were true, as to this particular plant, it would not affect the general question. The hardiness and vigor of the corn plant on a fine soil may enable it to withstand the depredations of some of the several tribes of insects which it breeds and nourishes; and others (as the cut-worm, so fatal in other circumstances) may be destroyed by the continued tillage and naked and open state of the soil. But though, by such or other means, land may continue to produce corn in long succession much better than other crops so continued, still this is not even an exception to the general rule of the necessity for rotation. On the rich alluvial low grounds, subject more or less to freshes, where corn is usually the sole and annually recurring crop, it is true that heavy growths continue to be raised. But it is said, that in the most favorable seasons, there is a considerable proportion of rotton grain, even when not exposed to or injured by water. These entirely rotten ears are often among the largest, and the product of flourishing stalks; and their unsound state may not be suspected until they are stripped of the enveloping shuck. This, and perhaps other inflictions of such crops, must be caused by the ravages of corn-bred and corn-sustaining insects. Yet this kind of land is not entirely without change of condition. The rank cover of weeds and grass which follow the last tillage of the corn, serves in some measure as a green shading and manuring crop. And even the inundations from freshes, which occur every year, however injurious in other respects, produce such great change of condition, that they may destroy or remove whole tribes of insects.

A stronger confirmation of this general position in regard to corn, I have learned on information from the proprietor of a piece of land in Virginia with which I am personally acquainted. It is a large field of deep, mellow

light soil, very rich, high and level land, and so peculiarly adapted to the growth of corn, that the proprietor thought fit to keep it under that crop every year. It was so cultivated for 13 years in succession ; peas being planted with every crop, which, with such supplies as were afforded of other manure, maintained the high fertility and product of the land. But though the quantity of corn produced was not perceptibly reduced, the rotten portion, (and rotten without any apparent cause,) continued to increase, until it reached so large a proportion of the whole product, and the evil was of so regular occurence, that this peculiar mode of cultivation was from necessity abandoned, and the ordinary previous plan of rotation was resumed.

But besides this important consideration, of certain tribes of destructive insects being sustained by some certain condition, and still more by the increased continued same condition of a field, and destroyed by a thorough change of that condition, such changes are better for the more complete eradication of some of the worst weeds, and still more for the better product of the cultivated crops. Ploughing or stirring the soil, however necessary to be well done while the growth of a crop needs it, is hurtful to general production, if continued year after year, without cessation. Perhaps the growth of all crops may require intervals of rest and consolidation of the soil ; and it is certain that some crops, which prefer a soil of firm and close texture, (as clover and wheat,) cannot be as successfully raised upon soils kept long before under tillage and hoed crops.

And while for some purposes of tillage or product, there may be required a partial consolidation of soil, others may be best forwarded by very deep and thorough working. And two crops which are peculiarly favored by the climate of South Carolina, and which are among the many great blessings of this region, serve admirably for these opposite purposes. These are field peas and sweet potatoes, which crops, extended as may be their culture already, and great their products, have not yet been duly appreciated in respect to all their benefits.

The pea crop, sown broadcast, is an admirable rest or manure crop—giving shade, moisture, and consolidation to the soil—and serving, by the sudden and great change of condition from any clean tillage crop, to remove or lessen the foulness of land, both of insect and vegetable plagues. Such I have known in my own practice, to be the highly beneficial operation of this crop, even under the much less congenial climate of Virginia ; and much better must it serve in South Carolina, where not only are the climate and soil more suitable, but where the want of a crop so operating is far greater.

The length and heat of summer in this region, greatly increases the value of the pea crop. Being generally planted among the growing corn, and at a late period of its growth, the peas have enough time and sun to cover the ground well, and to mature, after the corn ceases to grow or to shade the land. This peculiar benefit of a southern climate, in regard to peas, is generally appreciated and availed of ; and in this, some approach is made to an alternation of crops. Another and greater advantage, wherever wheat or oats are sown, is that the hardy black or red pea may be sown with these crops respectively, either late in autumn, or early in spring, and will often produce a good manuring green crop after the grain crop, at no more cost than the sowing of the peas. This process is, as yet, new, and so limited in extent, as to be deemed merely an experiment, of which the result is not

fully determined. I know only of Mr. Wm. K. Davis, of Fairfield, and Maj. J. Littlejohn, of Union, who have, for several years, made the experiment, and so far successfully. And their object was not to use the secondary crop of peas, for what I deem its main value, that of being given to the field as manure.

These hardy and thick-skinned peas, if left on or covered in the ground, will not rot from all the cold and wet weather of winter. The danger to be feared and guarded against, is from the occurrence of a warm spell, which would induce sprouting, and consequently, the killing of the peas by succeeding cold weather. The peas grow so slowly at first, as not to be in the way of the covering grain crop; but start rapidly as soon as the latter has been removed. On September 1st, I saw a field of Maj. Littlejohn's, which had borne wheat this year, and was then under a second growth of black peas, too thin indeed, generally, but of well advanced growth, and which promised a valuable manuring cover to the land. No seed had been sown for this crop. It sprung entirely from the peas grown there the preceding year among corn, and which, though the vines were pulled up and the crop removed as usual, from the shelled and wasted seed left on the ground this crop was produced the succeeding year.

In the sweet potato, this country possesses a root more valuable in product than that of any root crop of more northern climates, highly and deservedly as root crops are there prized. And potato culture, so far as it extends, ought to make an important and peculiarly valuable part of a general scheme of rotation, because of the peculiar growth of the crop, and the peculiar condition in which it puts the land. The sweet potato, though reported to draw heavily upon the soil, as do all root crops, yet, as one of the broad-leaved plants, it must draw largely from the atmosphere also; and as it can be so cheaply planted (by slips) and easily tilled, perhaps this plant might even be profitably used as a manuring crop. But, even when the roots are removed for use, and (as usual) hogs turned in to eat the remnants, the deep growth of, and digging for the roots, also the thorough and deep rooting by the hogs, produce a condition of deep and perfect tillage, which is rarely attained in any other case, and might be most beneficially made the preparation for some other crop requiring very deep ploughing and tilth to prepare for its growth.

Perennial, or other permanent grasses, of which, doubtless, there may be found some peculiarly suited to this warm climate, would still more serve to give the great benefits of changed condition to the fields, independent of the much needed benefits of grass husbandry for the feeding of live-stock, and giving rest and manure to the land. The grasses whose value has been fully established by long experience in more northern countries, should be tried—not because they are from the north, (which in itself is a strong objection,) but merely because their good qualities are known, and possibly some of such grasses may as well suit a more southern clime. And such, I trust, is red clover, the best of all green and manuring crops. For although this was long held to belong to the north only, I have fully experienced that its locality and the perfection of its growth are fixed much more by peculiarity of soil than by latitude. Not more than 20 years ago it was as general a belief in lower Virginia, as now in South Carolina, that there the soil was too scanty and the sun too hot to raise red clover. But since marling and liming have made many of these soils calcareous, it is found

that neither the sandy soil nor hot and dry climate forbid the raising e xcellent and profitable crops of clover. And so hereafter it will be fou nd in South Carolina.

It may be deemed a strange omission here that I do not recommend any particular scheme of rotation. It could be only from the presumption growing out of ignorance, had I done so. Rotations ought to vary in the length of the course, and in the succession of crops, according to circumstances; and it is sufficiently difficult for a person fully experienced in the existing agriculture and general condition of any one region, to adopt there for himself and his peculiar circumstanes the most beneficial and profitable plan of rotation. And without such advantages of knowledge and experience in South Carolina, all that I can presume to do is to indicate the general objects and proper principles of rotations of crops. Every planter who may be convinced of the advantages of alternate husbandry, if keeping in view these objects and principles, may best select such plan of rotation as will suit his own circumstances.

The small use made of the plough, (indeed its total disuse in many cases,) and its substitution by the hoe and hand-labor, is, to a stranger, the most remarkable and novel feature of the agriculture of the lower districts. I will not occupy here the time and space which would be required to answer each of the many reasons which are urged by different planters in defence of this practice. If, however, these reasons or any of them be valid, then all the remainder of the world, and in all ages, have been mistaken in universally supposing the use of the plough to be one of the greatest and most labor-saving improvements of process in tillage. And without going farther for examples of approving opinion and practice in this respect, it is enough to refer to the neighboring middle and upper districts of South Carolina, where the plough is used as extensively and as profitably, to save tillage labor, as in any other country.

But while denying the force of any of the many alleged reasons given for preferring hand hoeing to ploughing, where the latter might be substituted, it is sufficiently obvious why hand labor with the hoe should originally have been cheaper and preferable to horse labor and the plough, in this and in other newly settled countries; and the continuation of the former, so long after the original condition of things has ceased, is only to be ascribed to the difficulty of changing old habits and yielding old prejudices.

In the upper hilly districts and elsewhere there might be urged one strong (perhaps the strongest) objection to ploughing, which does not exist any where in the level surface of the lower districts; that is, the inducing more of the destructive washing away of the soil on steep and broken lands. Yet, notwithstanding this very serious attendant evil, no one there would think of seeking to lessen it by abandoning the use of the plough.

The manuring operations of the planters of South Carolina have justly commanded my admiration for their extent, and for the great amount of labor regularly and generally applied to this important object; and which amount of labor is the more necessary, because of there being almost no other means of improvement used. The general system of culture gives no considerable article of offal of crops, either as food or litter for cattle. The corn-stalks are left standing in the field, and are there picked over by the cattle; which practice (under the generally existing circumstances) is better than would be taking the double trouble of bringing the stalks to the

cattle pen for food and litter, and then carrying them out again as manure. There is almost no straw, except on rice plantations, and where it is mostly thrown away. Cotton seed furnishes a very abundant and rich manure; but this is applied alone, without passing through the cattle pen. The great source and material for litter is presented in the leaves raked up in the wood-lands of the plantations. And as there is attached to most plantations (other than in the sea islands) a large extent of wood-land, the supply of this material is limited only by the labor required for its collection. The quantity made and applied annually is so great, that it is not uncommon for more than half the cotton (which occupies the larger space of culture of most plantations) to be manured every year, from this material almost entirely.

But then this vegetable material, however valuable for its large supply, is very poor in quality compared to its bulk; and it is applied under the drill, or "listed in," so as to make a small quantity go as far as possible for immediate effect, and which, therefore, is the most transient effect. This mode of application is certainly preferable for the kind of manure and its object; and still more if on naturally poor land, where all putrescent manures would last but a very short time. On Edisto island, and other sea islands, where there is the most marked attention paid to manuring, and the greatest quantities of manure are applied, wood-land is generally scarce, and of course, wood's litter. There the grass of salt marshes supplies the deficiency of litter, and the marsh mud is also applied to every acre of cotton and for every cotton crop, besides a slight dressing of animal manure given by running summer cow-pens over the same land. The labor given to these different manuring operations is great, and perhaps in some cases the cost is carried beyond the profit.

Where there is so little food for cattle furnished in the offal of crops, and none by making hay, it follows necessarily that there can be no general feeding of cattle in winter, and of course no confining them generally to the pens then to obtain their manure. In many places the cane and other wild grasses of the swamp are so abundant through winter, that cattle fare well without any other food; and of course, under such circumstances, it is the best economy for all cattle not required to furnish milk or labor, to be suffered to run at large. But even where this resource has failed, there is still no regular winter feeding in the low country; and the condition of cattle is miserable, and their products almost nothing, except in manure, for which object alone large stocks are kept. As, under the circumstances stated, not much manure can be made from cattle in winter, (the main time for the manure harvest on grain farms, and where cattle are winter-fed,) the deficiency is supplied by penning through all the summer and grass season, in standing pens and on woods' litter. This plan (of penning in summer, and especially on litter, often wet and even fermenting,) however it may add to the quantity and quality of the manure, is very injurious to the cattle; and perhaps more so than is compensated in the additional richness they thus give to the vegetable manure. Hence it is not uncommon for a stock of 100 head of cattle to yield to the proprietor in labor, milk, and butter, less than would four oxen and four milch cows well fed and provided for.

The great objection to the usual plan of manuring with woods' litter, where used in much greater quantity than required for *comfortable* littering of the animals necessarily confined, is the double handling and double haul-

ing of so bulky and so poor a material. While applauding the greatest available extent of collecting leaves, I would prefer applying them at the least cost of labor; and that would be, so far as the system of culture permitted, by bringing them directly from the woods to the field during the year preceding its cultivation. This could not be done in the usual mode of unceasing tillage. But it might be well done on land during a year of rest, even if no other than the natural growth of weeds were to have the first benefit—and still more if the leaves were laid over broad-cast manure crops of field peas, immediately after harrowing in the seed. This opinion, as applied to this particular crop, is altogether theoretical, and in advance of practice and experience. But I have had long and satisfactory experience of the superior benefit of thus applying leaves and litter just drawn from the woods, as well as all more rich or more rotten putrescent manures, as top dressing, to clover. When thus used, rather than for tillage crops, there is much less trouble in making the application at first, and also subsequently. The effect is more immediate of all the manure that is enough rotted and soluble to act at once, or as fast as it attains that condition; for the first rain carries down into the soil all the soluble parts, and the roots of the broad-cast crop, being every where dispersed, immediately take up the manure, and convert it to an increase of crop. When the coarsest unrotted compost has been so applied, within a few days after such an application, in the spring, if a rain has intervened, the first effect of the manure may be plainly seen on the young growth. The more rapid growth and increased shade of the clover, the more it shelters and keeps moist the coarse manure, hastens its rotting, and protects it from waste. All that was unrotted, and would have otherwise remained hard and inert, is thus speedily made fit for use, and then immediately becomes the nourishment of the growing plants. Thus, in a few months, without any labor or risk after the application, the woods' litter or putrescent manure is mostly converted to a greatly increased stock of manure in a growing crop, which is then given to the land, as manure, with all that remains unconsumed of the applied manure, to sustain the next year's and succeeding exhausting crops. So far as woods' litter and other manure (especially if coarse and unrotted) can be thus used as top-dressing to manuring crops, the materials used go farther and produce most benefit. And if the materials be so abundant that their application was previously limited only by the labor required to collect and prepare them in the usual mode, then the extent of application can be greatly increased, because less labor will serve for much larger operations. And though I know of this operation on a large scale only in regard to clover, there cannot be much ground for doubt as to like benefit being the result of like applications to any other green or manuring crop, sown broad-cast, or not requiring tillage, or even to natural grass and weeds serving as a rest and manuring crop.

Another excellent application of woods' litter (and more especially of such as is mostly or wholly of pine leaves,) is on wheat or oats, to be spread over the surface immediately after the seed has been harrowed in or covered. Of course, care should be taken that the dressing is not too thick to prevent the wheat coming up well. The cover protects the wheat from the severe cold of winter, and the more injurious sudden changes of temperature, as well as serving as a slight manuring to the crop, and still better to the subsequent growth. This mode of top-dressing with woods' litter, though I

have experienced on a small scale its good effects, cannot be adopted where wheat is a large culture, and its seeding alone requires all the labor that the farm can furnish for the limited seed time. But where only small crops of wheat or oats are raised, as in the middle range of districts, this practice might be adopted generally and profitably, unless it be attended with inconveniences not yet made known by experience.

Remarks on the Granitic Region, embracing nearly all the Country above the Lower Falls of the Rivers.

Though some of the foregoing remarks referred only to the lower districts, most of them apply to the State generally. The exceptions of limited or partial application were so obvious that it was unnecessary to specify them as they occurred, more particularly than was done. I shall now refer entirely to the middle and upper regions of the State, or to so much of the territory as lies above the falls of the rivers.

Nearly the whole of this large portion of South-Carolina is of granitic formation, the soils generally being composed wholly or partially of the disintegrated parts of granite; which rock is exposed, or accessible by digging, more or less, in almost every neighborhood, and on most plantations, and is found both in the soft or disintegrated and stony state. The belts of slate, steatite or soap-stone, or talcose rocks, lime-stone, &c., present but small exceptions to the general prevalence of granite rock and granitic soils. Granite proper is composed of three different minerals, the parts of each of which are mostly separate and distinct, though united in mass to form one of the hardest rocks. These three minerals are quartz, felspar and mica. The composition of quartz is nearly all of silex; and its disintegration, according to its degree, furnishes sand, gravel, or pebbles, all silicious and extremely hard. Felspar is composed principally of silex, but with enough alumine for the whole mineral to form a clay by its decomposition. Besides these two constituent parts, which form much the larger portion of felspar, it contains the very important manuring parts of about 14 per cent. of potash, 2 or 3 per cent. of lime, and about 1 per cent. of oxide of iron. The third usual ingredient of granite is mica (vulgarly called isinglass,) which like felspar is principally composed of silex and alumine, and contains also from 10 to 15 per cent. of potash, but no lime, and 5 to 22 per cent. of oxide of iron—the black mica being most abundant in the latter. The proportions of these different constituent parts of neither of the three minerals respectively, are uniformly the same, neither are the proportions of the three minerals uniform in granite. Sometimes the quartz is more than ordinarily predominant; sometimes the felspar is so; and sometimes the mica is altogether absent, and is substituted by hornblende, a very hard tough black or greenish rock, of which lime also and iron are very important constitutent parts. These and other different varieties of granite rocks, all of which approach nearly in character to granite proper, are known by different scientific names, (as gneiss, scenite, &c.,) with which it is not necessary to encumber a report that makes no pretensions to be strictly scientific in language. Therefore, omitting and disregarding the different kinds and

minor distinctions of this great class of rocks, I shall comprehend all under the general terms of granite, and granitic rocks.

From this difference of constitution, it is manifest that the soils formed by the disintegration of granitic rocks, even if remaining in their original place, and affected by no foreign admixture, would vary greatly in composition and character. They may, according to the predominance, and also to the progress of disintegration, of particular ingredients, or of the scarcity or absence of others, be either stony, sandy, or clayey—and rich when lime, potash, and iron are most plenty, or poor if these parts are nearly wanting. The oxide of iron in sufficient abundance would make a red soil, and its absence a gray soil. But still greater variations of quality have been produced by the operation of ancient floods and violent currents, which have shaped the surface into the existing hills and valleys, and also of more recent alluvion, which has intermixed in the bottoms the washings derived from numerous and remote and very different kinds of high-land earths and soils of this great granite region. The powerful floods, whatever may have been their impulse and cause, which rounded the hill tops and sloped the hill-sides, and scooped out the existing valleys and ravines, served also to stir up for many feet in depth, and remove and suspend those vast amounts of the disintegrated granite, which by subsequent deposition became separate beds of red clay, and loose gray or white sand, and which are every where found the one on the other. The causes of the superiority of certain soils may thus be inferred from the evidence offered to the eye of the observer. For example: the red soils, containing remaining masses of blackish granite, are among the best of the high-lands. The blackish color of the rock whose disintegration formed this soil, owed its tint to the intermixture of hornblende, of which the lime and the iron added still more of value to the other manuring ingredients of the felspar. Also: the "Isinglass Lands," so termed, forming parts of the alluvial lands on the rivers, owe their peculiar character and value to the potash of the finely reduced mica, which gives the peculiar appearance, and forms so large a part of the body of these soils.

These preliminary and general remarks are necessary to a proper consideration of the soils of this great region, so various in different places and some respects, and yet so much alike generally. Through nearly all the countries lying above the falls of the rivers, (with the few partial exceptions above referred to of the presence and predominance of rocks of different characters,) the lands have a general similarity, in surface, soil, and natural growth. The surface is very broken and hilly, and the bottoms or alluvial borders of streams are generally narrow, and often are merely ravines, except on the rivers or largest water courses, where there are wide bottom lands. The upland soil is mostly red, and still more the subsoil, but of open texture permeable to water, and scarcely adhesive enough to be deemed clay. Gray and even sandy soils are also seen, but more rarely. Pine, which is almost the exclusive forest growth of the lower country, as soon as the granite is reached begins to give place to oak more and more, until there is scarcely any pine seen in the original forest land. Still, however, pine is the second growth of the worn-out old fields, after their being turned out of cultivation; but the growth is sparse and mean, showing that the soil is not at all adapted to pine.

The degrees of natural productiveness of these soils are as various as their qualities in other respects. But generally the high lands are much better than those of the lower pine-covered region ; and are more of medium fertility, but little of them being either very rich, or extremely poor. The alluvial river bottoms, as all such grounds, are of high and yet various grades of fertility ; but none equal in richness to the alluvial swamp lands on the rivers in the lower country.

The almost universally hilly surface of the high lands of all the granite region, and also the slight adhesion of the parts of the soil, render the lands very liable to be washed and gullied by heavy rains. And this evil has been greatly increased in operation by the generally injudicious ploughing, the long succession of corn or of cotton and their clean tillage process, and the rare occurrence of broad-cast grain crops, and of rest to the land under grass or weeds, which latter conditions would in some measure guard against washing. Consequently, where the land has been the most extensively cleared, and longest cultivated, the destruction both of soil and of fertility has been enormous. But still it seems comparatively easy to repair this great loss. The subsoil evidently contains some fertilizing principles which are never found in that of the pine lands, and by deeper ploughing, long exposure to the atmosphere, and the aid of putrescent manures of any kind, a new soil may be created, in most places, and preserved by succeeding and proper tillage, and especially with the protection of graduated hill-side or guard-ditches to conduct off harmless the excess of rain-water. In the district of Fairfield may be seen remaining many of the worst effects of washing rains on lands peculiarly exposed both by nature and by art to their operation—and also of the renovation of lands formerly so injured ; and of high improvement of many plantations, by the use of other means of improvement and preservation of the recovered fertility.

The greater readiness of the lands, in general, of this great region to receive improvement, (without the artificial aid of calcareous manures) than belongs to the lower country and to pine lands, (as I infer, judging from my own experience in Virginia,) must be owing to the potash remaining in the soil, and still more in the subsoil, furnished by the decomposition or disintegration of the felspar and mica of the granite, added to the usually much smaller quantities of lime and oxide of iron. But when hornblende is or has been present in sufficient quantity, lime and iron have been much more abundantly furnished by its decomposition, and such soils are very superior, and of excellent quality. Hornblende contains about 11 per cent. of lime, and about 32 per cent. of iron.

The great value of potash as manure is universally admitted. But of the degree of value little is known ; because the great cost of the article as prepared by art has prevented any extensive use of it as manure, and even of enough small experiments to serve to give correct information. And when potash is furnished by nature, in the decomposition of certain rocks, as has been done to all this great region, we do not know the rate nor the precise manner of the supply—whether it be furnished as uncombined potash, or as silicate of potash, (that is, chemically combined with silex—) nor to what extent the potash is, as a soluble substance, liable to waste by rains, both from the rocks while decomposing, or afterwards from the soils and subsoils formed by such decomposition.

If we were to reason and draw inferences from the well established value

as manure and ingredients of soil both of pure potash and of the silicate of potash, and to judge of the probable manuring effects of the alkali potash by those known of the alkili lime—it would be necessary to ascribe a very high character for fertility to all soils of granitic formation. And herein is the great difficulty, that, with all their peculiar values, as already stated, the best of these soils do not come up to the standard of fertility which their original constitution would seem to indicate ; and further, the inferior and worst are naturally very poor, though not among the poorest lands. I pretend not to explain this difficulty ; but possibly some approach to explanation may be made in the following supposition : The solubility of potash may be the means of its being continually carried off by rain-water, both from decomposing granite, and from soils formed from granite ; and either washed by rain floods from the surface of the land into the streams, and thus wasted and entirely lost, or carried by soaking rains deeper and deeper, with the progress of time, into the subsoil. If the latter, then it will account for the actual fitness of the subsoil to be converted to productive soil ; and also, for the many facts which I have heard, on undoubted authority, of parts of the subsoil, both red and gray, (as well as the white formed from pure felspar,) and whether of clay or loose sand, all serving in particular cases as obviously and highly fertilizing manures. When such effects have been observed, they were most generally produced by earth taken out of wells in the course of the digging, and from considerable depths. It is scarcely necessary to add that such valuable properties of the subsoils are particular, and not general. For if general, (as mere theory and reasoning in advance of facts alone might teach) the surface of every deep washing of a steep hill-side, and indeed every deeply yawning gulley, and the earth carried from both, ought to exhibit fertility instead of barrenness, as is most usual.

The foregoing remarks, so far as they are descriptive of soils, are designed to indicate the most general characters and features of the granite region, and not the exceptions, which are both numerous and strongly marked. Such exceptions, presented in soils either much better or much worse than the general character, doubtless owe their variance to the difference of their chemical constitution. Among the soils presenting most the remarkable exceptions, and of great value, are the large bodies of lands in Abbeville, well-known for their peculiar qualities under the name of the " Flat Woods ;" those in Fairfield, bordering on " Dutchman's Creek and Wateree Creek ; and those of Chester, the last being usually comprehended under the general though not always approprite name of the " Black Jack Lands." These are extensive tracts. The Flat Woods lands are composed of two separate bodies, one of about 8,000 acres, and the other between 15 and 20,000, separated by the ferriage of Little River, and also by lands of different character, high as well as low, bordering on that stream. Dutchman's Creek is more than 15 miles long, and its lands in question lie along its whole course, widening from half a mile near its source, to three miles at its outlet. In like manner, the main stream of Wateree Creek is 20 miles in length, and the south fork about 12, and both for their whole course are widely bordered with fine land, high hill sides, as well as low or undulating valleys. In Chester, this description of land is also of considerable extent, though I have no better idea of the quality, than from my road having been fully 6 miles in crossing what is there called "Black-jack land."

These several bodies of lands, with all their considerable existing variations, have yet a general and established character of uncommon fertility, and of durability under severe and long continued culture. Their forest growth is mostly sparse, stunted and mean in appearance, so as to have produced at first a general impression that these lands were poor, and which prevented their being taken up, and brought under cultivation, until the surrounding and much worse lands had been mostly occupied. The "Flat Woods," now perhaps the most noted and valued of these lands, were depreciated the most and longest under this early and erroneous opinion; and their culture and present high appreciation are comparatively recent. Traditionary accounts, derived from respectable persons who were not long since living, state that when the country was first settled, and even as late as 60 years ago, the lands on Dutchman's Creek, and some others, were almost in the "prairie" condition, the trees being so few and dwarfish in growth. These, and the other peculiarities of these lands, which will be here presented, induced the belief to obtain, among those persons who have latterly paid some attention to the qualities of calcareous soils, as maintained in my own writings, that these soils were calcareous, (or contained lime in the form of *carbonate*), and that either lime-stone or marl probably existed beneath them. My observations will show that though these inferences were erroneous, there is yet much ground existing for those too hasty deductions, and much also to be deduced which is both true and valuable, in regard to *lime* (though not now the carbonate of lime) serving to give their peculiar character and value to these soils.

These lands have surfaces more or less undulating, and generally much more level than the surrounding and high country. They also lie much lower, though the surface in some parts rises by gentle slopes into hills of considerable elevation. Still, so marked is the general depression of surface, compared to that of the surrounding lands, that some persons have inferred that all these fine bodies of land were in some remote times the bottoms of lakes; and to such supposed covering of water, continued for many ages, they ascribed the peculiar fertility and character of these lands. But my observations have given no support to this opinion. Even if the country had been so covered by lakes (of which there is no evidence in the existing features,) the fertilizing effects must have been in that case produced by the agency of alluvian, the deposition of vegetable or other organic and sedimentary matters, or the gradual accumulation of shells, from fresh-water animals, sprinkled over the bottom. No appearance of either of such processes of nature is to be seen. The larger streams, as every where else, are indeed here bordered by soil of alluvial formation, the tribute mostly of distant lands. But it is not materially different from the alluvial deposites made in like manner on the borders of streams which pass through poorer high lands; and is, in fact, not deemed by the proprietors equal in value and fertility to the higher and adjacent lands of these bodies, which are manifestly not affected by alluvian. Indeed the narrow strips of alluvial ground in these lands, are comparatively of little value; and are not meant to be included in the range of the following remarks, unless when particularly so stated.

The soils of these rich lands vary in depth, color, and texture, and of course much also in quality. But in general they are of unusual depth, and are colored of shades varying between dark red to brownish black, and in

texture are stiff, and when wet, are adhesive, and then scarcely manageable in ditching or ploughing. The subsoil, and especially where the stunted black-jack-oak most predominated in the natural forest growth, is of a light olive-brown clay, so close in texture as to be almost impenetrable to rain, or to the roots of plants, and to agricultural implements. When wet, and generally in winter, this subsoil is almost as tough and adhesive as pitch, into which a plough or spade can scarcely be made to penetrate ever so little, and which it is as difficult to get the implement out and clear of, as into. This subsoil is usually from one to three feet thick; and its presence is the greatest obstacle to the higher production of the land. Of course, the thicker this subsoil, and the nearer it rises to the surface, the greater its injury to the land. It is in this manner, and in general, the most injurious in Chester, next on Dutchman's Creek, less so on Wateree Creek, and perhaps least in the Flat Woods lands. Still the roads of the latter, in wet winters, as of the other lands, are among the most miry and worst in the world.

Next below this close clay-subsoil, or where that does not exist, next to the surface-soil, there occur disintegrated rocks, which furnish the true sources of the lime, and of the fertility and peculiar good qualities of these lands. The rocks are granitic, and largely composed of hornblende. Indeed the ordinary appearance presented in deep cuts of the roads and washed gullies, which descend below the clay-subsoil, is a disintegrating granitic rock, often soft enough to be cut by the plough or spade, and which is formed of particles of dark blackish-green hornblende, imbedded in a matrix mostly of soft felspar. As stated above, hornblede contains some 11 per cent. of lime; and with the presence of this rock, so rich in lime, and so universally underlying these soils, and disintegrating, there can be no difficulty in determining upon one cause, and the most important cause, of fertility.

In many places of all these lands, where the decomposing rocks below the subsoil were exposed by cuts or washes, I found scattered nodules or small masses of earth or stone composed mostly of carbonate of lime, the proportions varying from 50 to 70 per cent.* Still, as before affirmed, generally these soils, and even the undecomposed rocks below, contain no *carbonate* of lime generally diffused. The existence of similar calcareous nodules has served to perplex many persons in other parts of South Carolina, as well as elsewhere. Because such masses were manifestly calcareous, effervescing strongly with the touch of acid, they have been supposed to be lime-stone, or marl, or at least indications of such formations being close at hand. But such erroneous conclusions will cease to delude inquiers, when the source and manner of formation of these nodules are properly examined and understood. The gradual disintegration of the hornblende rock exposed its reduced parts to the contact and decomposing action of air and water. The lime below the soil, before combined chemically with other earths, (and forming solid rock having no action as soil, or as manure to soil,) was separated, and dissolved by rain-water. If not previously

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* The following proportions of carbonate of lime were found in specimens of these nodules found in the several different places named:

From near Abbeville Court House,	52 1-2	per cent.
" Fairfield, E. G. Palmer's land on Dutchman's Creek,	62 1-2	" "
" " near Cedar Creek,	47	" "
" near Chesterville,	67	" "

combined with carbonic acid, the lime soon became so in this new and separated condition, by contact and combining with the carbonic acid of the air or in percolating rain-water ; and as the water, after dissolving these small quantities of newly-formed carbonate of lime, evaporated in dry weather, the lime was again deposited in such fissures of the earth as offered, and in these the nodules were gradually formed, by long-continued and often-repeated additions from the first dissolving and then evaporating water. Generally these lumps are of stony hardness, and in color, size, and figure not unlike roots of dried ginger. In some cases they are soft ; and often the calcareous earth is seen merely as a light and loose powder covering a separate fragment of hornblende rock, as removed from its bed many feet below the surface. Sometimes when the nodules are moderately hard, some remaining dark-green specks of hornblende rock are seen scattered through their generally light yellow color.

It does not always require such abundant or rich sources of lime-producing rocks to form these calcareous nodules. Much poorer granitic rocks (or perhaps others also containing a little lime,) and such as would form poor soils by their disintegration, may yet under certain circumstances have a portion of the lime in their subsoils so collected in nodules. Such a subsoil, containing calcareous nodules from 2 to 4 feet below the surface, is to be seen near the junction of Richland and Fairfield, near Cedar Creek ; and the like is found in Edgefield, and I also saw such in several places in Abbeville, beyond the limits of the Flat Woods. Under the latter and other such rich soils, these calcareous nodules are the most abundant. But at no exposure have I seen them in sufficient quantity, and in a sufficiently reduced state, to be worth removing, together with the whole matrix of other earth, for manure to other lands. Though it may be rich enough for this in some cases ; and probably is so on the alluvial borders of Little River, between the two separated and distinct bodies of Flat Woods lands. Here, the proprietor, Charles T. Haskell, Esq., first found these nodules, and several years ago sent to me a description, and since specimens, of them. A sub-stratum of earth, of about a foot in thickness, richly supplied with these calcareous nodules, is reached or cut through in the digging of every deep ditch in these lower grounds.

The main positions assumed above will be recapitulated, and presented alone, and concisely illustrated, for greater clearness :

1. Lime is contained in all granitic rocks in small quantity, and in large quantity in hornblende, and in granitic rocks composed largely of hornblende. In this state, the lime is not combined with carbonic acid, so as to form carbonate of lime, but with the other earthy and metallic ingredients of the rocks. Of course, any such rocks, even the richest in lime, (as horneblende,) will not exhibit effervescence when a strong acid is applied to it, (as many persons would infer,) because effervescence upon such application is the result of carbonic acid being present and combined with the lime, and let loose as gas, by the strong acid seizing upon and itself combining with the lime. Neither can such rocks, no matter how rich in lime, give any to adjacent soil, before disintegration and decomposition of the rock have begun, from the action of air and water. An example of the condition and inertness and worthlessness of the lime previously, when combined chemically with the other ingredients of a rock, may be offered in the "slag," which is the product of the reduction of iron ore in the furnace

with and by means of lime-stone. The slag is a true chemical combination of the *lime* (of which the carbonic acid had been before driven off by the heat of the furnace,) with the silex and perhaps other portions of the iron ore. A very large proportion of the slag is necessarily of pure lime. Yet it has been by fusion so strongly combined with other matters that it is as worthless as manure to soil as if no lime were in the compound.

2. But as disintegration and decomposition of the granite and hornblende proceed, their lime, slowly and very little at a time, is separated, and may, in part, or wholly, become the carbonate of lime, by receiving carbonic acid from rain-water (which always brings down some from the atmosphere,) and from any decomposing vegetable matter close by. The latter agency could not be exerted, unless the decomposing rock, and its lime, were in contact with or near the surface soil. And if so, in so gradual a discharge of lime, and production of its carbonate, there could never be but a small portion of the latter existing at any one time. For the acid formed by soil would be continually operating—probably full as fast as the producing agency—to convert the carbonate of lime into some other salt of lime—whether the humate of lime or some other, or others, I pretend not to determine. But it is certain, (as I have heretofore and long ago proved by reasoning, and have since confirmed by observation and experience,) that this change does not take place in all soils which have been supplied by nature or art with carbonate of lime, and with not too much of it, or more than was required for the highest fertilization of the soil.*

3. If the gradual decomposition of the rock, as above supposed, took place so far below the soil, or separated therefrom by a close barrier of subsoil, so as to be out of the reach of the roots of the plants, or nearly so, then, the carbonate of lime, as fast as produced, after being first dissolved in water, would be precipitated, in the form of calcareous nodules, and in the manner already described; and the presence of which nodules, therefore, would not indicate carbonate of lime either in the soil, (or that it was a calcareous soil,) or in the undecomposed rocks, and still less the vicinity of either lime-stone proper, or marl, as their source, or their necessary accompaniment.

But besides the lime derived from the decomposing hornblende, the valuable soils under consideration have another source of peculiar and probably useful constitution in the presence of magnesia. There is much soap-stone or steatite, and other talcose rock, in parts of these lands—especially in the most low-lying of the Flat Woods and part of the Dutchman's Creek land. These rocks, and all the varieties of talcose rocks, contain a large proportion of magnesia—amounting in steatite or soap-stone to 24 per cent. The soil is in some low places of the Flat Woods so generally composed of this green-colored stone, disintegrated, but as yet unmixed, that the soil, when recently turned up by the plough, has a decidedly green tint, appearing, when seen at some distance, as if young grass had just begun to spring every where, and to tinge the surface. Such spots are always found more or less unproductive, compared to the other parts of the same land.

I am aware that all high authority and general opinion are opposed to my opinion indicated above, that magnesia is a fertilizing ingredient of soil, or a valuable manure. It has generally been supposed by writers to

* See my views of acid and neutral soils, on which the above are founded, stated and argued at length in the "Essay on Calcareous Manures."

be injurious when applied as manure (as in magnesian lime-stone,) even in small quantities—and that natural magnesian soils were the less fertile because of containing that ingredient, and in some cases (in France) were made thereby barren.* But though having heretofore had no sufficient proofs in magnesian soils, and no means for testing the effects of magnesia by actual experimental use as manure, I have long believed and have previously maintained, that, from the close resemblance of the chemical qualities of lime and magnesia, the effects of the latter in soils must be very like to those of the former; and therefore are beneficial, though probably much less so in degree; and perhaps also magnesia in excess may be more injurious than lime in excess. If I am correct in supposing the Flat Woods lands of the lower levels to be magnesian soils, they are the first of that known character ever presented to my observation; and their peculiar and valuable qualities sustain my previously expressed and merely theoretical opinion of the value of magnesia in soils.

There perhaps will be found a more popular and potent objection to my view of magnesia being of any value in soils, because soap-stone (which is here its scource,) is often found in or under lands in this region, and no such fertilizing effects have been observed, or ascribed to its presence, by those who have known its existence. Perhaps such stone is too hard to disintegrate, and therefore is of no effect. However, my own opportunities for personal observation have been too few to be worth any thing; and, therefore, I will for the present leave this part of the subject for the more full observation and investigation of others.

The well and spring waters of these lands are generally contaminated by lime so as to be offensive. This is especially the case of the black-jack lands in Chester. These lands are now the worst in quality of all these four localities; yet they formerly brought excellent wheat crops, and red clover is sometimes raised now, in the very few attempts made of its culture, notwithstanding the great exhaustion of the land. The impenetrable subsoil approaches nearest the surface in the Chester lands, which is enough to make the land the least productive, and also to cause injudicious tillage (in wet seasons) to be the most injurious. Besides, in showing a fitness for wheat and clover production, these and other lands furnish other indications, by which might be safely inferred their containing lime in considerable quantities, even if their manner and sources of formation did not prove the fact. One of these is the rapidity of the rotting of the leaves in the woods, as occurs on lime-stone soils, and which is altogther different on acid soils.

But it is unnecessary to describe the particular qualities of these lands at more length. I will now endeavor to account for their general marked difference from the other granitic soils, and the manner in which they have been so much more richly supplied with lime.

It has been already stated that each of these great bodies of land under consideration is much lower in surface than the surrounding country, of the ordinary granitic region, however irregular, and in some cases elevated and hilly, their surface. The land on Dutchman's Creek, which presents the strongest contrast in this respect, at Mr. Edward G. Palmer's plantation,

* See an article by Puvis, on magnesian soils—Farmer's Register.

is 130 feet lower than the close adjacent land. This lower surface may be supposed to have been produced, by denudation; that is, the washing out of the land, from a height previously equal to the surrounding country, down into the softer and more yielding rocks, as low or lower than the present depth. By this means, the soil and earths, before or otherwise similar to what exists generally elsewhere in the granite region, were swept off to a great depth, and a new surface exposed in the hornblende and talcose rocks, that is, the lime and magnesia producing rocks, lying at the lower levels. Some subsequent flood, loaded with fine close clay, on becoming tranquil, let fall the suspended clay, which formed a thick, impervious and general covering of the before denuded rock, and which cover of clay is the present close sub-soil. But this clay, adverse as it is to production, as subsoil, had been furnished from its original sources with enough lime to render it, as is known to be the fact, convertible to fertile soil, by being turned up by the plough and exposed to the air. Of course, when reaching to the surface, and operated on by the atmosphere and by the growth of plants, added to its own fertilizing principles of natural constitution (and that doubtless depended principally on lime contained,) it is plain enough, how under such circumstances, a fertile soil should be gradually formed by the growth and decay and admixture of vegetable matter. In the mean time, the decomposition of the hornblende rock below would be continually proceeding, and more lime would be thus furnished to such extent as the roots of plants could draw it up through the close barrier of clay. Such circumstances could scarcely fail to produce the effects and peculiarities of soil now existing.

But as certainly and highly valuable as those lands are under culture, it may seem strange that lands so abundantly supplied with lime should not be still more productive—as much so, indeed, as the best lime-stone lands of the Western States. And so I presume these lands would have been, but for the different manner in which the lime was given to this land by the decomposition of the rocks. This was not on the surface of the earth, but at the depth of several feet below the surface, and usually below the intervening and almost impenetrable barrier of tough clay. So completely enclosed and locked up as is the lime below, and so nearly secured from the access of rain water, and the roots of plants, it can do comparatively but little good to the soil above, and must have less effect than a twentieth part of the quantity if applied to the surface soil. Besides being thus locked up, the lime-producing rocks below are but in the course of disintegration, of which the progress is very irregular in different spots, and which may not be ended, even within three feet of the surface, for centuries to come. And not until the rock is decomposed, or only to such extent as its decomposition has proceeded, can its lime and other fertilizing products of decomposition have any effect as manures.

It is not unlikely that many other tracts of rich land in the granite region, may derive their fertility and value from the same causes as have been described of these four noted and large bodies, and agree with them in character. For this reason, I trust that these remarks may be found useful far beyond the limits of these examples, and of all my own personal examinations.

There is one more suggestion to offer in regard to the *neutral* character of the granite soils in general. Whether relying upon the undoubted testi-

mony of mineralogists and chemists for the sources of alkaline constitution of granitic soils, or upon the lime constituent part of hornblende soils, or on the general absence of pines in this region, it will appear, from either kind of proof, that such soils cannct be generally *acid*. And if they are not injured by the presence of that poisonous quality which belongs to and greatly injures almost all naturally poor soils below the falls of the rivers, then lime, if applied, however advantageous in all other respects, would not show that earliest and most obvious benefit which is produced by the immediate neutralization and destruction of this poisonous quality of soil.* Still, the other slower and yet more valuable operations of lime would be sufficiently powerful here, (unless where there is enough already,) so that the application need not be omitted because of there being no acid principle to correct. On the other hand, the absence of acid, (according to my views,) offers a very great benefit, not to be had on any acid soils, in the use of gypsum.† And this suggestion is not merely the offspring of my theoretical views and reasoning on the constitution of granitic soils, but is strengthened by facts which I shall here refer to generally as proofs. In Virginia the region of hilly red lands extending from above the falls of the rivers to near the mountains, has a strong general resemblance to those of South Carolina within the like limits. The pine bearing regions of both these countries, lying below the falls of the rivers, have also great general resemblance in regard to soil, notwithstanding marked points of difference. Now in Virginia, on the red hilly lands of the middle region just referred to, gypsum has been found to be very beneficial, generally if not universally, wherever applied to lands of good natural quality. As to the poor lands, the testimony is conflicting, or perhaps the results are very different on different lands. And in the very few cases of lime applied in this region, the effects have been either slight or not visible on the first crop. On the other hand, on the naturally poor and pine producing soils, which form the great body of the land of lower Virginia, I never knew lime to fail of producing both good and early effect—nor of gypsum, (if applied before liming or marling,) on such soil, to produce any remunerating effect, early or late, and scarcely ever enough to be distinguishable even for the most transient operation.

If gypsum be indeed suitable to much, or even but to the best grade of the granite lands of South Carolina, the fact is of great value. So small a quantity of this mineral serves to manure (usually a bushel to the acre is given,) and it produces, when suitable to the soil, such wonderful increase on clover, that the effects will not readily be given credence to by those who have not had occular evidence. Every farmer in this region, desirous to improve his lands, ought to hasten to make small and cheap experiments with this manure; which is universally available, because of the small quantity required, and its consequent low cost of transportation.

As has already been mentioned incidentally, the peculiar characters of the soil and the surface of the middle and upper districts of South Carolina, and the manner of cultivation, have caused great damage to the lands by the washing operation of heavy rains. This evil, great as it is to agriculture, is not confined to it, but has, perhaps, been even still more injurious to health.

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* See, for full views of acid in soil, Essay on Calcareous Manures, chap. vii. of part I, 3d Ed. † Same, pp. 95–98.

It is understood that the lands of the middle region, as, for example, of the districts of Abbeville, Newberry, Union, Chester, and York, were formerly healthy, and since have gradually become more and more and greatly affected by malarious diseases in summer and autumn. This change has taken place within the memory of many persons now living, and testifying to the fact. The unhealthiness of the upper country is said to have commenced and become extensive and severe in the districts or neighborhoods where the clearing of the lands and their cultivation has been most extensive. And hence, many persons have inferred that the clearing of the country, of itself, has served to produce disease. Others ascribe the effect to the production of cotton, which crop covers nearly one half of all the cultivated lands in the most sickly parts of the middle country. But I infer, from all the information of facts acquired from others, that it is neither the clearing of the land, nor its cultivation in cotton, which has produced this result—but that the effects of both, in washing the high-land soil into the bottoms and choaking the streams, have *mainly* served to nourish malaria and increase the malignity of disease.

The range of districts just named, with other lands adjoining next below, would appear to have been blessed by nature with every requisite for health. With few and small exceptions, the country is elevated and hilly, the bottoms generally narrow, and the streams every where rapid in their courses. There were few swampy or wet flats; and the highland soils, both by their permeable texture in general, and broken surface, permitted no rain water to stagnate on or near the surface of the ground. And the country was, at first, as its features indicated, nearly free from malaria and all its noxious effects. But as soon as the incessant and injudicious use of the plough caused the soil to be washed from the hilly grounds into the bottoms, the before unobstructed clean-bordered channels of all the small streams were filled and clogged with earth and vegetable rubbish, and finer matter, and the adjacent low grounds thereby rendered swampy. The washing of the highland earth into the valleys, so altered the original surface level, as to kill the trees; and their decay, and later, the obstructions by their fallen trunks, increased the general evil. These operations would continue, and the evil effects necessarily became worse and worse every year, so long as the bottoms and their streams were left uncleared and undrained.

At a much later time, when the good uplands had been mostly cleared and exhausted, some of the proprietors began to drain and clear the narrow bottoms which their previous practice had changed to swamps. It may be supposed that this operation, when effectually performed, will counteract in a great measure the previous disease-producing practices. And that supposition, as well as my whole view of this matter, seems to be sustained by the facts of the case.

The commencement and progress and subsequent greatest virulence of the diseases of this great region, proceeded gradually from the lower border towards the highest districts, which latter have not yet been much afflicted. And after long and much suffering from the annual visitations of disease, a general mitigation, or a return to a comparative degree of healthiness, commenced also below, and has continued, and seems to be proceeding, up the country—but still far in the rear of the most advanced and still advancing invasions of malaria; which latterly have made fatal ravages in neighborhoods so elevated that they had previously been deemed perfectly secure. Nor

will the progress of the desolating invader be stayed, I fear, until it has swept over the highest, and as yet, the almost perfectly healthy districts.

Now, if I have been correctly informed as to these effects, they suit exactly with my supposition of the manner of their production, and also subsequent partial remedy. The practices of more cautious use of the plough, and general and effectual drainage, are gradually making progress in those lands, and as yet, on those only, where the opposite and disease-producing practices had done their worst. And probably, no community will learn to profit by these good and profitable practices, until after having first suffered all the evils from their neglect. But with the progress of such improvements, there has been already a marked diminution of autumnal diseases, in the districts where the facts are most numerous, and therefore may be best observed. Of these, Fairfield, perhaps, offers the best evidence, in its former state of tillage and health, compared to the present improved condition of both.

There has prevailed another practice by which a bad state of agriculture has given additional power and virulence to malaria. In the upper districts, when new clearings of forest lands were made along the borders of the smaller rivers and large creeks (as they are called,) not opened for navigation, it has been, and still is, the usage to throw as many trees as could be conveniently done into the water, as the easiest mode to get rid of them. The freshets afterwards would drive these trees, and all the rubbish which they would stop, into certain parts of the stream, and much of the great mass might be submerged in deep places, and kept covered under the ordinary height of water. But almost none of the trees, or their boughs, were floated entirely out of the rivers. The consequences were the greatly obstructing the current, and raising what would have been otherwise the usual height of the water, and much more the height of freshets; the inundating more often and more injuriously the low lands which could be cultivated, and the rendering hopeless the cultivation of much more not before cleared, and which otherwise might have been valuable and safe, as well as highly productive lands. And worse than all other effects, the greater rise and spread and frequency of inundations, and the subsequent drying of the flooded grounds, and the exposure in great droughts of the rafts of sunken and rotting trees and all their rubbish, together served as most productive sources of malaria. The latter effect has already been experienced most disastrously, in seasons of unusual drought and low waters, as high up as the southern part of Pickens District, where generally, and in most years as yet, the air is as pure and the region as healthy as would be inferred from the neighborhood and full view of the Blue Ridge mountains.

Doubtless, there are other and potent sources of malaria, besides those produced by improper cultivation—as mill-ponds, and the greater spread and more deadly operation of their miasma, permitted by the cutting down the forests which before served as a partial defence. But the consideration of these causes would be out of place in this report; and they are only thus referred to, lest if passed over, it might be inferred that their injurious influence on health was not deemed certain, and most important in results.

The more judicious use of the plough, and the introduction of guard ditches on hill sides, have both served greatly to check the previous progress of the washing away of the soil. But still there remains in operation one of the surest causes of washing, in the almost perpetual recurrence of ploughed

crops, either corn or cotton, by the clean tillage of which the land is kept always in the condition the best adapted to its being washed off by rains. The means for prevention will not be complete without the introduction of proper rotation of crops, by which rest to the land, under weeds or grass, or broad-cast crops of small grain and of peas, which bind and guard the surface soil, are alternated in proper and profitable manner with the tillage crops of corn and cotton, which latter are now cultivated almost exclusively and continually on the greater part of the arable land.

REPORT

ON THE RICE CULTURE OF A PART

OF

GEORGETOWN DISTRICT.

General Description of the Tide Swamps in their Natural State.

The great body of alluvial swamp lands on the Waccamaw and Peedee rivers, and subject to their tides, are of similar general character to all other swamps formed by the alluvium of fresh tide waters. In South Carolina, and generally elsewhere, the soil being wholly formed by matter deposited by the rivers and by the remains of plants which died and rotted where they grew, these lands are necessarily composed very largely of vegetable matter, mostly decomposed; and so far as that composition may serve, they were as rich as lands could be, and of an unknown depth of soil. Their earthy parts are mostly of fine clay, such as could remain long suspended in water, and which has been mostly brought by the long course and turbid current of the Peedee. Of course, rivers flowing through calcareous regions, and washing down fertile and well constituted soils, must have also brought down much calcareous matter intermixed with the clayey, and serving to fix and retain the great and enduring fertility which these lands have exhibited under the long continued and increasing drafts made by incessant rice culture. Still there cannot be near enough of lime in these soils; and there is a still greater deficiency of the ingredient of silicious sand necessary for a properly constituted soil of the best productive power.

The rise and level of the tides have necessarily fixed the final elevation and grade of surface of all such lands. The earthy matters brought down the river by its floods would continue to be deposited on the marshes, and wherever else the water was most tranquil, until such deposited earth reached to the level of the height of tide water. The lower the surface was at any previous time before this height, the more water, loaded with materials for alluvium, would be over it, and the more it would receive of the tribute. And when by such additions, the surface had risen to the full height of ordinary high tide, it would no more be covered, except on rare occasions, and of course its increase would almost cease. Thus, there was for ages a constant tendency of the waters to raise all the lower parts the fastest, and to make the lower equal in height to the highest. And when this was done as nearly as might be over any certain extent, the operation ceased there, and was continued lower down towards the sea.

Thus, the alluvial lands formed by the deposites of tide rivers necessarily have surfaces very nearly level. The only general and slight exceptions are seen in the channels of small creeks or "slues" as they are called, which are needed to give discharge to the retreating waters, the rapidity of the motion of which serves to keep such passages open and deeper; and also

that the land next the river side is generally higher than that farthest off, and next to the high lands. The cause of the latter effect is also obvious in this, that the water first leaving the more rapid course of the river, and spreading over the swamp, must necessarily deposite most of its suspended earthy matter first, and carries only the lighter portions to the more remote ground. However, the slope thus made is so gradual, that the difference of elevation is very slight between parts of the same swamp. This general evenness of surface is in a remarkable degree favourable to rice culture, which requires overflowing the crop at a depth as nearly equal as possible.

The trees forming the natural growth and dense cover of such lands are of great size and vigor—principally of tupelo gum, ash and cypress. The undergrowth of cane, and numerous perennial or annual vines and water grasses, serving in summer to make a dense thicket. The earth, always saturated with water, is rendered firm only by its close and deep mat of roots of every description, and but for this, would be a quagmire in its natural state, and the more so in proportion to the excess of decomposed vegetable matter in the marshy soil. Also, according to the large quantity and excess of vegetable matter, will be the subsequent sinking of the land, after draining and cultivation. The excess of vegetable matter in any soil, over and above all that is chemically combined with the soil, is liable to rot and waste away. And such must be the case, sooner or later, on all tide marshes, the drying and cultivation of which produces the commencement of rotting, which the before continual wet state of the earth prevented.

All the tide swamps are not capable of being profitably subjected to rice culture. There must be a sufficient "pitch of tide," or ordinary variation between the levels of high and low tides, to enable the lands to be, at any desired time, either quickly flooded, or as quickly to have the overflowing water discharged. The latter object is opposed more and more by the freshets the higher the rivers are ascended, so that the upper tide lands are from this cause too precarious for rice culture. Again, salt or even brackish water is fatal to rice; and therefore the usually fresh water tide-lands near the sea are as much in danger of "salts;" that is, of the water, when needed for flowing the crop, being contaminated by salt, owing to a dry season and a scant supply of river water from above. Thus, omitting the upper tide lands, too much endangered by the river being swollen by rains, and the lower lands, too much endangered by salt tides in dry seasons, there remains on all the rivers but an intermediate body of tide lands fit and safe for rice culture.

The General mode of Embanking, Draining and Clearing Tide-Swamps for Rice Culture.*

When a body of new tide-swamp on the Waccamaw or Pee Dee was to

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* For the substance and for all that may be of any value in the following statement and description of Rice culture and management, I am indebted to verbal information, which I derived in conversation with practical and judicious Rice Planters, and principally from Dr. Edward Heriot and John H. Allston, Esq., in regard to the subject in general, and as to the more usual modes of culture and management of Rice; and to Messrs. Stephen Ford and S. C. Ford in regard to "Leggett's" and the "All-Water" plans of flooding and cultivation, as practised on Black River.

be brought under Rice culture, the first process has been to cut down and clear off all the trees and under-growth of bushes, cane (or reeds,) &c., along the course designed for the outer embankment, for the width of about 50 yards, or such distance as would prevent the subsequent cutting down of the remaining large trees injuring the works. In making this clearing, care is taken to leave untouched a margin next to the river-side; which ought to be, but rarely has been, as wide as from 50 to 80 feet, varying according to the irregularity of the water-line. The trees, &c., cut from the cleared space, are moved inward among the standing trees, or far enough to be out of the way both of the outer embankment, and the main ditch within and next to it. The site of the outer embankment is then determined precisely; and along the centre of its intended base there is dug a ditch 3 feet deep, 3 feet wide at top, and as much or nearly so at bottom. This digging is for two purposes: first, and principally, to remove all stumps and roots of trees from below the bottom of the future outer embankment, which, if left, would, in subsequent time, by their rotting, cause leaks to be produced; secondly, the earth dug out of this central ditch is laid regularly and closely just outside of its edge, and forms a bank sufficient to exclude the ordinary high tides from covering the land, and troubling materially the main operations which are to follow, for thoroughly embanking and clearing the land. Through this first low-bank, at a suitable out-let, there is put in one of the ordinary tide-trunks, such as will serve afterwards for one in the finished embankment, and which will serve sufficiently to exclude the high-tides, and at low-tide to discharge any accumulation of water in the area, from rains, springs, or leakage of the low-bank.

When carrying around this first ditch and slight embankment, all the low places which serve as out-lets of small creeks or "slues" are omitted at first. When all the other parts are finished, these lower parts are undertaken, for which a different and more laborious procedure is necessary. For the length across each such slue, two parellel lines of strong stakes or piles are driven perpendicularly and deeply into the mud, and the lines wider out from the designed large embankment than its two base lines. "String-pieces," or long horizontal timbers, are placed outside of and against these upright stakes, 2 to 3 feet lower than the designed height of the bank; and these string-pieces kept in place, and made to brace and support the lines of stakes, by upright and much stronger and longer piles driven at intervals of 4 or 5 feet outside of the string-pieces, and opposite to each other across the intended embankment; and, as high as its top is to be raised, cap or cross pieces, made of round cypress poles 6 or 8 inches through, extend from each of these piles to its opposite pile, securing them in place, and the whole structure together, by mortises in the cap-pieces held by tenons on the posts. The embankment is then made within this frame-work, fully as high as the general level of the small bank, if it be not convenient then to complete the full intended size at once at these low places.

The central ditch being completed, with its bank and the trunk fixed, (its bottom, as in all cases, being even with lowest tide,) the inner and outer lines of the base of the outside embankment are staked off—which is usually not more than 12 feet wide (and sometimes less,) for a designed height of 5 feet. It ought to be 15 feet, or thrice as much as the height, at least. Within the inside base line of the embankment, stake off another line paral-

lel to it, and 15 feet distant, if the soil be stiff, or 20 feet if light and porous, which space is for the *inner margin.* This width is for the river-side, or exposed parts of the embankment. If along narrow creeks, or cross-banks, the inner margin need not be more than 10 to 15 feet. Along the inside of this margin is laid off the main-ditch, 8 feet wide, and 5 deep, with sides nearly perpendicular.* Out of this ditch all stumps, roots and buried bodies of trees should be entirely removed. But this is not often faithfully done; nor is the ditch always dug 5 feet deep. The earth dug out should be thrown by the ditchers as far as they can towards the site for the embankment. Afterwards, when it has stood long enough to be in good condition, or is neither too wet nor too dry, this earth is thrown by women and other inferior hands to first fill the central ditch, and then to build up the embankment; keeping the earth nearly within the limits of the base. After standing long enough to be somewhat consolidated, the sides of the bank are trimmed to their proper slope, making the embankment 5 feet high, generally, 3 feet wide at top, and as before stated 12 feet (or more) at bottom. The rise of ordinary tide is 4 to 5 feet†—spring tides, 12 to 15 inches more. The general level of higher land at first usually above common high tide. If the main parallel ditch does not furnish earth enough to make the bank every where, the deficiencies are supplied by digging earth where it can be best spared from the wide outside margin; but care should be taken, if this course can be ever justifiable, at least not to dig any thing nearer than 15 feet from the outside base line of the embankment. Unfortunately this care has been in general practice but little regarded. Generally, too little margin was left at first; and nearly all which was left at first has been since cut away to heighten the embankment, so as to leave it exposed to the winds and waves, and requiring enormous annual labor and expense to oppose the destructive action of storms upon the embankment.

In beginning to bring in any one body of marsh, no matter how large, it is sometimes better to carry the first operations, already described, around the whole, (except the land side, of course,) although the subsequent entire clearing of the forest may require a long time for completion. Of so much of the land as is designed to be cultivated the first year, after the above described operations, all the cane, bushes, and smallest trees are cut down, then the smaller size only of larger trees, which are lopped, and the bodies cut into lengths of 12 or 15 feet, leaving from 5 to 7 of the largest trees standing in each half acre. At a dry time the next spring, and with a good wind, fire is put to the windward-side. The effect is according to circumstances; but it is deemed "a good burn" if all is consumed except the logs. If there is much cane, it serves so well as fuel, that the fire is much more effectual. In other cases, much less. The remaining logs are heaped and burnt when convenient; but by some persons often left scattered on the ground for years. The large trees left standing are afterwards killed by belting, or taken out for timber as needed for use.

The land cleared should be divided into fields of convenient shape and size, and each one be separated from the next by cross embankments, and

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* This is wrong. A wider ditch, with well-sloped sides, would stand much better, and need less clearing out and subsequent repair.

† The greatest rise of tide low down the river—the least highest up—and in proportion between the extremes.

surrounded, except on the sides where joining the high-land, by large ditches parallel to the cross embankment. These embankments being only to keep out of one field the water admitted into another, need not be more than 7 or 8 feet wide at base, and 3 feet high—or 2 feet less high than the outer or main embankment. If however they could be as large, it would be better; as then a breach in and overflow of the outer embankment might be kept from overflowing all but the first field. The ditches furnishing earth to make them, need not be more than sufficient for that purpose, or 5 feet wide and 4 to 5 deep. The margin between the bank and the ditches is 10 to 15 feet wide. Each field thus separately embanked and ditched, should discharge and receive its water by a separate trunk connecting with the river or creek. Or if it be a back field not joining such natural outlet, then into a canal confined within two banks, and discharging through a trunk into the river. However, when such a canal is needed (as is usual) for navigation to the barns, &c., as on many plantations, then it is dug 15 feet or more, with margins say 10 feet wide, and in time becomes sometimes 20 to 25 feet, by its sides falling in, and successive clearings. There is no trunk in such case, to exclude the tide; and therefore the two banks on the sides must be high and strong enough for that purpose. Sometimes, however, the navigable canal, instead of being always open to the river, is separated from it at its out-let by a flood-gate, wide enough to pass the largest flats used in transporting the crops. This is the better plan, where the canal is long, as it protects the banks on each side of it.

In laying off the land into separately embanked divisions, or fields, regard ought especially to be had to having the surface of each one as nearly equal in level as possible, so that it may be flowed and drained equally. This consideration should have most influence in shaping the fields. As to the proper size, if the level be alike, that depends much on the amount of working force; as no one separately embanked division ought to be larger than the hands can finish any one operation upon in one day. Twenty acres make a very good quantity for the size of trunk used.

The tide-trunks used are well-planned and constructed for this purpose. The trunk is 4 feet wide by 2 deep. Both ends are cut slopeing, so that the bottom of the opening extends 1 inch further out than the top. The valve or door to close the end, hangs from upright arms rising 10 or 12 feet from the bottom, by long mortises in the arms, or hinges far above the trunk, and closes it by the mere pressure of the water, when higher that side of the bank than on the other. The other end of the trunk has a like valve. But a great improvement in the trunk, which has not been very long introduced here from Savannah, is to have each gate to be raised by sliding upward, (as a flood-gate does,) as well as to swing open by pressure of water from the opposite end. Thus, a valve can be hoisted by sliding up, by use of a lever, when the tide is pressing the valve to the aperture; whereas were it merely to open by its hinges, it could not be done until after the fall of the tide on that side, or higher rise of the water on the opposite side. This simple improvement is of great convenience and utility.

When thus embarked, wide ditched, and as yet but very imperfectly cleared, the land is put the next season under rice culture. The then still remaining higher level of the surface, and the open, loose, and permeable texture of the soil, filled as it is with roots and other undecomposed vegetable matter, make this slight drainage sufficient at first, and perhaps for some

years after. As the surface subsequently becomes lower, and more compact, by decomposition, settling, and tillage, more close and perfect drainage will be needed. And the natural drains furnished by the former beds of crooked creeks and small "leads" are deepened, and side, or "spring" ditches will then be required, and should be cut 3 or 4 feet wide, along the foot of all the high lands, whence springs ooze out. Afterwards, when further drainage is found wanting, straight drains are cut in each field, 20 to 24 inches wide and 3 feet deep, parallel to the longest straight side of each field, and to each other, discharging at each end into main ditches, and either 300 or 150 feet apart, according to the wants of the land. After another or more crops, the intervals left between these narrow drains are split in two by other similar drains; and again, when needed, others made in like manner to subdivide the land, until these parallel drains are at every 75 feet apart, as is usual lower down Waccamaw Island, where the freshets have less effect to flood and low tides more effect to drain, or at 37 1–2 feet, as usual higher up the rivers. The working acre is not the same size, of 4,840 square yards; but, as marked and estimated in all culture in lower South-Carolina is a space of 300 feet by 150, or 5,000 square yards. And thence, the drainage at 75 yards is technically called "Quarter draining," and that at 37 1–2 yards as "Half-quarter draining." When the drains are very long, it is usually best to intersect them at right-angles, by cross-drains, at distances of 3 and 4 half acres apart. With making all these, the general and usual plan of draining is complete; and thereafter, the planter has but to preserve and keep in perfectly good condition for operation, his embankments, ditches, and flood-gates, or tide-trunks. And to do this requires continued care, and annual and great labor, which are increased greatly according to the amount of omissions or defects of the early construction of the embankment, or retaining of sufficient out-side margin. Regularly every winter as or early as may be in spring, all the drains are cleared out, and such of the main ditches as require it; and the mud from the latter used to partially repair the waste of the adjacent banks. The further waste and defects of the banks, made necessarily by decomposition of the vegetable portion of the earth itself, or by its being washed away by the waves of the river, or of the "flows" dashed against the banks, are repaired by earth from the most convenient places—and generally (and destructively for the future,) by cutting away the out-side margin, until none is left, and the whole force of the breaking waves is thus allowed to be spent upon the embankment on the river-side. The consequences of this very general error will be again brought into view.

When a considerable leak has been made through, the bank is cut through at that place down to the leak, and the passage carefully stopped. When an old bank has by neglect become generally leaky, or admitting oozing water, it is "split" or "centre-ditched." A narrow ditch is dug lengthwise along its middle, and down below the leaks, and the opened space is then filled up by "slush," or the soft mud obtained by clearing out the ditches. A better filling material for such a central ditch is used by some persons in the purest sand they can obtain. This prevents the burrowing of snakes, craw-fish, and other small animals, which often make leaks.

Culture of Rice.

Rice is an aquatic plant, and naturally, it may be inferred, its growth was on lands always under water, or saturated with it whenever not altogether covered. And under culture, and even when in other than in its native region, doubtless rice would prefer the continuance of water. But other needs than the mere supply of food for the plants have to be provided for, which require a dry condition of the soil, at some periods. And fortunately, rice is so hardy that it will grow either under water or on dry land, and with violent alternations of these opposite conditions. It is necessary that the land should be dry to prepare for and plant the crop—also for the purpose of removing weeds, which being native to the soil and climate, are therefore more hardy than the cultivated crop—and again to reap and remove the matured crop. But it would seem to be the general principle of the culture, that the growing rice should be kept covered with water as much as is consistent with effecting the foregoing objects; and with another important exception, to indulging its aquatic nature and preference, which exception is, to avoid too sudden and thorough changes from the wet to the dry condition, or rather from the effects of those conditions.

Preparation of Land and Ploughing.

The flooding and drying of the rice land, when new, is conducted much in the same manner as in after time; but the preparation for, and tillage must vary, according to the state of the land and its wants, while the stumps, roots, and other superabundant and fine vegetable matters are gradually rotting away, and the soil consolidating and becoming lower and closer. Passing over the less regular operations of earlier years, let us suppose the latter condition reached; and the proper and usual course of culture, suitable to this permanent condition, will be now stated.

We suppose the field to have been in rice the preceding year, and it is never otherwise on new and good land, and very rarely on any,—if the land be still new, or the soil loose enough, and sometimes also on old land, many persons, just before planting time, open new trenches for planting between the rows of the last year, the stubble having been burned off previously. But usually, and especially on old land, the whole surface is broken up flush, either by the hoe or the plough. The plough is far from being in general use; nor indeed is it admissible except on well drained land, and also firm land, such as the Peedee swamps. Even in these cases, some object to its being used every spring, but prefer it in every other spring, alternating with breaking by hoeing. This is because fearing to make the subsoil too close by pressure. The breaking, whether by hoe or plough, rarely exceeds 3 inches deep; the deepest hoeing, done by sinking in the ordinary hoes "up to the eye," cannot be more than 4 inches, owing to the oblique direction of the cut. It is aimed to subvert the earth by the hoe; but this is always but imperfectly done, as is shown in the first flow by the quantity of floating stubble and roots, which had been left on the surface. I should have stated that the stubble of the preceding crop is most generally burnt off before the breaking up of the ground, or otherwise

is turned in by the plough or hoe. If the birds had not been early enough in coming, and numerous enough to eat up all the shattered grains of the last year's crop of rice, the turning the stubble in, by planting all remaining grains, tends to increase the growth of volunteer rice—which evil, in such case, the other plan of burning to stubble would lessen.

After the land is dug up, the next process is to "slush" or clean out all the drains. When planting time draws near, part of the land, say about one third, is "mashed," that is, the clods chopped and the surface levelled by hoes. This is sometimes expedited by previous harrowing, but it is not a general practice. The balance of the land is mashed as wanted for planting, and just before the planting.

The time to begin planting is from March 20th to April 1st. For this, the land, having been prepared and made fine enough by the "mashing" process, just before, the rows are marked off, 13 inches apart, as follows: having determined on the direction of the rows, which is sometimes with the drains, but by most good planters is preferred across the direction of the drains, a number of rows, say 30 or more, are laid off 4 feet 4 inches apart, by 3 stakes stuck up in each row, the end stakes or "trenching stakes" not reaching near to the extremity of the field designed to be planted at one time. Guided by these stakes, expert hands "trench" rows with trenching hoes, about 2 inches deep. These hoes are narrowod to 3 or 4 inches at the edge, and of course open trenches of that width. Next, another hand follows, and by similar trenches splits the intervals, and then splits the halves, thus completing the rows at 13 inches. The expertness of the hands, and the accuracy of their work in these operations are admirable. The seed is then strewed along the trenches, and scattered as wide as their width, by women. Two and a quarter bushels of good rice (rough, or in its close envelope of chaff,) are by many deemed enough for an acre. The seeds are covered immediately, either by rakes, hoes or covering boards, which are fixed with handles like rakes, and struck on the edge of the row, so as to throw a little earth upon the seeds.

"*The sprout flow.*" The planting of each field should be completed the day it is begun, and on the next rise of tide, the trunk's outer door is lifted, and the water admitted to overflow the field. It should cover every part; and the depth is not deemed very material, though the shallowest complete covering by water is enough, and perhaps the best for the seed. A deep flow may injure the banks by washing them when the wind blows. Or it may even break an interior bank, if weak, by inward pressure. If the land be very light and loose vegetable soil, the water should be admitted slowly, for fear of washing or even of floating some of the soil. As soon as a field is completely flowed, and the remains of stubble and other floated trash is wafted by the wind against a bank, it is drawn out by long handled rakes, and burnt as soon as it becomes dry. The inner valve is closed, when there is enough water on. This first watering is called the "sprout flow," and is continued until the seeds "pip," or the sprouts burst the envelope of chaff, when the water is drawn off. The time of this flow depends on the warmth of the weather. Sometimes only 4 or 5 days. In this most remarkably cold and backward season, (1843) some plantings have been under the sprout flow for 14 days, and the seeds have not yet (on April 7th) sprouted.

"*The point flow.*" After the water has been drawn off, it is necessary

to guard the fields from birds. The land remains uncovered and drained until the plants have risen above ground enough for their fine spires to show like small needles, when viewed before sunrise, while tipped with dew, and when the rows can thus be seen for about 50 yards in length from the banks. Then the water is admitted again to cover the field. This is called the "point flow." It serves to protect the seeds from birds, to soften the hard lumps of earth, and to kill the grass, while it does not injure the rice plants. This flow continues from 3 to 7 days, and until the plants are 3 or 4 inches high. If the water be continued longer, the plants grow too slender and long, and will fall on the ground, when the support of the water is taken away—though they will rise again; and even were they to rot off, in that case new leaves will spring out. It is preferable to see the plants thus fall, rather than expose the rice too soon to the depredations of birds.

As the different fields, or separately embanked portions, are successively planted (and the planting is usually continued from 4 to 5 weeks,) of course the flowing should follow in like order. Thus while water is going upon one piece, it may be passing off from another; and the separate but adjacent fields present all the various states of flooding and drying.

Planting in "open trench." The foregoing description applies only when the plan of covering the seeds by earth is adopted. There is also in general use, and latterly a more extensively pursued plan, of *not* covering the seeds, and which will be now described.* For this mode, before planting, the seeds are "clayed." This consists in pouring water in which clay has been mixed and is suspended over a pile of seed rice, which is kept stirred and worked up until every grain is wetted. If this claying were not done, the small and short fibres on the grain would prevent the immediate access of the flow water, and the grains would float, which they cannot do. With this treatment, after being "clayed" (the effect of which is so slight as scarcely to alter the appearance of the grains,) the rice is dried enough to be distributed easily, and strewed in the trenches as before described. But no covering of earth is given; and as fast as each separate piece of land is thus planted, (or even before the last of it is finished,) the outer trunk door is lifted, and the tide admitted, slowly and gradually at first, to flow the land. The land remains undisturbed under this flow until the sprouts, which are at first white, become green, or the plants rise high enough to "fork," or for the first two leaves to separate, which will be when the plants are one and a half or two inches high, and at from 10 to 30 days, according to the weather. After this, the water is passed off, and the land dried. Floating trash should previously be removed, as before stated. If the surface should afterwards become too dry, the water is admitted to flow in for a single flood tide, to barely wet the soil, be kept shut in during the next ebb, and passed out and again excluded with the first lowering of tide thereafter.

By this method (of "planting in open trench") the longer duration of the first flowing unites and brings into one the "sprout," and the "point flow"

* From a communication to the State Agricultural Society by the Hon. R. F. W. Allston, which has been published since this report was written, I learned that the honor of having first used and introduced this important improvement in rice culture, is due to John H. Allston, Esq.

of the covered planting. At the stages now reached by both, it may be considered that the plantings on the two methods cease to differ, and thereafter the crops on both are treated alike, and will be described as one.

The advantages of the "Open Trench" plan are the following:

First: The whole labor of covering is saved, which requires twice as much labor as the strewing the seeds.

Second: The depredations of birds and other vermin are prevented.

Third: Most of the seeds of "Volunteer Rice" and other weeds and grass seeds, may be presumed to have been drawn out-side of the trenches in opening them; and instead of being again drawn back into the drills of rice in the earth, as must be done when the rice is covered, these seeds remain and grow out-side of the drills, and may afterwards be more easily destroyed by hoeing or pulling out.

Fourth: If a freshet of the river compels the water of the "Sprout Flow" to be kept up much longer than the prescribed termination, the covered rice is apt to rot; of which there is no danger on the "Open Trench" plan. The cause of this important difference is not understood—though it is supposed to be the beneficial influence of light in the one case, and its exclusion in the other.

There are also countervailing objections to the "Open Trench" plan, which will be named:

First: The long continuation of the water, (which sometimes, in early plantings or backward seasons, may extend to 25 or 30 days,) promotes the growth of water grasses.

Second: In light soil, the loose mould may be so moved by the agitation of the water by high winds, as to cover much of the seed unequally and too deep.*

Third: The same operation is injurious to ditches and drains, by carrying soft earth into them.

And fourth: By the dashing of the waves washing the sides of the banks, which last is the greatest defect in the plan.

The balancing of the advantages and disadvantages of the "Open Trench" plan prevents either that or the other mode being generally adopted exclusively. It is deemed best to choose between them according to circumstances; and usually, to plant and cover in part of the fields, say for about one-third of the crop, and to leave the balance in open trench.

First and Second Hoeings, and the "Long Flow."

The rice (on both the foregoing plans of planting) from the removal of the water, as already stated, remains dry until the plants have acquired enough size and strength to resist the pressure of the light earth as falling from the hoes. Then the intervals between the rows are hoed, by chopping short and shallow, suited to the then low state of the plants, and care should be taken not to cover the plants by clods; and all clods left previously on the plants should be cleared off at this hoeing.

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* This objection may be easily obviated by letting the loose pulverized mould settle before sowing the seed. A rain will effect this purpose; and without rain, it may be done by turning in water for a single tide, and drying just before sowing the rice.

The rice land is left dry from the first hoeing until after the second, which is to be given from 14 to 18 days thereafter. This second hoeing is given a little deeper than the first; and any large weeds or grass then distinguishable in the rows are pulled up. The rice then has 3 leaves and is 6 or 8 inches high. If in dry weather, the land is left dry a day or two after this second hoeing, for the uprooted weeds to die, before the next water is turned on; but if wet weather, the land is flowed immediately. This is the "long flow." The water is raised at first above the tops of the plants, so as to float off trash, bugs, &c., which floating stuff will be driven by the wind into corners of the fields, and should be gathered up and removed. Then the water is lowered so that, if the surface of the field be as level as usual, (and as it ought to be,) the tips of the plants are then seen above on the highest parts of the field. Then the water is lowered very gradually, and during several days, until the tips of about two-thirds of the plants of the entire field, or division of land, are above the surface of the water. The flow is then kept stationary at this precise height, (which is fixed by making and observing marks on the trunk posts,) for a duration of from 10 days on the lighest land to 20 on the stiffest, when the water is again entirely drawn off, which closes the "long flow." This is the most important flow, and its execution requires judgment and careful attention. At this critical period, a field of rice may be much injured either by too deep flowing, or by suddenly lowering and taking off the water. If the flow be continued too long, or the water be drawn off when the roots of the rice are in an exhausted condition, the plants will "fox," or take a reddish-brown tint.

Some planters change the water during this flow, preserving the same level, but others object to it. If the same water is continued, it ferments, and a frothy scum rises, which being collected by the wind in particular spots, will adhere to and kill the plants. To prevent this, in such places the water is beaten or agitated, which causes the scum to break and sink to the bottom.

Third and Fourth Hoeings, and the "Lay-by Flow."

When the earth has become dry, the third hoeing is given, still deeper than the preceding, and afterwards each hand passes over his task, and pulls the grass out of the rows. The field then remains untouched and kept well drained until the plants are about to joint, when the fourth hoeing is given, light, and pulverizing all large masses left by the preceding deeper digging. The water is then again put on, and kept at about the same height as during the preceding "long flow;" and this is maintained until the rice is fully headed and the blossoms dropped. The water is then raised as high as may be done without danger to the banks. It serves to support the plants, and prevent their being laid or tangled by high winds. This entire flowing is termed the "lay-by water," it being the last. It should have been mentioned that during the early and low stage of it, there is a distinct operation of the hands passing over the ground with baskets, and pulling out as much as possible of the volunteer rice, tick-grass, and other weeds, which would, if left, by admixture, injure the quality of the grain. The volunteer rice is carried off; and all other weeds are knotted together

in handfuls and trodden in the wet earth under water, so as to be certainly killed. These two operations are performed at different and the most convenient times during the flow.

Harvesting.

The rice ripens usually from the 1st to the 10th of September. When all the grains are hard except the lower two or three at bottom of each head, (though the stem and leaves are still quite green,) the crop is ready for reaping. And when the time for the commencement of reaping is determined upon, the water is drawn off of the field just the day before, or it may be best the preceding ebb tide; and the reaping may be begun when the flow has not yet entirely passed off. The reaping is performed by the sickle. Each hand usually carries a breadth of 3 rice rows. Some planters have 4 rows carried. The stubble is left about 12 inches high—or higher if of rank growth. The reaped rice is laid in handfuls as cut, in rows, on the stubble, to cure. The stubble is abundantly thick to thus support the rice, unless the growth is very thin, or has partially failed.

All the rice reaped from morning until noon of one day is usually enough cured to be sheaved by noon the next day, and removed to the barn-yard before night. The test of its being dry enough, is when no juice can be made to exude from the joints, when twisted together by strong pressure. The rice is then bound or tied up in sheaves, as large as single lengths of the reaped rice will serve to tie around. The sheaves are generally made smaller than this. The sheaved rice is immediately carried to the barn-yard on the heads of the laborers, if near enough, or by water in large *flats*, if far from the barn. It is there put up in small cocks or ricks, to remain until dry enough to be put into larger long ricks, or larger round stacks, to remain until taken down for thrashing. The mode of putting up the rice in the ricks or stacks cannot be well made clear by mere description. The execution, however, is excellent, and of the round stacks is admirable. The latter is the best mode, when well performed. The loss or injury of the grain by the exposure before thrashing is not usually considerable, when the ricking or stacking has been well executed.

Volunteer Rice.

What is called "Volunteer Rice" is the product of grains scattered at the previous harvest, and which remain on or under the surface of the ground through winter, and come up with the next planted crop. By this long exposure to cold, wet, and overflow, as would occur in a state of nature, it seems that the plant is disposed to revert from its artificial character and qualities, as before improved by culture, to its previous natural character and habits. At least this is the only reason that I can conceive for the singular production and qualities of volunteer rice. The plants thus produced, and also the product of their seeds, (as generally believed,) if saved with the crop and planted, become intermixed with the good seed, have grains with a red interior skin or pellicle instead of white, as of ordinary and good rice. There are 4 different and common kinds of volunteer rice, and even different

varieties among each of these, in the lighter or deeper tint of redness, or less or greater thickness of the red pellicle. These 4 kinds of red or volunteer rice, all agreeing in having a red pellicle, are distinguished as follows :

First : White chaffed samples.

Second: With white chaff, having a black point, and spike to one end of the chaff. This is the ordinary and general kind.

Third: With yellow chaff, and having a long point.

The seeds of all these three fall off so easily, as rarely to be harvested and brought to the barn-yard ; and especially the last, which drops its seed before they seem ripe.

Fourth : With yellow chaff, and like the last, except that the seeds do not fall off in the field, and the grains cannot readily be distinguished from good rice, while the chaff remains unbroken.

All these, except the last kind, may be distinguished in the field before maturing the seeds, and by using care and labor enough, the plants pulled out and destroyed. But the last kind cannot be known either on the stalk or in the chaff. But with all the care used to keep land clear of red rice, it continues more or less infested with all the kinds. And though the grain is not the worse in anything but a slight remains of red tint, so despotic is Fashion in the market, that a crop of rice loses greatly in appreciation if thus showing many grains of volunteer rice. I have been informed that in Italy the admixture is not regarded by the buyers for home consumption. The plants of volunteer rice are usually the most hardy, thrifty and luxuriant of the crop—which helps to confirm the opinion that it is rice approaching more nearly to its natural and hardy character.

As there are different varieties of cultivated rice, it is probable that to this difference of origin may be owing the different kinds of volunteer rice. A white chaffed rice was formerly generally cultivated, which has been universally substituted by the " gold seed" or yellow chaffed rice.

The circumstances stated require great care to prevent as much as possible the growth, and still more the increase, of volunteer rice, which is indeed a very injurious weed to the crop ; both because its own product (if it were worth anything,) is mostly lost to the crop, and moreover that what of it is saved serves to contaminate the seed, and lower the quality and market price of the crop for sale.

Resting and Manuring Rice Land.

The cultivation of rice on embanked marsh lands is generally continued year after year, for a long time, without cessation or rest to the land. But rich and deep as is the alluvial soil, it becomes tired and gradually less productive under this unceasing and unchanged production of rice, and it is found profitable to give rest, and also manure, to the lands when long cultivated. Most planters, who have land enough, give a year's rest at distant intervals, and always find a profit from it, in the increase of the next year's cultivation. It may be doubted whether this increase may not be truly ascribed in part to the alternation or change of growth, as well as to the improvement of fertility. Mr. John H. Allston rests his land (which is clay soil on the Pee Dee) for two years together, keeping it dry during the time ; and he finds that this, if done once in 10 or 12 years, will add 50 per cent. to the next crop, or raise it from a previous product of 40 bushels to 60

per acre. Manuring with the rice-straw is also practised with advantage by those planters who have no high-land or other culture, or not enough to require the straw as manure. Dr. Heriot is one of these, and has lately applied his rice-straw to fields thrown out of rice culture for that year, and cultivated (dry, of course,) in cowpeas. This change and manuring he has found to double the next crop of rice. Colonel Belin has, by manuring and rest, made upwards of 90 bushels of (rough) rice to the acre. Both he and Dr. Heriot own and reside on Sandy Island, of which barren sandy soil is their only high-land, and on which their manure was before entirely thrown away, or left to rot in waste, without producing the most transient productive power.

Some of the Other Approved Modes of Rice Culture Described.

There are other approved and practised methods of rice culture, which vary so much from the more usual and general method described in the foregoing pages, that they require, and will receive, separate notice. And there are minor variations, too numerous to even mention in detail. The variations, whether great or small, mostly consist in giving more or less water at different stages of growth. And the two extremes of management present almost entire dry culture, (which is only adopted where no water or wet land can be used, and to small extent) and entire watered or flowed growth of the plants. Taken together, the great variety and opposition of conditions under which rice may be grown, prove that it is the most hardy of all cultivated plants, and that its amphibious nature will enable it to thrive both dry and flooded, and to withstand any but the greatest sources of injury, both from excess of water or its absence.

Plan of extended flowing. I will first mention a variation from the foregoing general plan, recently practised and preferred by Mr. John H. Allston, on Peedee, who is one of the most judicious and successful rice planters of the State, and who, to long experience, adds the further advantage of having cultivated in several different parts of the State, and on all varieties of soil. He does not deem any one method as the best for all situations and soils. And while concurring in the preceding description, and approving the directions in general, he prefers, for his own lands, to make the following important variation. The soil of his land is generally stiff, or more clayey than usual, which quality enables land to bear water better—and his situation is in the upper part of the available rice region of the Peedee—where the occurrence of high freshets begins to operate to prevent certain and effective draining at any desired time.

This method agrees with the early management described according to the open trench plan, in preference, when circumstances permit, up to the time when the "long flow" is to be drawn off. (See page 108.) Instead of thus drawing off the water, Mr. Allston retains it to the end of the growth, or until the crop is ready for reaping, taking care to raise the water gradually as the rice grows, and to partially change or "freshen" the water frequently, by turning it out during one ebb tide, and in the next flood. But when the growth of grass shows that hoeing is needed, the water is drawn off, and the laborers hoe the ground, pick out long grass, and then the water is returned immediately. This variation of plan

consists simply in uniting the "long flow" with the "lay-by flow." And when, (as usual) also, on the "open trench" plan (which brings together the "sprout flow" and the "point flow") this is almost entirely a water or flooded culture and growth of rice, with the important exception of the dry interval, and two hoeings between the end of the "point flow" and the putting on the "long flow," as described at page 109.

Mr. Allston considers this more extended flooding, (with the limitations stated,) to have these advantages:—1st, of lessening manual labor: 2nd, of preventing rust, to which disease rice is subject on some lands, and which prevention is made the more certain by frequent changes of the water; and 3rd, that on this plan, more rice and of better quality is produced.

"*Leggett's, or the sixty days' water plan.*" There are two other plans of rice culture, which agree in giving much more watering than usual, and which are severally advocated and practised by some good planters on Pee-dee and Black rivers. The first and most celebrated of these is called the "sixty days water," or Leggett's plan, after the name of the person who commenced its successful execution. This plan differs from the general and more usual course in the following particulars:

The rice is generally planted on the "open trench" plan, and as usual the water put on immediately after, and kept on high enough to cover all the land until the plants reach the "needle state"—that is, when the point of the spire begins to flatten. The plants are then from 2 to 4 inches high. This is also called the "jumping state"—because the roots have so little hold of the soil, that the agitation of the water by the wind often breaks the roots of the plants loose, and they then suddenly rise, or "jump" up, and float on the water. Then the water is drawn so low that the tops of the plants are barely exposed on the lowest parts of the ground, (and of course leaving naked the higher spots.) The water is not permitted to go lower; and as the rice grows, the water is again gradually raised, (but always taking care not to cover the tops,) until all the land is again under water, if the unevenness of the surface of the ground does not forbid. The water is partially changed every second night, by running out one tide and one in. But this entire time of flowing must not exceed 60 days for early planted rice, or 50 for late planted, and of more rapidly advancing growth; and usually before that time the plants will be at the proper state to lower the flow, which should be done when the plants are from 6 to 12 inches high, and strong enough to bear the first hoeing, and when new upper roots have just put out, and are about half an inch long. The water is then lowered as much as may be, without the slender and weak plants leaning too much. The working is then performed by the laborer's drawing the hoes along the intervals, cutting very shallow, which serves to cut up volunteer rice and grass, and sweeps some loose earth around the bottoms of the stalks of rice. The water is then raised again to its previous height, and kept up about a week, making in all about 60 or 65 days of continued flowing. Then it is drawn off entirely but gradually, so as not to let the plants fall for want of support before the stalks strengthen, and the land is made dry, and kept so for some 30 or 40 days. During this time the land is hoed usually twice—the first time deeply, and the next, chopping the rough lumps fine. The water must be again put on before the jointing of the rice, which is about 90 days from the planting, and kept on as usual till drawn off to begin reaping. It should be kept during this time also at the same height as at

the previous highest watering, and the water changed once or twice a week, by turning it out one tide and in the next, at night when tides suit, to prevent injury from the sun on the plants while left by the water.

"*The all-water culture.*" What is called the "all-water plan" differs from Leggett's in these respects: at the "needle state" of the rice, the water is drawn off for three days, for the roots to strike well into the ground. Then the water is returned and the field treated precisely as on Leggett's plan, until the time (at or near 60 to 65 days from planting,) when on Leggett's plan the water is drawn off and the land drained. Instead of that, on the "all-water" plan, the flowing is continued until the time for reaping, except that when the crop needs hoeing, the water is drawn off entirely, and returned immediately after the hoeing. Three or four hoeings are given in all. Also, when the little white worm attacks the roots of the rice, (which is evident from the appearance of the plants in spots,) the land is made dry for from 3 to 7 days, to kill the worms, and at the same time to hoe. At the last hoeing, as usual, the operation of pulling out the long grass is performed. The last hoeing is preferred by some, when the rice head is "in tight barrel," or just before it puts out. But this is deemed by others to be a hazardous practice.

The first commencement of this "all-water system" was caused by accident and supposed disaster, and not by design or upon a previously formed theory. But having been found beneficial, it was continued, and has now been several years in use, and preferred, by several good and judicious planters on Black river. It was Mr. Stephen C. Ford whom accident caused to introduce, and then continue to pursue, this method His design was to adhere to Leggett's method; but just at the time for drawing off the "60 days water," and drying the land, a freshet overtopped his banks as well as his rice, and continued so long that the water could not be drawn off afterwards, without prostrating the then slender and weak stalks. It was therefore necessary to hold on the water so long, and reduce it so gradually, for the purpose of strengthening the stalks, that the flow was kept up nearly all the remainder of the growing season. It was found advantageous, instead of a total loss, as was at first expected, and so the practice was adopted. The Messrs. Ford deem it greatly preferable to the ordinary method, at least for the Black River lands, which have much more vegetable matter in their constitution than the Peedee and Santee rice lands, and which, therefore, as they suppose, require more water and take it better. They consider that under this system they make 10 or more bushels to the acre more than would be made by the usual methods, and with much less labor.

Remarks on the several practices of culture. I learn from John W. Allston, that more than 30 years ago, Gen. Thomas Pinckney, on Santee, first commenced a still more entire water culture of rice, and published a pamphlet to explain and advocate it. He kept on the water from planting the seed, changing it often, but never draining it off, until to reap the crop. But this course, with the want of hoeing and clearing processes, was found to increase the growth of water grasses and weeds; and after some years the plan was abandoned by its introducer as well as by his followers. Long afterwards, Mr. Leggett recommenced the system, with the important modifications which have been described above; and his method is now preferred and pursued by many planters. And those who approve and those who

oppose his and the more extended "all-water" methods, are equally confident in their respective and opposite opinions.

The objections made to Leggett's method are these: 1st, that in lowering the water in the early stages of growth, to suit the lowest parts of the field, (see page 113,) the planter is compelled to leave all the higher parts naked, and in what is called "a scalding state," which is the ill effect of hot sun on ground not overflowed, but completely saturated with water; which state sickens not only the young rice plants, but the hardiest aquatic grasses. From the enfeebled condition thus produced, the plants take some time to recover, even after the water has been returned to them. 2nd. The necessary hoeing of the ground and picking of grass in shallow water must be injurious to the health of the laborers—and the operations also are apt to be imperfectly executed, for want of the planter's personal supervision. 3rd. The destructive ravages of the root worm cannot always be quickly stopped by applying the proper remedy of temporarily drying the land, because to remove the water suddenly would "throw down" rice that had been upheld long by the support of water.

The advocates of the system (and also of the "all-water system") deny that the mode of culture is injurious to the health of the laborers, and assert the contrary, because the labor is much lighter.

A general remark should be made, which applies to every mode of culture. When water entirely and deeply covers growing rice, the necessity of the plant for communication with the air causes it to grow in height (or "stretch out") rapidly, at the expense of the size and strength of the stalk, which becomes too slender and feeble to stand erect except by the aid and support of the water. As soon as the top stretches above the surface of the water, and the leaf can imbibe air, the previous rapid upward growth ceases, or is greatly checked for the necessary time, and the stalk begins to increase in size and strength, so as subsequently to permit the water to be gradually and safely drawn off. If the high flooding be continued too long above the top of the plants, they die. If it be withdrawn too suddenly, the slender plants fall to the ground, die above ground and rot off, and a new and rapid growth springs out from the root.

These peculiarities of the growth and dangers to, as well as recuperative powers of, the rice, require attention throughout every kind of culture. And on them was founded a peculiar method, which formerly was known as "Macauley's system," and had advocates and followers, but which has been entirely abandoned, and needs to be mentioned only as a matter of curiosity in rice culture. On this plan the water was kept up high overtopping the plants, (but not too long) until they had been drawn up as slender as threads. The water was then quickly drawn off, and the land dried. The plants were prostrated, and the fallen leaves rotted off, and new leaves sprung out with great vigour, and the plant had a perfectly clean soil to grow in, as the previous early and long flow had destroyed or kept down all grasses.

Thrashing. The thrashing of rice was formerly done altogether by the flail, which laborious and tedious process is still in use on many plantations. But generally, now, thrashing machines are used, worked by horses, and on some plantations by steam engines. The general principle of the thrashing machine is the same with the spike machines used to thrash wheat. One worked by 6 mules will thrash commonly from 250

to 300 bushels of rough rice per day. The steam machine of Mr. J. I. Middleton thrashes from 600 to 1,000 bushels a day.

The Pounding and Preparing Rice for Market.

The rough rice is next carried through all the processes connected with the main one of "pounding," to be prepared for market.

The pounding-mill on many plantations is an appendage of the rice fields, it being worked by the tide, and one or more of the separately embanked divisions being used as a pond to receive the flood-tide, the discharge of which during low water drives the water-wheel, and all the machinery. This conversion of rice fields to a mill-pond is done only from after the removal of the crop to the next spring, when it is necessary to dry the land just before the latest planting. This flooding of the land is found to enrich it, and to make it produce better. But it is more apt to become foul with weeds, for want of the earlier and better preparation which the other lands have.

But since large steam mills for pounding rice have been erected in Charleston, most of the rice is sent there "in the rough" to be pounded. And it is understood that plantation tide mills are of so little profit that few if any others will be constructed, and those now operating are used only because the great expense of their erection has already been incurred.

When brought to the pounding-mill, the rice is first raised by elevators to the upper floor, where it is passed through a rolling sand-screen. The operation of this is to separate all the sand, the foot stalks, and also the smallest grains of the rough rice, all of which fall separately. The rice thus cleansed passes from the screen by a spout into the mill-stones, which grind off the outer husk or close envelope of chaff, without breaking many of the enclosed grains. Perhaps about three-fourths of the chaff is thus removed from the grains; and the balance is cracked and loosened, but still adheres to the grain. The whole passes from the stones as fast as ground, to a wind-fan, by which the loose chaff is separated from the grain. The chaff is conveyed away by a spout, without the building, and usually goes to waste. The grain is drawn by hand labor into the ground-rice room, or bin, which is next adjacent, and from which it descends by spouts to the mortars below. These spouts have closing slides, to stop the passage of the grain when the mortars are filled. In these mortars large pestles or upright beaters shod with iron operate. The effect of their pounding is to take off all the still remaining outer husks, which had been loosened but not removed by the grinding; and also, to entirely divest the grains of the thin white inner-coat or pellicle, which covers and adheres closely to the grain. The hollows of the mortars are egg-shaped—the upper part or opening being rather smaller than midway lower down. About 4 1–2 bushels of rice is put into each mortar. To prevent the pestles breaking the grains at the beginning of the pounding, there is used a "cotter," which is a broad hoop or hollow cylinder, made of a strip of sheet-iron, 6 inches broad, and about 12 inches in the diameter of the circle. The cotter is placed in the mortar so that the pestle shall fall within its circle, and is sunk its depth in the rice. The operation is, that the descent of the pestle in the middle of the mortar drives the rice somewhat up the outside; and the outside of the mortar being contracted towards the top, the highest grain at the outside falls within the cotter, and is exposed to the next blow of the pestle.

Thus a continued circulation is preserved. But after a while, and when the pellicle is partly detached, the grain becomes warm, and feels slippery, and will then keep in proper circulation of itself. The cotter is then no longer wanting and is removed. Just before the pounding has produced its complete effect, the grains of rice sometimes become so slippery that they yield too readily to the pestle, and there is danger, from that opposite cause, of the pestle breaking rice, by descending too easily to the bottom. This is prevented by throwing in a little "head rice," or even chaff. When the pounding has effected its purpose, the pestles are lifted and secured, and the rice taken out of the mortars and carried up to the rolling screen. This screen is made like the bolting-cloths of wheat-flour mills, except that the seives are much coarser, and made of woven wire, and of different sizes. The first division separates the finest parts broken by the pestles, or what is called the "rice flour." The second division separates the "small rice," that is, the smaller broken grains, and the small grass-seeds, if any. With these two parts thus separated will come away the particles of chaff. The third division of the screen takes out the "middling rice," or the largest of the broken rice that is separated. The fourth division passes out the prime or market rice; which, however, still is not yet fit for the market. At the end of the screen falls out the "head rice," which consists of grains too large to pass through the last division of the screen, and which is either of grains not entirely freed from their covering, or otherwise of the largest and finest grains. This mixture is the material above-mentioned as being put back into the mortars. Each of the other portions pass by different spouts to different places. The "rice flour" needs no further process, and passes to its place of deposite. The "small rice" passes to a fan, which separates from it the chaff and dust, and thence to the barrel. The middling rice also goes through another fan, and thence to its barrel. The prime or "whole rice," and great body of the product, is conveyed to the brushing screen. This consists of a hollow cylinder of woven wire, standing perpendicular and fixed, in which turns with great velocity a smaller wooden cylinder, to the outside of which there are nailed strips of sheepskin, with the wool on, about 4 inches wide. These strips are nailed on the cylinder by one edge only, lengthwise, and somewhat spiral in direction, and parallel to each other. When the cylinder is turning the centrifugal force causes the loose sides of the strips of sheepskin to extend outward and the wool to brush closely against the surrounding wire-screen. Between the screen and the sheepshin the rice is passed, and by the friction receives that polish which is now required by purchasers, and deemed essential to the perfection of the commodity. Next it passes through a fan, to remove all flour or dust, and thence to the barrels, in which the rice is packed and sent to market. The barrel contains 600lbs.; and it requires from 18 to 20 bushels of prime rough rice to produce a barrel for market.

The small grained rice separated by the sand-screen, when enough has been accumulated, is carried through all the foregoing operations, and produces a grain for market, smaller and therefore lower-priced, though as good as any. The "middling rice" is sometimes again screened, and the larger grains (called "cracked rice") sent to market. The remainder, with the "small rice," is consumed on the plantation, for provisions for the negroes, and often in part for the proprietor's table. It is even preferred

by many persons to the market rice. The "rice flour" is fed to cattle and hogs, and is a very fattening food.

Usual Tasks of Laborers in Rice Culture and the Connected Operations.

The various daily tasks of laborers in the operations necessary for rice culture, are as follows:

Ditching of New Swamp Wood-land, (for men only)—500 solid feet; which, however, has to be altered according to greater or less difficulties. In new cypress-swamp, 200 feet may be enough; and in embanked salt-marsh, where no trees grow, 1000 feet may be dug.

Cutting Drains, (Men)—20 inches wide and 3 feet deep, —— running feet.

Digging stiff Land early, and turning in the Stubble, (Men and Women)—One-half acre to 3 hands.

Digging the same late, and the stubble burnt off—One-half acre to 2 hands.

In light lands, a proportional slight increase.

Levelling or "mashing" land—One-quarter to one-half an acre.

Hoeing Rice—First hoeing, when lumpy and hard to clear the drills, 20 compasses, or two-thirds of a half acre. (The compass space is 5 feet, and its measure is always made across the half acre of 150 feet, which is 30 compasses.)

The usual task in first hoeing, is half an acre.

Second hoeing, usually half an acre—depending on condition of grass.

The third hoeing (deep) 20 compasses, or two-thirds of half an acre, if on stiff land. This includes hand-picking of grass.

Fourth hoeing, (light work,) and including hand-picking, half an acre.

Reaping Rice—Three-quarters of an acre. If new-ground and tangled rice, much less.

Reaping, tying up sheaves, and carrying to the barn-yard—One-quarter acre of each.

Thrashing by Flails—600 sheaves by men; 500 by women.

Making Barrels, (Cooper's task)—3 per day.

Ploughing with two oxen (changed for another pair at midday)—One acre a day. This includes the ground lost in and near ditches and drains.

Trenching (if on well-prepared land)—Three-quarters of an acre solid trenching, 13 inch rows, for each able man.

Marking or Trenching every fourth row only—Nine-quarters of an acre.

Sowing Rice—Three half acres, (with some, 2 acres.)

Covering Rice—Three quarters.

NOTE.

When resigning my office of Agricultural Surveyor of South-Carolina, and about to close my labors in performance of that trust, I beg leave to add some expression of my acknowledgement and thanks to those citizens of the State who have, by more than ordinary attention, useful information, or other aid, facilitated and furthered my investigations. The following names of persons to whom I have been thus indebted, are placed somewhat in the order of time of our meeting, and of the commencement of their attentions or aid:

Dr. JOSEPH JOHNSON,
Rev. Dr. JOHN BACHMAN,
R. W. ROPER, (to whom also, as Chairman of the Committee of Agriculture, is due the honor of zealously advocating and procuring the institution of the Agricultural Survey,)
Hon. MITCHELL KING,
RICHARD YEADON,
Dr. WM. G. RAMSAY,
JOHN S. BRISBANE,
Dr. SANFORD BARKER,
Col. JAMES FERGUSON,
WILLIAM CAIN,
Dr. EDMUND RAVENEL,
JOHN RIVERS,
Hon. WHITEMARSH B. SEABROOK,
Gov. JAMES H. HAMMOND,
JOHN A. RAMSAY,
ISAAC M. DWIGHT,
J. JENKINS MIKELL,
ROBERT BARNWELL,
JOSEPH HAZEL,
JOSEPH H. POPE,
FREDERICK G. FRASER,
A. HUGUENIN,
Gen. HOWARD,
WILLIAM SINKLER,
JAMES GAILLARD,
HENRY W. RAVENEL,
MAZYCK PORCHER,
PHILIP PORCHER,
Dr. J. S. PALMER,
Col. S. J. PALMER,
Dr. ROBERT GOURDIN,
JOHN A. ALLSTON,
Col. R. F. W. ALLSTON,
J. I. MIDDLETON,
Dr. EDWARD HERIOT,
JOHN H. ALLSTON,
STEPHEN FORD,
S. C. FORD,
HENRY DAVIS, Sen.,
JOSEPH A. JOLLY,
CHRISTOPHER F. HAMPTON,
Dr. J. R. CHEVES,
Col. DAVID J. McCORD,
Dr. A. T. DARBY,
Gen. DAVID JAMISON,
JACOB STROMAN,
Dr. B. H. SWEATT,
CHARLES C. HAY,
JESSE CHERRY,
J. TERRY,
Hon. J. P. RICHARDSON,
Dr. C. R. F. BAKER,
Dr. WM. ANDERSON,
Dr. JAMES B. DAVIS,
WILLIAM K. DAVIS,
Rev. J. P. COOK,
Hon. JAMES A. BLACK,
Hon. JOHN C. CALHOUN,
J. O. LEWIS,
THOMAS M. SLOAN,
CHARLES T. HASKELL,
Hon. GEORGE McDUFFIE,
Dr. WM. V. JONES,
EDWARD G. PALMER,
DAVID GAILLARD,
Dr. JOHN DOUGLASS,
Dr. J. Y. MOORE,
Dr. THOMAS SMITH,
Col. JOHN N. WILLIAMS,
Professor LEWIS R. GIBBES,
Col. J. F. ERVIN, and
Rev. J. M. TIMMONS.

If the attentions merely of hospitality and kind feelings were also thus particularly acknowledged, it would require that there should be named all of the very many persons whose hospitality I have enjoyed, and the much greater number whose invitations I could not accept. For all these and other favors I have the more reason to be grateful, because I had come into South-Carolina, upon the duty to which I had been invited, almost a stranger, personally, to every resident of the State.

EDMUND RUFFIN.

Columbia, Nov. 30, 1843.

APPENDIX.

PAPERS REFERRED TO IN, OR CONNECTED WITH, THE REPORT OF THE AGRICULTURAL SURVEY.

Correspondence with and communications from Agricultural Societies and individuals.

To the Hon. Whitemarsh B. Seabrook, President of the State Agricultural Society of South Carolina.

SIR:—For the fulfilment of my duties as agricultural surveyor of the State of South Carolina, it is essential that my efforts shall have the support and aid of the agricultural community, whose interests the survey was designed especially to promote. Deeming it the most proper mode of seeking this needed and important aid, I take the liberty of thus addressing the planters of South Carolina, and more especially the many agricultural societies, through you, as the president of the State Agricultural Society which is the representative body of all the others, and requesting your agency to induce the desired action of the different agricultural societies. The act of the constituted authorities of the State of South Carolina which invited me to her service is the most honorable distinction which has yet been earned by my long continued efforts to advance agricultural interests; and I am impelled by every consideration to desire that the services, sought in my appointment, shall be as faithfully performed as zeal and industry and my imperfect ability and means may permit. But all these, however faithfully applied, will avail but little, unless aided and given effect to by the co-operation of some of the well informed agriculturists of every section of the State, and in every department of agricultural practice and inquiry. Such co-operation and action, properly applied by the agricultural societies, will leave to the surveyor the more humble, and yet the most useful function of his office, that of serving as the organ or channel of communication, to receive and bring together, for diffusion and general use, the vast amount of information already in each particular section, and which may easily be collected and reported by the agricultural societies, or by individuals. In this manner, the agricultural survey may lead to important and general benefit, by inducing the furnishing of full and general information. But without such aid, the surveyor's services must necessarily be confined to narrow limits, whether of space, or of subjects of investigation.

With these views, I respectfully submit for consideration the annexed list of general and particular heads for inquiry, merely as suggestions or memoranda, on any of which, or on any others more appropriate to the general object, information is requested to be furnished in reports from agricultural societies, with the design that such papers shall be annexed entire to the surveyor's more general report of the progress of the work confided to his charge. And besides such reports from societies, embracing many subjects, and the general practices and the received opinions of practices in every section, it is hoped that particular subjects of investigation and of instruction will be undertaken and reported upon by any individuals disposed to render such service to agricultural improvement.

In regard to a few particular subjects of agricultural improvement, I am not so distrustful of my ability to offer useful and profitable instruction, and therefore to these subjects my own efforts and personal labors and researches will be first and more especially, though not exclusively directed. These are the seeking for, examining, and endeavoring to induce the use of the very extensive and as yet scarcely touched sources of calcareous manures in South Carolina. To this subject, my personal attention and particular advice and instructions will be given, and as early as possible, wherever they will be enough valued to be put to immediate use; and if I can thus induce some hundreds of cultivators to begin during this season to apply marl or lime, there will be no danger of the agricultural survey being hereafter deemed a useless or unprofitable measure, or that its cost will not be repaid tenfold in the results of the first year's operations. Millions of dollars in value of newly created agricultural wealth will accrue to the State within a few years after the commencement of the general use of calcareous manures. From my examinations already made, I feel authorized to assert that the marl (or soft "limestone") formation of South Carolina, is more widely extended and abundant, more rich in calcareous earth, and more generally accessible, and that the proper application will be more profitable compared to the necessary out-lay, than of any other extensive region yet known. Believing as I do that a new era of improvement will soon be entered upon, by the bringing into proper use these calcareous manures, it is especially interesting to mark the earliest progress; and therefore it is desired that every case may be reported generally of the use already made of marl or lime, and the results, whether of benefit or supposed failure; and also all experiments that may be made during this year, of which I trust many will be commenced even after this time.

Very respectfully,

EDMUND RUFFIN,

Agricultural Surveyor of the State of S. C.

Charleston, Feb. 23, 1843.

General Head. I. Geographical character of the particular Agricultural District or section of country under consideration.

1. Situation and extent, and natural divisions.
2. Climate, and especially any peculiarities thereof, and the causes.
3. Surface and face of the country.
4. Minerals, especially such as may be valuable for agricultural or economical uses.
5. Water, in reference to uses of navigation, propelling machinery, irrigation, &c.

II. General description and management of land.

1. Quantities of arable land, of meadow, of wood, of swamp or marsh, and of other waste lands.
2. Soils and subsoils, and the actual productive value of lands in reference thereto.
3. Sizes of farms or plantations.
4. The usual crops, both of large and small culture, and rates of product.
5. Rotations or succession of crops.
6. Application of manures—kinds and quantities used.
7. Depth and manner of ploughing, (or of hoeing instead) and preparation for, and tillage and general management of each of the several kinds of crops.
8. Expenses of cultivation.
9. Foreign grain and hay purchased, and the general total cost.

III. General market prices of lands, past and present, and rate of rents—and products in usual crops compared to these prices.

IV. Drainage and Embankments.

1. Of tide marshes and tide swamps.
2. Of swamp lands, of level higher than the tide.
3. Of arable, or other firm land of low level or flat surface.

V. Implements and Machines for Agricultural Operations.

VI. Fencing and Enclosing.

VII. Grass Husbandry and Grazing.

1. Natural meadows on moist ground.
2. Artificial (or sown) grasses on permanent meadow.
3. Artificial grasses, peas or any other green crops for stock food or for manure, alternated with tillage crops on arable land.
4. Mowing and hay.

VIII. Live Stock.

1. Teams or animals for labor.
2. Animals reared and fattened for food or sale, and their management.
3. Animals purchased from abroad, and general cost thereof.

IX. Dairy Management.

1. Products, used or sold.
2. Supplies of butter obtained from abroad.

X. Manures.

1. Sources and supplies of manures of all kinds.
2. Preparation and application of stable and yard manures, and composts, the quantity and effects.
3. Marsh or swamp mud as manure.

XI. Orchards, Vineyards, and Fruits.

XII. Wood Land.

1. General description of the growth on different soils.
2. Uses made and value of timber and other products.
3. Quantity of land necessary to be kept in wood for farm purposes.
4. Disadvantages of excess of wood land to agriculture.

XIII. Waste Lands.

1. Tide marshes.
2. Unreclaimed swamps.
3. Sterile sands, or such as are so loose as to be liable to be moved by the winds.
4. Land of rocky or precipitous surface.

XIV. New or recently introduced and valuable processes, or improved practice in Agriculture.

1. Marling, and extent of applications before 1843, and subsequently.
2. Limeing or any other calcareous applications before 1843, and subsequently.
3. Clover.

XV. Notices and suggestions of any new resources for fertilization, or for agricultural improvement or profit.

XVI. Obstacles to agricultural improvement and profit.

1. Obstacles opposed by natural and unavoidable circumstances.
2. Obstacles caused by erroneous governmental policy, or by want of proper legislation.
3. Obstacles caused by individual action.

XVII. Diseases of residents caused by climate and condition of the country.

1. Local sources of malaria, their extent and operation and comparative malignity—as rapid streams sometimes overflowing their borders—tide water marshes, fresh or salt—

swamps, whether in their natural state or under culture—mill-ponds—and the passage of transient and irregular floods of fresh water over salt marshes.

2. Increase or decrease of extent and virulence of malarious diseases in past time, and the supposed causes of either.

3. Means of diminution of such diseases within the reach of the separate action of individual proprietors—such as require combined action, and such as require legislative direction.

XVIII. Miscellaneous observations and statements on any thing conducive to the improvement of agriculture, not embraced under any of the foregoing heads.

To the Presidents of the Agricultural Societies of South Carolina—

Gentlemen—I know of no disposition of Mr. Ruffin's letter, which he has done me the honor of addressing to me, so appropriate, as that of submitting it to your consideration, with the expression of my earnest desire, that the societies over which you severally preside, will promptly adopt such measures as may be desirable, to aid him in his highly responsible and arduous labors. Without the zealous co-operation of the planting interest, it will be impossible for him to accomplish but a very few of the objects, which it was the design of the Legislature that the survey should effect. Whilst directing his researches the present year mainly to those subjects of agricultural improvement, upon which he is so competent to afford profitable instructien, he asks the assistance of every one interested in the prosperity of the State, on the various other matters to which, through me, he has invited the public notice. It is not expected that any Society will reply to all his queries, but to such only as it best understands. The information, however, though it may be concisely given, must be minute and full.

The advantages that have resulted from Agricultural Surveys in England, on the Continent, and in this country, there is already abundant evidence for believing will certainly accrue to the State. With a genial climate, and a soil naturally fertile, and admirably adapted to many of the most valuable crops in the world, the wealth of South Carolina might be immeasurably increased, if her agricultural resources were known. In their examination and development Mr. Ruffin is now engaged. His discoveries have already far exceeded his anticipations. Extensive beds of marl of unusual abundance and richness, it is now evident not only exist in the lower Districts, but there are satisfactory indications that calcareous matter in some form is generally diffused through a large portion of the State. The use of this well known meliorating agent ought, then, no longer to be withheld by any planter who desires the advancement of his own interest. It is especially important, that by the result of experiments with lime or marl, without reference to the other ordinary means of amending exhausted lands, we should be enabled to satisfy the constituted authorities that the appropriation for the survey was a wise, judicious, and profitable expenditure of the public money.

In reiterating my request, that you will bring the subject matter of this communication to the early notice of your respective societies, allow me to add that, if every facility in the attainment of his purpose be afforded to Mr. Ruffin, he will, in my judgment, be enabled to render to South Carolina in two years more substantial service, than the concentrated labors of her Agricultural Socicties have hitherto performed.

I deem it not irrelevant to state, that Mr. Ruffin will prosecute his examinations in the malaria region of the State until the first of May, and afterwards direct his attention to the middle and upper Districts.

I have the honor to be,

Very respectfully, your obd't. servant,

WHITEMARSH B. SEABROOK,

Pres. S. A. S. of S. Carolina.

Edisto Island, Feb. 28, 1843.

FISHING CREEK, Chester District, S. C.

E. RUFFIN, Esq. Sir:—In compliance with your request, made through the President of the State Society, the Agricultural Society of Fishing Creek, through us, present the accompanying Report upon the various questions propounded by you. The variety of the subjects treated of, their scientific nature, and the knowledge requisite to treat them as they deserve, render the report difficult to make; and it is not to be expected that a committee of common farmers, should examine these subjects scientifically; and had our zeal in the cause of agriculture, not been equal to the distrust in our abilities, we would not have undertaken the task. Imperfect as it is, we beg you to accept it, together with the assurance of our high consideration and esteem.

Very respectfully, your obedient servants,

B. JOHNSTON,
L. A. BECKHAM, } *Committee.*
JAS. A. LEWIS.

REPORT.

SECTION I.

Answer 1. Our Society and Agricultural District, is located on Fishing Creek and its tributary streams. This is a bold Creek, that takes its rise about the centre of York District, and after running a course of more than forty miles, the greater part in Chester District, empties into the Catawba river at the top of the Great Falls. It is the natural outlet for most of the water that sometimes covers those vast plains, known in the up country as the *Blackjack*, from the tree that constitutes their chief natural production. Though not as extensive as the hilly lands around them, they are, probably, as important in an agricultural point of view, as the latter are not so fertile when first cleared, and the soil is more prone to move under the washing rains we are exposed to, and sooner becomes worthless.

2. Our climate is a very unfavorable one, subject to frequent and sudden changes of heat and cold, and to the extremes of long drought and floods of rain. We live in or about the 34th degree of North latitude.

3. Except the comparatively level land, called the Blackjacks, our section of country is very broken; like most of the upper part of this State, it has, in time past, been overwhelmed by a mighty flood from the North, washing off the surface soil, and all that grew upon it, scooping out deep vallies down to the solid rock, forcing back the ocean, and forming the low country from the wreck and ruin of this, studding our hills with huge balders, and leaving exposed beds of granite, quartz and hornblake that resisted its force successfully. On all land so dealt by, the soil must be thin, except where the current was too feeble, or by eddies forming deposits of gravel, sand, &c. Ages have passed since, plant after plant has lived and died, until the subsoil has been covered to the depth of a few inches, with a vegitable mould on the high land, forming beds of alluvial soil on the vallies of several feet in depth, confining the streams that flow through most of them, to channels only wide enough for the current in dry weather, but being subject to overflow in wet seasons; generally producing good crops of corn and oats. A geological survey of the Blackjack region, would, probably, lead to the conclusion, that it *was* a lake or lakes, with bays, promontories and islands. Hence, the land that was covered with least at that time, is now the driest and most productive. It abounds in extensive grassy glades, and is but thinly covered with a short, gnarly growth of blackjack and post oak, showing that not many ages have passed, since the barriers gave way that confined the waters which covered it.

4. Granite balders are frequently found, fit for mill-stones, and for steps, sills, &c., for building, but most of that kind of rock in siter is lamulated, and so hard and compact, as to render it unfit for cutting. We have veins of soap, iron and crystalline sandstone, that would be worth quarrying, but brick only is used in building; good clay for which, and for pottering, abounds.

5. Excellent mill-seats are to be found on all our larger streams, and generally occupied by good grist and saw mills; and from the fall in the smaller streams, many could be conducted along the hill sides, so as to render them very productive; springs of good water flow copiously from every hill.

Section II.

1. Nearly all our lands produce a little for a few years, but much has been cut down, that is so poor that the timber destroyed was worth more than the land has ever been since it was cleared; we have many good meadows of indigenous grass, but not one tenth of the land that would produce it, has been cleared or improved. Our wood is so much cut down, that timber for building, fencing and fuel, is becoming scarce; the only really waste land we have, is our old fields, many of which are so washed and gullied, as to be absolutely irreclaimable.

2. The soil varies from stiff, red or brown, to grey; the former rests on clay that is easily rendered productive; the latter, on a sterile, thirsty till, full of coarse gravel and rock, easy to wash into gullies, and the earth so removed, by settling on our good flats and vallies, injuring or destroying them, by covering them with its worthless materials. The grey land, when fresh, produces more, and better cotton, than the red, but the latter is the most valuable, as it is the most durable, and by retaining manure, is the most susceptible of improvement.

3. The size of our farms varies from fifty to one thousand acres; perhaps we err in purchasing more land, instead of improving what we have.

4. Cotton is our only market produce; it averages about two hundred pounds of picked cotton to the acre; corn, our chief provision crop, yields but little over fifteen bushels; wheat, is next in importance, and produces, in good seasons, ten bushels per acre; oats are more productive, and rye yields about as much as wheat; Sweet or Irish potatoes, are cultivated only in small quantities for the table Our latitude is too high for the former, and too low for the latter, to become objects of extensive cultivation; they both yield tolerably, if the seasons favor them.

5. We generally plant cotton on fresh land, four or five years in succession—then corn—then wheat or oats—again corn and cotton; and after it will produce little else, we sow it in rye, and let it rest for two or three years. There are no fixed principles observed in the rotation of crops.

6. Stable and cowpen manure is the most we have; we usually apply it to the old land we intend for cotton; it is strewed in a drill and bedded on. We make but little in comparison to what we might make, but the quantity is increasing annually. Cotton seed is getting into extensive use as a manure, and succeeds well; the best way to apply it, is to sow it with the wheat in the fall, but it is more frequently applied to the corn-hill.

7. Experience proves that deep ploughing is injurious to land that is so thin of soil, that the till or substratum is turned up in ploughing. Our stiff land, however, is greatly benefitted by deep ploughing, turning it to the depth of two or three inches, and looming the subsoil by a bull-tongue. One-horse ploughs are chiefly used in fresh land, and in the cultivation of our crops; three ploughings and as many hoeings are what we generally give the crops. From twenty to twenty-five acres to the plough, is the quantity usually planted in corn and cotton. One-third in cotton, the balance in corn. No particular rule is observed as to the quantity of small grain, it is regulated by the corn land of the previous year, as the stalk land, and none other, is sown. Wheat and oats are the principal kinds sown, except in the Blackjack region, where rye grows luxuriantly, and is used as food for stock, and forms a considerable item of market produce.

8. We have no data whereby to fix the expense of cultivation accurately. We know this, however, that at the price of produce, for the last two or three years, we are sinking money.

9. We make our own bread stuffs, and could frequently spare large quantities of corn and wheat, but have no regular market for them.

Section III.

1. Land has fallen in value the last three years about one half; the best will not bring more than 10 dollars per acre; rent is extravagant, and usually falls most heavy on poor people, who can neither buy nor move away; the usual rate is the third and fourth of the crop, or 2 dollars per acre.

Section IV.

The alluvial lands on the margin of our creeks, afford the richest and most lasting plantations, but are subject to frequent over-flowings; corn and oats are their principal produce.

Section V.

In addition to the ploughs already mentioned, we have excellant wagons and carts built in the neighborhood. Our cotton gins and screws, thrashers and fans, with their propelling machinery, are *all* the work of our own mechanics, and form heavy items in the accounts of our expenses.

Section VI.

Worm fencing only is used.

Section VII.

But little attention has been paid to the cultivated grasses, and that little chiefly for pasturage, or to obtain seed for more extensive operations; for meadows, see section 2d. Hay is generally cut twice, seldom three times per year. The hay obtained is not very good, being mixed with many plants that afford but little nourishment, and some of them deleterious.

Section VIII.

Horses or mules are our principal dependence for labour either in the plough or wagon; oxen are sometimes used with advantage, especially in hauling on our farms.

Kentucky supplies the most of our horses and mules, horses from 50 to 100 dollars per head, and mules from 40 to 50. The farmers of our region raise the most of their beef and pork. Pork sells from 3 to 6 cents gross; many good colts are raised, and our stock of hogs and cattle is improving by the introduction of foreign breeds.

Section IX.

Our dairies usually furnish milk and butter in abundance, which are generally used in our families, but a considerable quantity of butter is sent to market from our neighborhood; little or no attention is paid to cheese.

Section X.

We have many good apple orchards, and some sections produce good peaches in favorable seasons, but too little attention paid to either of them.

Section XI.

The upland, if deep loam, produces white oak, hickory, walnut and pine; post, red and black oak are the natural growth of the next quality of upland; spanish oak, pine, chesnut and chinquepin, grow to good size on our poorest ridges; the creek bottoms are shaded by a noble growth of hickory, white oak, black walnut, ash and poplar; cold and wet ground produces water oak and sweet gum.

Section XII.

Nature has left many hills so covered with rock, (quartz, chiefly,) as to be unfit for common culture, but the timber on them is worth something; and if they were cleared, would produce grasses, or the mulberry for silk culture; in either, they would produce crops more valuable than corn or cotton on our best lands, to the same extent.

Section XIII.

Peas and clover have been ploughed in as manure, to a limited extent; the difficulty of starting a crop of corn after clover, deters many from the pasture; peas are the most convenient, and will probably take precedence of every other green crop as a fertilizer.

Section XIV.

The nature of our lands in many places, will always prevent our improving them, for the manure washes off as fast as we can apply it, and the subsoil is of such a nature as to be irreclaimable, if once the surface is removed.

The Federal Government, by continually legislating in behalf of the Western States, prevents permanent improvement in agriculture, by inducing emigration; but nothing operates more powerfully to prevent improvement than the wretched condition of our roads, and the system adopted by the State is calculated to fasten the evil upon us.

Every district has boards of commissioners independent of each other, and every one

else, for it is a farce to talk of returning them to Court to be tried by jurors, who are the persons liable to do the work, if it had been insisted on; besides, the task is an unequal one; on the ridges, one day is sufficient to do all that can be done to repair them; in other places, 12 days are insufficient to make good roads, although the work is actually applied; we would suggest the importance of some legislative action on the subject, to equalize the burden and remedy the bad roads. As the roads are, it costs as much to convey our cotton to Columbia, as it costs the merchants to land it in Liverpool.

If the owners of dogs were obliged by-law to pay for the sheep they kill, we would be able in a short time to raise all the wool necessary for family consumption.

Section XV.

We are so situated as to be exposed to billious fever, in all the forms common to the low country in summer, and the typhoid form of fevers in winter, and that too without any apparent local source of malaria, within our border. Intermittents are evidently on the increase, and yearly assuming a more malignant form.

Until lately, our farming condition has not been flattering; with some few exceptions we were rather planters than farmers. A spirit of improvement is stirring amongst us, that bids fair to elevate us above the wretched state we have been in as farmers; many gentlemen, chiefly members of this society, have within a few years introduced the artificial grasses, and thus commenced, in the proper manner, the improvement of stock, for it is folly to expect any permanent improvement in that line, until our barren fields are stocked with grass, as no breed, however valuable, have been found to fatten and thrive on oak leaves or sapless sedge; several Berkshire hogs and Durham bulls and cows have been imported from the West. But the most important change to be observed is the disposition in the people, to acquire agricultural information, which they will soon have, as there is much discussion on the subject, and industry and enterprise, stimulated by interest, will soon effect a great change.

Report of the Committee appointed by the Milton Agricultural Society to answer* Mr. Ruffin's *queries.*

The committee appointed to answer the queries profounded by the State Agricultural Surveyor, report that they have had the same under consideration. They have not found it an easy task to select such as they might be expected to answer. They will, however, make the attempt, and take them up in the order in which they stand.

The "surface and face of the country," within the bounds of this Society, is for the most part gently undulating, rarely flat or precipitous. It is intersected every where with numerous rivulets and creeks, the last affording water power sufficient for as many grist and saw mills as are needed by the community. On the margins of the creeks, there are more or less extensive bottoms or low grounds. In some instances these have been brought into cultivation, and when properly drained and cultivated, are very productive; they are also sometimes cleared and devoted to pasturage, and are again valuable; but generally, they still lie neglected, and are prolific sources of malaria.

"Soils and subsoils." It is not known that any analysis has ever been made to determine the composition of our soils and subsoils. The soils are generally classed as mulatto and grey—the subsoils are generally compact red clay. The mulatto soils are supposed to be best suited to corn, wheat and tobacco, and the grey to cotton.

"The usual crops" are corn, cotton, wheat, oats, rye and barley—root crops, turnips, and all the varieties of the potato.

"Rotations of crops." There is no uniform rotation in this vicinity—the most common is an alternation of corn and small grain. In some instances, 1 cotton, 2 corn, 3 small grain—and by a few, 1 corn or cotton, 2d small grain, 3 rest. The subject is, however, attracting more attention, and it is hoped, that ere long an analysis of our soils and of our various vegetable productions will enable us to adopt a rational system of alternations of crops.

"Sources and supplies of manures of all kinds, &c."

"Application of manures, &c."

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* This Society embraces adjacent parts of Laurens and Newberry districts.

Our cow yards and stables furnish the principal supply of manures. The general practice is to litter the stables and yards with leaves from the woods, and when they are sufficiently cut up by the treading of stock, to draw it together in heaps or pens, and litter again. Some bulk these together, for the purpose of undergoing fermentation; others cart them from the yard without this preparation. The first is no doubt the better mode. In applying them to the soil, various practices prevail. By some, they are applied to the corn crop, in the hill, either covered with the corn or droped on the hill, our planters differing as to which is the better mode. More generally, however, they are applied to the cotton crop, in the drill; although a few prefer to apply them broad cast. The more prevalent opinion is that their benefit, in a dry year, is more certain in the cotton than in the corn crop. When the seasons are favourable, they probably increase either crop, one third. In no crop which we raise, are the good effects of manure more evident than wheat or turnips. As to the quantities used, the business is too loosely conducted to admit of an estimate. This is to be regretted; but the practice of manuring is comparatively new in this vicinity, and much remains yet to be done by the attentive and industrious farmer.

The other sources of manure are cotton seed and wood ashes. Cotton seed are mostly applied to the wheat crop, at the rate of from 10 to 30 bushels. In this crop, their good effect is very apparent and almost certain—an impression begins to prevail, that they tend to prevent rust. They are also much used in the corn crop, at the rate of 30 or 40 per acre. Here again, if the season is not too dry, their good effect is very apparent. Planters differ as to the mode of application. Some apply them in their sound condition, while others prefer to have them rotted—some cover them with the corn, while others prefer to drop them on top of the hill. Your committee prefer having their vegetative powers destroyed, and dropping them on top of the hill.

Ashes have been applied to cotton, to corn and to wheat, and with great benefit to each of these crops. We do not know any manure which, in small quantities, is capable of effecting so much.

No trials of lime as a manure have come under our observation, except in one solitary instance; in this, a bushel was strewed over some 30 feet square, in a garden, and planted in sweet potatoes—the yield was greatly augmented. No trials, so far as we know, have been made with marl or gypsum, nor with "marsh or swamp mud."

"Depth and manner of ploughing, &c." Generally the custom of shallow ploughing prevails here, say from 2 1-2 to 4 inches—going deepest in breaking up, and in the early culture, and shallow in the late. As our subsoil is for the most part a close compact clay, there is but little doubt we ought to plough deeper. We have witnessed only one trial of subsoiling. The result was highly in favour of its beneficial effects.

The implements most commonly used, are the scuter for breaking up and preparing stubble; and the shovel for tending the crop. Some of the most simple turnploughs are sometimes used.

"Fencing and enclosing," is invariably done with rails, made for the most part of oak, which is very abundant in our forests.

"Grass husbandry and grazing." Our native grasses, except the crab grass, are of the poorest kind, principally sedge. Of the artificial grassess, some trials have been made with red clover and herds-grass. On rich lots, the first appears to succeed very well. For alternating with tillage crops, we do not know of its having been tried; but our impression is, that without manuring more highly than is customary here, it will not answer. We are not aware that it has been ever sowed with gypsum. The herds-grass, as far as it has been tried, appears to succeed very well on the bottoms that border our branches and creeks.

"Live stock." For teams we use horses and mules, perhaps the greatest proportion of horses. Most of the horses and part of the mules are raised on our own plantations. A considerable number of mules are still obtained by purchase, causing the expenditure of large amounts of money. It is believed at this time, (it was not so formerly,) that we raise among ourselves nearly all the hogs, and all the cattle, that we need for consumption. It may be proper to add here, that every farmer raises all the grain which he consumes, and usually markets a surplus of wheat or flour.

"Local sources of malaria." It is believed that almost the exclusive source of malaria is to be found in the bottoms, along the margins of our creeks and branches; and even these, except when a secret "epidemical constitution of the atmosphere" prevails, do not appear to be very active. If these were drained and brought into a proper state of cultivation, we do not see why ours should not be one of the healthiest regions of the globe. To attain this we need no legislative aid. All that is necessary, is a thorough

conviction on the part of individuals concerned of its necessity, and the evil would soon be remedied.

All which is respectfully submitted.

P. L. CALHOUN.
JNO. D. WILLIAMS.
NEWMAN GARY.
JNO. H. DAVIS.

COLUMBIA, 28th Nov. 1843.

DEAR SIR :—According with my promise made last summer, I beg leave now to transmit to you the result of my essay to redeem the pledge which I gave to the President of the State Agricultural Society, namely, "to prepare for your use in the Agricultural Survey of the State," some account of Rice, the staple production of that section in which I reside.

If the accompanying memoir be not as full or as particular as was desired, I yet believe that the statements which it offers, may be relied upon.

With the view to procure facts from various quarters of the rice growing region, I applied for information to several gentlemen on Cooper river and elsewhere, but unfortunately, I have not been favored with the replies which I expected.

Such as it is, I place the memoir at your service, as the best compilation which I could make during the past summer, from the sources within my reach.

Allow me to refer you to the report of the committee on rice, to the State Agricultural Society, for 1842, for a few facts not fully embodied here—also, to the report of same committe, for 1843, for an account of the extraordinary rice which has commanded, during the two past seasons, some 15 per cent more per cwt. than any other rice whatever, in the clean rice market at Charleston.

I am, dear sir,
Yery respectfully,
R. F. W. ALLSTON.

To ED. RUFFIN, Ag. Surveyor of the State of So. Ca.

MEMOIR.

THE State of South-Carolina, small in territory, in population, and in relative weight in the scale of the Union, is blest with a most delightful climate, regarding together all the seasons, and in the possession of the elements of great and lasting wealth.

In the production of her two great staples, her agriculture exercises an important influence over the comfort and well being of mankind. With the various manufactures of cotton wool, the greater portion of the human race are clothed. With the manufactured or prepared rice, the greater portion of the human race are fed—as an article either of occasional diet, or of daily subsistence.

Rice was known and cultivated in the East from time immemorial. Whenever that hitherto sealed book, the Chinese Empire, shall be opened to the inspection of mankind, we may learn something more of its early history and culture—at present we only know from the books that a large proportion of the inhabitants of that ancient dominion subsist upon it, and we are told that it is grown sometimes by transplanting on the shores of the rivers, sometimes on rafts covered with earth and floating on lakes and rivers. That in some parts of China two crops are made from the same ground in one year, one ripening in May, the other in October or November. That the seeds are there white and oblong, but vary in size and form. That a small spot of ground is enclosed by an embankment, lightly ploughed and harrowed, and the grain, previously steeped in dung diluted with animal water, is then sown thickly on it; "a thin sheet of water is immediately brought over it, either by a stream or the chain-pump." "When the plants are six or seven inches high, they are transplanted in furrows made by the plough, so as to stand about a foot apart every way. Water is then brought over them, and kept on till the crop begins to ripen, when it is withheld; so that when the harvest arrives, the field is quite dry." "In Japan, Ceylon and Java, aquatic rice is cultivated nearly in the same manner." "To this grain the Chinese and Hindoos owe their early

civilization. An immense population in those and the surrounding countries is now dependant on the rice crops; and when these fail thousands perish of hunger."* (*See Appendix A.*)

BOTANICAL DESCRIPTION.

CLASS *Hexandria:* ORDER *Digynia:* NAT. ORD. *Gramina.*

Oryza Sativa—Native of Ethiopia—cultivated in tropical countries very abundantly, as well as in some of the warmer parts of Europe, in grounds for the most part artificially inundated. Annual—flowers in midsummer. *Root* fibrous—*Herb* grassy, about four or five feet high—light green, smooth—leaves linnear, narrow, taper-pointed. *Stipula* long, abrupt, jagged, crowning the very long striated sheath—*Panicle* terminal, much branched, many flowered, nearly erect, slightly spreading; its branches angular, rough. *Flowers*, when closed, obovate, oblique, or most gibbous at one side; their corrolla somewhat hairy, minutely granulated or dotted. *Awn* straight, rough, various in length.

Rice—A plant cultivated in the East, in America, North and South—in Africa, Spain, Italy and Piedmont. Its stalk not unlike that of wheat, but fuller of joints, and with leaves resembling those of the leek. It branches into several stems, at the top of which the grain grows in clusters, and each is terminated with a beard, and enclosed in a yellow rough husk. When stripped of this, the seed appears to be oval in shape, of a shining white color, and almost transparent. One species, several varieties.

1. Common Rice—Stem four feet high—Panicle spiked, simple—Husk, pale, oblong, with long awns or beard, a late sort—grows in moist places; injured by either drought or salt-water.

2. Early Rice—Stem three feet high—Panicle spiked—branched; husk tinged, brownish-red; awns shorter—grows in marshy places, is not injured by salt inundations.

3. Mountain Rice—Stem three feet, more slender—Husk longer, the awns very long—grows in dry situations; exposed to cold—exposed to continued inundation, it decays—sea-water kills it.

4. Glutinous or Clammy Rice—Stem four feet high, leaves wider, yellowish—Panicle large, with shorter awns—seed oblong, rather large, glutinous, very white—grows in both wet and dry places.

There is a variety having a black seed highly flavored, as well as another having red seed. Rice seems to contain more silex in its composition than most of its natural order. Even the seed is not destitute of this substance. Brilliant imitations of precious stones, are said to have been made of rice, for which purpose a large quantity of the grain is required.†

ORYZA—*from the Arabic* ERUZ.—*In Modern Europe* RIZ, REIS, RICE.

Oryza sativa, the common rice, has the culm or stem from one to six feet in length; annual, erect, simple, round, jointed; leaves subulate-linear, reflex, embracing, not fleshy; flowers in a terminal panicle; calycine leaflets lanceolate, valves of the corolla equal in length, the inner valve even, awnless; the outer twice as wide, four grooved, hispid, awned; style single, two parted.

Oryza mutica, the dry or mountain rice, cultivated in Ceylon, Java, and of late in Hungary, has the culm or stem three feet high, and more slender; fruit longish, with awns the longest of all. It is sown on mountains and in dry soils: rots with a long inundation, and perishes with sea-water.

The varieties of rice, as of other cultivated grains, are as numerous as the different soils, climates, and other physical circumstances, in which it is cultivated; besides the dry rice, the chief sorts, by some considered species, are the *O. præcox*, or early rice, and the *O. glutinosa*, or clammy rice, both cultivated in irrigated lands.

The native place of rice, like that of the other sorts of grain in common use, is unknown.

In the hilly parts of Java, and in many of the Eastern Islands, the mountain rice is planted upon the sides of hills, where no water but rain can come; it is, however, planted in the beginning of the rainy season, and reaped in the beginning of the dry season. The natives call it *paddy gunung*, which signifies mountain rice. It is entirely unknown in the western parts of India, but it is well known in Cochin China, where it thrives in dry light soils, mostly on the sides of hills, not requiring more moisture than the usual rains and dews supply, neither of which are frequent at the season of its vegetation.

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*Ency. Am.—Art. Oryza.
†Rees' Cyclopedia—Art. Oryza.

There is a kind of hill rice which is hardy enough to grow on the edge of the Himalayan snows; it is almost to be expected that this will, at some future time, prove an acquisition of value to the European cultivator.

In Lombardy and Savoy, rice is sown on rich lands, the sower often wading to the knees in the water; one crop a year only is obtained, but four crops are often taken in succession.

In Westphalia, and some other parts of the south of Germany, rice has long been cultivated; there it is sown on lands that admit of irrigation, but water is not admitted till the seed has germinated, and it is withdrawn, as in Italy, when the crop comes into flower. From long culture in a comparatively cold country, the German rice has acquired a remarkable degree of hardness and adaptation to the climate, a circumstance which has frequently been alluded to as an encouragement to the acclimating of exotics. It is found, Dr. Walker remarks, that rice seeds direct from India will not ripen in Germany at all, and even that Italian or Spanish seeds are much less early and hardy than those ripened on the spot. In Hungary rice has not been long cultivated; the mountain sort has chiefly been tried, and that in the manner of our barley, or summer wheat.

In England a crop of rice has been obtained near Windsor, on the banks of the Thames.

By far the best imported rice is from Carolina; it is larger and better tasted than that of India, which is small, meagre, and the grains frequently broken.*

The varieties of Rice which are most common with us in Carolina are:—

1. The *Gold Seed Rice*, (the ordinary crop Rice most highly esteemed, and therefore universally cultivated,) an oblong grain 3-8ths. of an inch in length, slightly flattened on two sides, of a deep yellow or golden color, *awn* short; when the husk and inner-coat are removed, the grain presents a beautiful pearly-white appearance—an ellipsoid in figure, and somewhat translucent. This Rice has been introduced into the Winyaw and Waccamaw region since the Revolution. It was planted by Col. Mayham on Santee in 1785.

2. The *Guinea Rice*, so called from its resemblance to one of the varieties of Guinea Corn in the shape of the head and clustering of the grains. In color the same, or perhaps a little deeper, the grain of this variety is in shape both broader and shorter, but not thicker, than No. 1. In figure, a sort of oblong sphereoid, compressed on two opposite sides, so as to be nearly twice as broad as it is thick; *awn* short, blunt; it is not cultivated as a crop, and is rarely met with.

3. The *Common White Rice*, in shape and general description like No. 1, except that the color of the husk is white or cream colored, and the grain when hulled is not as broad, nor as pearly; *awn* short: Some grains of this mixed with a sample of Seed Rice, constitute an objection to it, although it is this variety that constituted the earlier crops of the country.

4. The *White Bearded Rice*, very much the same as No. 3, in general characteristics. The grain of this kind is rather larger, and is furnished in its unhulled state with a very long *awn* or beard—grows well on high land. A sample of this last was brought from the East Indies in 1842, by Capt. Petigru, U. S. Navy. Some years ago it was cultivated more or less extensively by planters for their negroes.

There are several other kinds of Rice in appearance, to be found in both the fields and the barn-yards, differing either in the size and shape of the grain, or in the size and appearance of the stem and leaflets. They are believed to be modifications of either one or other of the foregoing descriptions; none of these have, as yet, established a sufficient claim to be classed as distinct varieties.

They may be classed as

1. An improvement of the grain chiefly cultivated, arising from a long-continued, careful selection of seed, the vigorous nature of the soil in which it was successively planted, the peculiarities of the cultivation pursued consistently from year to year, and other circumstances—of this character, it is believed, is the large grain Rice so successfully produced by Col. Ward.†
2. A commingling of the grain, arising from a careless selection, or a neglect of selection of seed—and two or more of the foregoing varieties being planted in the same field, or in closely adjoining fields—the farina of each fructifying some plants of the other, &c.

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* Loudon's Encyclopedia of Plants—Art. Oryza.

† See Report of Committee on Rice to the State Agricultural Society, 1843, for Col. W.'s account of this grain.

3. A corruption or deterioration of the grain, arising from utter neglect, and exposure of the seed to the vicissitudes of weather from year to year, or the being covered so deep, in either earth or water, as not to have vegetated for years.

Of this last, the Volunteer Rice affords examples, viz., the red grain having the same exterior husk as No. 1, with perhaps the *awn* a little longer—the red grain, having a white husk like No. 3; and the red grain having the husk white like the last, with a longer *awn*, and dropping from the stem in the field as soon as it is matured—this kind of volunteer never can be harvested on the stem; it is sometimes stripped into bags and baskets, and used as horse and poultry-feed. In either case, whether the grain has dropped from being touched, or has been stripped off for use, the stem, relieved of its superincumbent weight, stands erect, and towers above the worthier and well freighted heads of the surrounding fields. Hence it is called, in the vernacular, "*Proud Rice.*"

The cultivation of Rice in Carolina has added materially to the wealth of the Province —the Colony—the State; and has enhanced, in no inconsiderable degree, the value of the active commerce of both the kingdom of Great Britain, and the Federal Republic of the United States.

It is destined to add still further to the productive wealth of our country. The consumption of Rice, it is believed, will continue steadily to increase, in proportion as the various uses of this valuable grain shall be more generally ascertained, and rendered familiar in the useful and ornamental arts, as well as in its culinary preparations, as an ordinary vegetable, or a delicate luxury. (*See Appendix B*)

By this grain a large portion of the human race actually subsist, and it is believed it may be yet more universally consumed. It is a vegetable which undergoes no very material change, from change of climate. When put up for exportation, it deteriorates less than any other grain or bread-stuff whatever, and when cleaned and brushed in the best manner, it will keep sufficiently sweet and sound during the longest voyage.

Indeed, Rough Rice, or Rice in its primitive state before the chaff or husk has been removed, may be kept fresh and sweet for years; even should it, for a moment, have been immersed in water, the sun's warm rays, and a little dry air, effectually preserve it for a long time. One hour is sufficient to reduce a bushel of Rough Rice (one-half,) to a state fit for cooking; and the only instrument requisite is simply a wooden mortar and pestle.

Professor Liebig, in a note to his admirable and valued work on Chemistry, as applied to Agriculture and Physiology, p. 98, furnishes a chemical analysis of Rice, in terms substantially the same as those in which the same analysis by Braconnot is given by Berzelius. "According to the analysis of Braconnot, (*Ann. de Chim. et de Phys.* t. iv. p. 370,) this grain is thus constituted:

	Carolina Rice.	*Piedmont Rice.*
Water,	5.00	7.00
Starch,	85.07	83.80
Parenchyma,	4.80	4.80
Gluten,	3.60	3.60
Unchrystalizable Sugar,	0.29	0.05
Gummy matter approaching to Starch,	0.71	0.10
Oil,	0.13	0.25
Phosphate of Lime,	0.13	0 40
	99.73	100.00

with traces of muriate of potash, phosphate of potash, acetic acid, sulphur, and lime, and potash united to a vegetable alkali.

Vauquelin was unable to detect any saccharine matter in rice.—*Thomson's Organic Chemistry*, p. 883." An analysis of the straw and offals of Rice is now in progress.

EARLY INTRODUCTION AND CULTURE.

As early as the year 1666, the facilities afforded by the character of the low country of Carolina for the cultivation of this seed, were remarked by agents of the English interested in the settlement and improvement of the new world.* In less than forty years

* In "A Brief Description of the Province of Carolina on the coasts of Florida, &c., printed for Robert Horne, near Bishopsgate-street, London, in 1666," [the charter of Carolina is dated the 30th of June, in the 17th year of the reign of Charles 2d,] "it is mentioned, among other things, that the marshes and meadows are very large, from 1,500 to 3,000 acres and upwards, and are excellent food for cattle, and will bear any grain being

from that time the swamp seed was actually introduced, and successfully cultivated in South-Carolina.

It happened thus, by accident.* Landgrave Thomas Smith, (or Smyth, as honest John Archdale wrote the name,) on a visit to the East, before coming to this country, had observed the plant and some of the circumstances attending its culture. After settling in Carolina, it occurred to him that the low grounds and climate of the country were admirably adapted to this culture. Earnest in this opinion, and desirous of an opportunity to test its value by experience, providence brought within his reach the only means necessary to do so; and thus by his instrumentality, bestowed upon a portion of the new world a great and permanent blessing. In the year 1694, after Landgrave Smith, dissatisfied with the Province, had entertained thoughts of quitting it, a vessel from Madagascar, in distress, put into the harbor of Charleston, having on board a little Rough Rice, in the cook's bag. This Rice was given to Mr. Smith, who planted it in a low moist part of the garden, at his residence near White Point.† The plant grew luxuriantly, and the grain matured finely. The product was wisely and liberally disseminated as seed‡ among the neighboring planters, who in their turn supplied other planters living more in the interior; and so on, till this became the chief article of production, the staple commodity of the Colony.

There is extant another account of the introduction of this valuable seed, which refers it to the year 1700‖ or thereabout, and associates with it the name of another gentleman, a Mr. Woodward.

It is further recorded§ that a Mr. Du Bois, Treasurer of the East India Company, did, some short time after, send out to this country a small bag of seed Rice. Whether these were distinct and successive importations, which is highly probable; and whether or not there were two or more varieties of the grain introduced, certain it is the seed was so rapidly dispersed along the rivers, and inland-swamps, that soon the Province became a Rice-growing country. And since, under different forms of Government, as a Colony of Great Britain, and as a Sovereign State, constituting an integral part of the United States, under a Federal Republican form of Government, the principal staple production of South-Carolina has been the best Rice in the world.

At first, Rice was cultivated on the high land, and on little spots of low ground, as they were met with here and there. These low grounds being found to agree better with the plant, the inland swamps were cleared for the purpose of extending the culture. In the process of time, as the fields became too grassy and stubborn, they were abandoned for new clearings; and so on, until at length was discovered the superior adaptation of the tide-lands, and the great facilities for irrigation afforded by their location. For these, the inland plantations were gradually and slowly abandoned, until now, that the great body of land, which little more than a century ago furnished for exportation over 50,000 barrels of Rice, now lies utterly waste, constituting, where trees have not overgrown it, the finest natural pasture which could be desired.

As may very well be supposed, the seed was, at first, very sparingly sown, and the ground, being new, furnished an immense yield in return.

A peck of seed to the acre, sown thin in drills, eighteen inches apart, would, on good land, yield thirty, forty, fifty, and even sixty bushels, in proportion to the care bestowed on its culture.

As the grain became more plenty and common, and the space between the drills was slightly diminished, the quantity of seed was by little and little increased.

It is now from two to three bushels per acre, varying according to the character and condition of the land, and the peculiar notions of "watering" entertained by the planter —a free use of water justifying, and indeed requiring, a liberal allowance of seed.

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prepared; some cattle, both great and small, will live well all winter, and keep their fat without fodder. The meadows are very proper for *Rice*, Rape-seed, Lin-seed, and many of them be made to overflow at pleasure with a small charge."—2 *Car. Col.* 13.

* Ramsay's History of South-Carolina, chap. 5th.

† A spot now traversed by Longitude-lane.

‡ In new land, well drained, under favorable circumstances, from one grain may be matured 24 ears or heads, carrying each from 10 to 380 grains. There is a tradition, that some forty years ago, a stalk of Rice having 60 branches or tillers, was seen at the old butcher-pen, near Georgetown. There was grown the past year in the garden of Dr. E. T. Heriot, a plant from one grain having 70 branches.

§2 Car. Col. p. 270.

‖Ibid.

The space between the drills now, from centre to centre, is thirteen, fourteen or fifteen inches—the best distance is thirteen inches, where water is used freely—the dry culture requires a more frequent use of the hoe, and therefore the largest space is preferable.

The average product of Rice-land at present varies from twenty-five to sixty bushels per acre, generally increasing in quantity, (though deteriorated in quality,) in an inverse ratio to latitude.*

The seed should be selected with the greatest attention to purity and maturity of the grain. A sample containing one red grain in one hundred grains, is considered by the best planters inferior. Seed-rice, having a greater proportion of red or volunteer rice than one per cent, is totally unfit for planting. To procure the most mature rice for seed, a good plan is to thresh the rice over a barrel or large log, the butt of the sheaf being held by both hands. In this way the riper grains alone are whipped off, serving as seed; whilst the remainder on the sheaf is threshed off in the usual way.

Product.—Within seventy degrees of latitude, radiating from the Equator, this valuable grain is cultivated all over the Globe—even in the Himalaya mountains there is said to be a variety naturalized and grown†—another, or possibly the same, in Siberia. From climate and peculiar treatment, the vegetable rice acquires a certain constitution; adapting itself to the habitude of the region in which it grows, it does not so readily succeed elsewhere, until it is acclimated by time. Grown in India, in China, in most of the Asiatic Islands, in Southern Europe, in Africa, in South and North America, each country yields its own peculiar seed.

In North America, although there is known on the margins of some of the Northern lakes a kind of wild rice, which, when that country was in a state of nature, furnished no little subsistence to the aborigines, yet it is scarcely cultivated North of the State of Virginia. The census of 1840 exhibits the following scale of production in the United States.

Missouri,	taking the crop of 1839	as a basis,	produced 65	lbs. Rice.
Illinois,	do.	do.	598	do.
Virginia,	do.	do.	3,084	do.
Arkansas,	do.	do.	5,987	do.
Tennessee,	do.	do.	8,455	do.
Kentucky,	do.	do.	16,848	do.
Alabama,	do.	do.	156,469	do.
Florida Territory,	do.	do.	495,625	do.
Mississippi,	do.	do.	861,711	do.
North Carolina,	do.	do.	3,324,132	do.
Louisiana,	do.	do.	3,765,541	do.
Georgia,	do.	do.	13,417,209	do.
South-Carolina,	do.	do.	66,897.244	do.

As it is only in tide-water swamps that this grain can be cultivated to advantage, and therefore only in such lands that the culture will probaby be extended, the system of culture pursued on the tide-lands of Carolina, only will be detailed.

The swamp and marsh lands in this region, when in a state of nature were overflowed by the tides in ordinary times. In the time of spring-tides, they might have been found covered at high water to the depth of from twelve to twenty inches. When reclaimed they are furnished with a sufficient dam to exclude the tide-water, and a "trunk," or framed culvert, furnished with a door at each end swinging upon long levers, which are attached to sturdy uprights, so as to admit or exclude the tide at pleasure—retain or discharge it, after being admitted. The large enclosure is subdivided by "cross-banks," or dams, into fields of convenient size, containing variously from fourteen to twenty-two acres. In constructing the banks, large ditches (five to eight feet wide,) are excavated to the depth of five feet, leaving between the ditch and bank, a margin of twelve feet or more. These serve to drain the field. From one of these ditches to another, in one direction, and at the distance of 37 1-2 to fifty feet apart, are cut smaller ditches or "drains," eighteen inches wide, and three feet deep. Thus thoroughly reclaimed, and completely drained, the swamp, if well seeded, will produce abundantly from the first. The follow-

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* The higher the latitude, generally, the better the Rice in quality;—hence planters look to the northward of their own locality for their seed-rice, when it can be obtained thence comparatively free of volunteer.

† Ency. Am.

ing remarks, however, will be undersiood as applying to old land, from the surface of which stumps and marsh have entirely, or for the most part disappeared. In this condition are now found most of the lands in the rice-growing region. Fields, as they become exhausted by long-continued cropping, are revived by manuring with rice-straw and tailings, or by turning under the spontaneous growth of a dry fallow for one or more years. For a system of fallowing *see Southern Agriculturist, N. S.* vol. iii. p. 243—also *see Appendix C.*

Preparation.—The land is ploughed, or dug with the hoe, as early in the winter as can be—if before Christmas, the stubble is turned under—if later, the stubble is burned off. The land is then covered with water during any warm changes of weather in winter, and exposed to the frost when it is colder. In March, the field is kept dry, the drains are cleansed, the upturned clods are broken, and the whole levelled with the harrow or hoe—the field is trenched in a direction across the drains, with a hoe made for the purpose, to open a trench of from 3 to 5 inches in width. The trenches or seed-furrows will be 13, 14 or 15 inches apart from centre to centre. In April, and until the middle of May, the rice is sown in these trenches, say 2 1-4 bushels of seed to the acre of 45,000 square feet.

Dry Culture.—The seed is covered lightly with a light board attached to a hoe-handle, and the field is inundated from 4 to 6 days, just long enough to swell the grain, and prepare it to sprout. As soon as it is sprouted, and the plants become perceptible, like so many needle points above ground, the water is again put on for four or six days, according to the warmth of the atmosphere.

With Water Cover.—The more common practice now in the neighborhood of the writer, is not to cover the seed with earth, but to "clay"* it first, and after sowing, to flood the land forthwith, making the "sprout" and "point" water, one and the same. The method first mentioned is the best for early planting, though the labor required is greater. After the season is sufficiently advanced for the grain to germinate quickly, the "open" planting, less laborious, is equally certain, and by some persons is considered more certain to procure a regular and even stand. In all his early planting, *i. e.* until the middle of April, the writer allows three bushels of "clayed" seed to the acre. His trenches are fourteen inches apart from centre to centre, and five inches wide—the seed is scattered in the trench. He uses the water freely.

When the plant is five to six weeks old, the earth is stirred with the hoe; in ten days more, the hoe is again used, and the "long-water" put on for two weeks or thereabout; deep the first four days, then gradually diminished until the plant, somewhat recovered from the exhaustion occasioned by its rapid growth under water, stands up erect, and begins to throw out a new root; the water is then drawn. About eight days after, when the field is quite dry, a very deep hoeing is given, and the plant left undisturbed until it is prepared to form a joint; so soon as this is apparent, the field receives a light dressing with the narrowest hoe, and is "laid by," *i. e.* the "joint water" is put on to remain until the grain is matured, which is usually two months from this time. A few days before cutting, the water is run off, and the ditches washed out by the succeeding tide. The rice is cut with a sickle, (task one quarter of an acre to the hand, to cut and

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* The process of "claying" rice, was introduced some where about the year 1826, by that judicious, practical man, and observant, experienced planter, Capt John H. Allston, of Prince George Winyaw. It may be thus described—take two large tubs, say the two halves of a hogshead; fill one with water three fourths full, add to it 3 or 4 baskets or more of good red clay; stir it well until the clay is dissolved and the water has taken up a sufficiency of it to feel clammy between the fingers. Pour off this water into the other tub, into which also measure as much seed-rice as the tub will hold without wasting; stir it about until every grain has been wetted by the clayed water, taking care to pause every now and then for the purpose of skimming off the grass seed, and light rice, which rise to the top and float on the surface. Then dip out the seed rice in seives, allowing the water to drip back into the tub, and spread it in the barn to dry for the next day's sowing. Put more seed into the tub, and, when requisite, a fresh supply of clayed water, prepared as before, and so on.

The advantage of this preparation is that the grain furnished on its exterior husk with a hairy fuz, retains about it, (after being dried sufficiently to be handled in the sowing,) particles of the tenacious clay; this, on the grain in the trenches being reached by the water with which the field is flooded immediately after sowing, makes it adhere to the earth, and of course prevents the seed from floating.

carry,) and laid carefully across the stubble to cure, till the succeeding day. The dew off, it is then bound in sheaves of convenient size, just as wheat is, and packed in large floats, (bearing 5 to 7 acres,) to be conveyed to the barn-yard. There it is stacked temporarily in small ricks, and when thoroughly cured, put away in large stacks made to contain from 200 to 400 bushels each when threshed.

The threshing is performed, almost universally, by a labor-saving machine; and the grain is cleaned and prepared for market, by means of the Pounding-mill herein described.

Water Culture or "*sixty days system.*"*—The land is flowed soon after harvest, for the purpose of sprouting the volunteer and scattered Rice, until the winter sets in; it is then dried, and kept dry. As early as practicable, the stubble is burned off. The ditches and drains are well cleansed at convenient times, and the land is turned late—a short time previous to planting. After this the preparation is as usual—the trenches are fourteen† inches apart from centre to centre, and are opened four inches wide. The seed, after being "clayed," is scattered in the trenches, allowing two bushels and twelve quarts to the acre. The water is put on so as to cover all the hills, and kept so until the sprout of the rice is green, and the blade well opened; or until the rice begins to float. The water is then slacked down, until the tops of the plant show out on the level land, not regarding the low places. At this level it is held until the low places come out; it is then raised gradually every three or four days, until about six inches deep on the level parts of the field; at this it is held—observing to freshen the water every other *night*. As soon as the plant is sufficiently strong, the water is slacked down quite low, the hoe is dragged through between the trenches, and the hands pick out the long grass, weeds and rushes. The water is then forthwith returned up to the same mark as before. This working should be given about ten days before drying the field—as, soon after it is done, the plant puts out new roots, by which it is sustained and prevented from "checking" when the water is drawn. In drawing this water, the condition of the plant must guide the judgment. In ordinary seasons, the first planting may be dried in forty-five or sixty days, the last planting in forty to fifty days; whenever, about that period, the plant is putting out a new root, and always early enough to allow it thirty days dry growth at least, before forming the second joint. Seven days after the water is drawn, the field is hoed very deep, and if the land is stiff, the sods are turned over, or it is "backsodded"—in a fortnight after, it is hoed again, if practicable. As soon as the plant has formed a second joint, and the hollow is perceptible, the last or "joint water" is put on, to the same depth as before, and never raised until the rice begins to shoot forth the ear.

VALUE OF THE RICE CROP.

The value of the Rice crop, as derived from examining the actual nett revenue of six different planters for ten years, from 1830 to 1840, has been equal to $140 per annum to the hand—that is, only taking into account the *efficient force* of the respective plantations.

The price of rice for the same time, averaged as follows;—

In 1830	1831	1832	1833	1834	1835	1836	1837	1838	1839.
$2 5-8	$2 3-8	$2 13-16	$2 5-8	$3 3-16	$3 1-4	$3 7-16	$3 11-16	$4 1-17	$2 1-2

being an average for that time, of $3 1-8.

During the past season the price was low, owing partly to the want of demand for Rough Rice, which caused an undue quantity of clean Rice to be forced upon the market at the same time—partly to the increased production arising from a favorable harvest—but, principally, to the low price of breadstuffs generally, and the depressed state of trade all over the world, and the low standard value affixed to almost every thing, by a return to a Bank issue based upon a specie currency—the only safe and permanent basis.

To those planters, somewhat in debt, who have been met, in the full career of habitual expenditure, by the late and present low prices of produce, they have proved seriously embarrassing.

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* Reduced to a system by Mr. Archibald Ligett, of Winyaw, who has politely furnished this synopsis. Mr. L. thinks, and very properly, that the practice of making rice with water altogether is a vicious one, and should be resorted to only where the land is in such bad order, that the labor of planting would not be compensated by any other.

† Various distances, from twelve to sixteen inches, have been tried by Mr. L. and he has decided upon fourteen inches as the best. The writer's experience confirms this decision.

Low prices, if they continue permanent, so as to effect a corresponding graduation in price of all the usual objects of expenditure, are doubtless favorable to the lasting prosperity of the country. If this be true, our planters will not complain. The sooner they and their society can accommodate themselves to the new condition of things, i. e. *buy less*, and endeavor to make more for sale, the sooner will those, whose business it is to supply them, graduate their prices to the reduced standard—and their renewed prosperity, if it be less sudden and ostentatious, will not be the less sure and permanent for that; nor the less gratefully acknowledged.

DRILL PLOUGH.

Some where about the year 1812, the late Dr. Robert Nesbit, returning from a visit to his native country, (Scotland,) introduced an implement in the economy of Rice-planting, which excited no little interest among the planters in his neighborhood. It was called the " Drill Plough." Its office and uses were to open the trenches and deposit the seed, which it was found to do very well when managed with care, to the saving of so much labor.

The Drill Plough was borne by a carriage on two wheels, very much resembling in size and height an ordinary dray, and was drawn by one horse between shafts. It consisted, generally, of a long box parallel with the axle and above it, into which the given quantity of seed grain was placed and locked up. From this box the grain was distributed by means of regulators into and through tin tubes, descending nearly to the earth, at the required distance from each other for planting. These tubes or cylinders were guided in their descent, and sustained in their respective positions, by rods of iron fixed firmly into the frame, but so as to yield to an obstacle when pressed hard against. The rods, on their part, were each furnished at bottom with a sort of shoe, protruding a little beyond the tube, for the purpose of marking and opening the trench into which the seed was to be conveyed by its corresponding tube. Although a little too complicated, it was, upon the whole, a complete and interesting labor-saving machine. Drawn by a good horse, over ground in high tilth, and managed by a skillful and judicious hand, the Drill Plough would trench and seed from eight to twelve acres of ground in the day, in proportion nearly as it was furnished with a less or greater number of trenching-shoes and tubes It was used successfully by the importer, and, more or less, by several other planters on the Waccamaw and Pee Dee, up to the year of his death, (1821,) since which time it has been entirely adandoned. This result is supposed to be owing not to the fact that the plough was not found to be highly useful, so much as to this, that to use it successfully, it required more minute attention and judgment than could be calculated on, among the field laborers of that day. The writer is inclined to the opinion, that the Drill Plough will again be introduced, and successfully used in Rice-planting.* Indeed he has himself ordered the importation of an improved one from Scotland, to be accompanied by a laborer who is familiar with its use. One of these ploughs, used by the importer, having four tubes, would, on long beds, trench and sow *ten* acres in a day. Another furnished with six tubes, could accomplish *fifteen* acres under like circumstances, in the same time.

A simple trenching plough, furnished with coulters for opening two or three trenches at a time, has been used with advantage on light soils; but it has not been generally adopted.

THRESHING MILL.

The same gentleman, Dr. Nesbit, who was as much distinguished by his general intelligence, and scientific ingenuity, as he was noted for skill and success in the practice of his profession, imported and used upon his plantation in the year 1811, the " Scotch Threshing Mill." His motive power was the wind. When the wind was fresh and the weather fair, this machine would thresh and winnow five hundred bushels in a day.

Among the various attempts of the several inventors in this country to improve upon the Wheat Thresher so as to make it available for Rice, none met with permanent success until the year 1830, when was produced a machine, the beaters of which were shod with sheet iron and serrated with iron wire.

The principle to which is owing the superiority of this invention, is that whilst revolving with increased rapidity, (600 to 800 to the minute) by means of the teeth with which

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* Since writing the above, it is ascertained that Mr. Francis M. Weston, of Waccamaw, who has just returned from England, has ordered for importation an improved *Drill Plough*, which, on its arrivel in this country, will be left some time at the Agricultural Repository of J. D. Legare, for the inspection of planters. Should Mr. Weston furnish me with a description of this implement, it will be found in the Appendix.

the beaters are furnished, it combs off the grain from the numerous foot stalks of which the ear of Rice is composed. The invention, which is now in very general use, yielding, when worked by animal power, from two to three hundred bushels per day, and when propelled by steam 450 to 700 bushels each, is due to the ingenuity and mechanism of Calvin Emmons, of New-York. (*See Appendix D.*) To the liberal enterprise and public spirit of Gen. James Hamilton are the planters of Rice indebted for the first thorough test of the powers of this machine, and for the subsequent early notoriety of its successful operation.

☞ See in the Drawing Department of the U. S. Patent Office an illustration of Mr. Emmons's patent, dated 27th of July, 1829.

MILLING.

Although it is recorded that planters early in the 18th century cleaned their Rice by mills worked by horses or oxen, yet this could not have been the case generally, till about the middle of that century. Even towards the period of the war, hand-mortars were still extensively used.

The method was, that each male laborer had three pecks of Rough-rice in a mortar, and each female two pecks, to pound before day or sun-rise; and the same at night, after finishing the ordinary task in the field. The pounding was done in wooden mortars made of the common pitch pine, to contain a bushel or less; the pestle was made of lightwood or the heart of pine seasoned: the process was conducted on the floor of a large barn prepared for the purpose. The Rough-rice was sometimes ground by being passed between wooden blocks twenty inches in diameter by six inches thick, worked by hand. The mills early in use, and propelled by animal power, were the Pecker-machine, (so called from the striking resemblance of the pestle when in action, to the bill of the Wood-pecker,) and the Cog-mill, both of which have been entirely superseded by the improved Pounding-mill, propelled by water or steam.

Between the years 1780 and '90, the first *Water-mill* was erected by Mr. Lucas, the elder, to whom solely the credit of the invention is understood to be due.

It is to be regretted that the family of Mr. Lucas have not favored us with more full and accurate notes of their ancestor's early ingenuity and skill as a mill-wright. His son Jonathan, inheriting the father's mechanical turn and skill, constructed on Cooper river in 1801 the first *Toll-mill* for cleaning rice. He yielded at length to the invitations of the British Government and transported his improvements to England, where he himself passed the remainder of his days. His son Jonathan, now living, shipped in 1823 the first load of Rough-rice which was exported from this country.

The first Water-mill built by Mr. Lucas was, in the year 1787, for Mr. Bowman, on a Reserve at his Peach-Island plantation on the river Santee.

The next, on the same river, was on the Reserve at Washo plantation, for Mrs. Middleton, afterwards Mrs. Gen. T. Pinckney.

About the same time or soon after, a Water-mill was put up on a Reserve on Winyaw bay, for Gen. Peter Horry. Also for Col. William Alston, on the Reserve at his Fairfield plantation on the river Waccamaw.

In the year 1791-2, Mr. Lucas built on Santee the first *Tide-Mill*, for Mr. Andrew Johnston, on his plantation called Millbrook.

In a year or two after, the same indefatigable and ingenious mechanic erected on Cooper river an improved Tide-mill, being furnished with Rolling Screen, Elevators, Packers, &c., at the plantation of Mr. Henry Laurens, called Mepkin.—(*See Appendix E.*)

Upon these, the mills erected at a later day have been improvements in construction chiefly. Some substantial improvements are said to have been introduced recently by David Kidd, a machinist from Scotland, of very high character for ingenuity and practical ability. He is himself one of the best millers, practically, in the State.

In the preparation of Rice, much depends on the grinding of the rough. (In Northumberland, England, are the best quarries of stone for this purpose.) In this process, as in that of brushing and polishing the grain after pounding, there has been latterly a decided improvement, owing mainly to the observation and genius of the mill-wright just named.*

At present almost every planter of four hundred acres and upwards, is provided with a Tide-water or a Steam-pounding mill for preparing his own crops for market.

There are also a number of Toll-mills in the State, nearly sufficient for preparing all the rough-rice which is not pounded at the plantations.

In Georgetown, besides various Tide-mills on the neighbouring plantations, which

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*Mr. Chisolm.

pound on toll, more or less, there is a very good Steam-mill owned by Mr. Benjamin King.

	Tierces	600 *lbs. nett.*
To 3000 bushels of fair Rough-rice this mill will yield of prime Rice for market,	144	300 lbs
Of Middling,	7	
Of Small Rice,	6	
OfFlour,	320 bushels.*	

In Charleston and its vicinity there are numerous Tide-mills and several Steam-mills; the chief and most successful of the latter are those of Mr. Chisolm, Mr. Hume and Mr. Lucas.†

Mr. Lucas has not favored me with a reply to my queries in relation to the operations of his Mill. Nor has Mr. Hume.

From accounts of the operations of Mr. Chisolm's Mill, I infer that 3000 bushels of fair rough-rice will yield of prime Rice for market, *Tierces* 600 *nett.* 148 300 lbs.

Of Middling,	3
Of Small,	3
Of Flour,	330 bushels.*

In the city of New York, owing to the public spirit and enterprise of Col. Benjamin F. Hunt, there has been for some years in operation a very good Steam-mill, which receives Rice on toll, and consumes, besides, some 50,000 bushels of Rough on its own account.

As the other Toll-mills from which I have heard have furnished results based upon the preparation of South-Carolina Rice alone, I have thought proper to use only Mr. Bilby's experiment with the Charleston Rice.

	Tierces	600 *lbs.*		
To 3000 bushels of Rough Rice, the New York Mill yields of prime Rice,	82	422		
Of Good to Fair Rice,	45	570	*bbls.*	*lbs.*
Of Broken Rice, (middling?)	16	129	144	521
Of small Rice or Chitts, (26.31 bushels.)			2	510
Of Flour or Douse, (381. 21 bushels)			15,630	lbs.*

In the Mill erected by Mr Napier on Cooper River, "*Wire Cards*" are used instead of Pestles for cleaning the grain.—This mode of preparing Rice imparts a slightly blueish tinge to the grain, tho' it is supposed to keep longer than rice prepared in the ordinary way. Rice thus prepared will not command as high a price per cwt. as that from the pestle of similar quality, but it is said to be the interest of the planter to patronize the "Cards," inasmuch as the yield in whole rice from a given quantity of Rough is invariably gr ater, the offal being less. In the year 1842-3, this mill prepared about seven thousand barrels, and seems to have given satisfaction to patrons.

The trial upon Mr. Deas' Rice from Santee is selected as the fair test of this mill, 1950 bushels. At the same rate 3000 bushels of prime rough rice will yield in prime

	Tierces	600 *lbs.*
Rice for market,	144	
In Middling Rice,	368.85lbs.	
In Small Rice,	1.323.23 "	
In Flour,	226 bushels.*	

Recently an ingenious method of lifting the pestles has been invented by Mr. S. K. Williams of the city of Charleston, to be used in substitution of the lever ("lifter") described in Mr. Lucas's mill. One advantage of this invention is said to be the greater rapidity with which the pestles (themselves lighter) may be driven without interfering or "slamming." Another, that a system of pestles and mortars may be more compactly arranged in circular form, and may be moved by a less power.

The invention is called "The Spiral Shaft Rice Mill." As it has never yet been actually tested, nothing more can be said of it here.

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*See Appendix F.

†Since the above was published it is ascertained that Mr. Nowell has applied a steam engine to his mill.

PROCESS OF PREPARATION.

The stones which are used for grinding rice should be 5 to 6 ft. 2 in. diameter, and 18 inches thick at the centre. There is said to be a quarry in Northumberland affording stones of such excellent substance, that they will grind rough rice enough for packing 1000 barrels without being taken up.

The whole process of preparation may be described generally as follows. From a shed or convenient store-room attached to the mill-house, the rough rice is taken by means of elevators, (*i. e.* a system of small tin buckets attached to a long revolving band of leather) up to the highest apartment in the building, to be passed through a sand-screen revolving nearly horizontally, which in sifting out the grit and small grain rice, separates also all foreign bodies, and such heads of rice as were not duly threshed.

From the sand-screen the sifted rough of large size is conveyed directly to the stones on the same floor, where the husk is broken and ground off, thence to a wind-fan below, where the chaff is separated and blown off. The grain is now deposited in a long bin, placed over the pestle-shaft and corresponding in length with it, whence the ground rice is delivered by wooden conductors into the mortars on the ground floor, (ten, twelve, fourteen or twenty-four in number, as the power applied may justify.)* These mortars, improved by Mr. Kidd's design, are constructed beautifully of four pieces of the heart of pine, seasoned. They are in figure a little more than a semi-ellipsoid, and are made to contain four and a half bushels of ground rice each.

The pestles, also constructed of the heart of pine and corresponding in number and position with the mortars, are sheathed at foot with sheet-iron, partially perforated in many places from within by some blunt instrument, so as to resemble on a very coarse scale the rough surface of a grater. They are intended to weigh each 240 to 280 lbs. or thereabout, are lifted by levers six feet long attached (2 feet out) to the large pestle-shaft, and make from forty-four to forty-eight strokes in a minute. A mortar of rice is disposed of, or sufficiently pounded, in one hour and forty minutes to two hours. The grain thus pounded is again elevated to the upper floor, to be passed through a long horizontal rolling-screen, slightly depressed at one end, where, by means of a system of wire-seives grading coarser and coarser towards the lower end, are separated first the flour, second the "small rice" (the eyes and smaller particles of the broken grains) third the "middling rice" or the smaller, and the half broken grains, fourth and last the "prime rice," the larger and chiefly unbroken grains, which fall through the largest wire, and forthwith descends to the "polishing" or "brushing screen" below, whence it descends through a fan into the barrel on the first floor, where it is packed and the preparation is completed.† The head rice (or largest grains of all,) together with the rough, unbroken by the stones, passes off at the lower end of the screen, to be pounded over.

The "*brushing-screen*" consists of a vertical cylinder or drum two feet in diameter, by from four and a half to six feet in height, to the surface of which are attached, vertically, shreds of sheep-skin closely packed; this drum is made to revolve with great velocity within, and lightly brushing a cylindrical frame of iron wire made into a fine seive. In passing down spirally between this clothed drum and the exterior cylindrical wire-seive, the grains are relieved of the particles of flour which still adhere to them, and which are brushed off by the wool and forced out through the meshes of the wire. The rice thus brushed clean and polished against the wire, is packed in barrels constructed of pine staves to contain six cwt. nett. The middling and small rice are passed through a fan which blows off from them the flour into an apartment kept for that purpose. They are packed separately, and used as provisions for the laborers on the plantation during the warm months, chiefly at Christmas holidays and throughout harvest, and habitually by the families of both the proprietor and his overseer.

Rice being so completely protected by its silicious husk, and thus so much less liable to damage from transportation in the rough, than when cleaned, owing too, to the superior manner in which clean rice can be presented in the European markets fresh from the screen, capitalists concerned in this trade have caused mills propelled by steam to be erected on Mr. Lucas's plan at various ports in England, and on the Continent, at which

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* It is understood that Mr. Lucas's mill drives 28 pestles, and Mr. Chisolm's 30.

† Mr. Chisolm has constructed in his mill a second screen for polishing, through which the rice from the brushing screen is passed on its way down to the barrel.

upwards of 400,000 bushels of rough rice from this State are annually prepared—besides a quantity of paddy from the East Indies, and from other quarters.

To encourage the construction of such machinery in Great Britain, and to protect the capital invested in the mills, the importation of rough rice, rather than clean, is encouraged in that kingdom by a discriminating duty in favor of the former, equal to four dollars per barrel of the latter.

In England, there are in operation four mills—two in London and two in Liverpool, consuming each about 75,000 bushels of rough annually. When the price of Carolina rice ranges high, these mills are, to a great extent, employed in manufacturing paddy from the East Indies.

The mill in Scotland has been converted to another purpose.

In Denmark, at Copenhagen, a mill has been in operation about six years—consumption about 90,000 bushels of rough.

At Bremen, there is a mill intended to prepare either wheat or rice, according to the state of the markets.

At Flensburgh, also, there is a mill constructed for both wheat and rice—capable of manufacturing 20,000 bushels of rough rice.

In Holland, at *Amsterdam*, a mill has been some years in operation which requires from 60 to 80,000 bushels of rough rice annually.

In Portugal, at *Lisbon*, there is a small mill which prepares either wheat or rice, requiring about 10,000 bushels of Carolina annually.

In France, at *Bordeaux*, a mill has but recently been put in operation—for it, in the year 1842, were shipped about 60,000 bushels of Carolina rough.

A mill constructed after Mr. Napier's plan has been erected by the "Northampton Rice Company" at *Maranham*, in *South-America*, where it is in successful operation. It is supplied with paddy grown in the neighborhood.

The articles received from the several countries above named, as well as from Cuba, may here be mentioned.

From *Denmark* and *Holland*, as indeed from all the other countries, (England and France excepted,) little is received in the shape of return cargoes—the purchases of both rough and clean rice, being, for the most part, paid for by bills of Exchange on London.

From *Bremen*, were once received glass-ware, bottles, bagging, hams, paving-stones, &c., but the United States Tariff of duties has put a stop to these importations.

From *Portugal*, the returns are fruit and wines principally.

From *France*, the articles at present received are silks, wines and brandy. This trade also has been affected by the tariff.

From *England*, are imported in return, iron, hard-ware, manufactures of cotton, woollen and linen, salt, coal, &c.

From *Cuba*, the returns are sugar, molasses, coffee and fruit.

The consumption of rice in Cuba is estimated at 15,000 barrels for the North-side, and 2,000 for the South-side of the Island. (*See Appendix G.*)

EXPORTS.

John Archdale, Governor of Carolina, in 1694–5, who gave more general satisfaction to all parties than any other under the proprietary rule, was a Quaker—a very pious, mild man. He succeeded in the government Landgrave Smith, and was in turn succeeded by Joseph Blake. He returned to England in the year 1696. In the year 1707, was printed for him in London a pamphlet, which, from internal evidence, appears to have been written some two or three years anterior. In this pamphlet he says—"Notwithstanding all the discouragements it (the trade of the Colony) hath met withal, which are many, yet *seventeen* ships this year came laden from Carolina with *rice*, skins, pitch, tar, &c. in the Virginia fleet, besides several straggling ones."* From this time to the year 1720, during the greater part of which time the coast was infested by fleets of piratical vessels under command of the notorious Steed Bonnett, and others, there is extant no record of the exports of the Province.

In a statement, intended for the House of Commons, drawn up about the commencement of the war with France, by the merchants of London concerned in the rice trade,

* 2 Car. Col. p. 97.

and published by Governor Glen in his "Description of South Carolina," 1761, the exports of Rice from Carolina are thus given:—

From	1720	to	1729,	inclusive,	264,788	barrels=44,081	tons.*
"	1730	to	1739	"	419,525	" =99,905	tons.†

From another source is obtained the following statement:—

Exports of Rice from the Port of Charleston, S. Carolina, from	*Casks.*
Nov. 1724 to Nov. 1725,	17,734
From 1725 to 1726, from Nov. to Nov.	23,031
" 1726 to 1727,	26,884
" 1727 to 1728,	29,905
	Barrels.
" 1728 to 1729,	32,384
" 1729 to 1730,	41,722
" 1730 to 1731,	39,487
" 1731 to 1732,	37,068
" 1732 to 1733,	50,726
" 1733 to 1734,	30,323
" 1734 to 1735,	45,317
"	and 1,038 *Bags*

From the Commercial Column of the "South Carolina Gazette."

Exports from Charleston, S. Carolina,	*Bbls.*	*Bags.*	*Price at last mentioned period.*
From 1735 to 1736,	52,349	1,554	
" 1736 to 1737, from Nov. to Nov.	42,619	519	£3
" 1737 to 1738,	34,324		
" 1738 to 1739,	67,117		40*s.*
" 1739 to 1740,	91,110		45*s.*
" 1740 to 1741,	80,040	2,137	55*s.*
" 1741 to 1742,	46,196		

From the Carolina Gazette.

	Bbls.	*Bags.*	*Price at last mentioned period per cwt.*
From 1742 to 1743, from Nov. to Nov.	73,416		40s.
" 1743 to 1744, " "	80,778		25s.
" 1744 to 1745, " "	59,627		17s. 6d.
" 1745 to 1746, " "	54,101		20s.
" 1746 to 1747, " "	54,146		46s.
" 1747 to 1748, " "	55,132		55s.
" 1748 to 1749, " "	41,034		
" 1749 to 1750, " "	48,011	525	
" 1750 to 1751, " "	61,522	223	37s.
" 1751 to 1752, " "	78,360	186	70s.
" 1752 to 1753, " "	35,522		45s.
" 1753 to 1754, " "	88,659		50s.
" 1754 to 1755, " "	96,778		40s.
" 1758 to 1759, " "	51,718		
" 1759 to 1760, " "	60,789	44	45s.
" 1760 to 1761, " to Oct. 10th,	101,359	74	37s. 6d.
" 1761 to 1762, " Nov.	79,642		30s.

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* The weight of the barrel would seem to have been about 325 lbs.

† The weight of the barrel now.....400 "

‡ 2 Car. Col. p. 265.

§ From the French of G. M. B. Dumont, (1755,) furnished by the Hon. M. King.

				Bbls.	*Bags.*	*Price at last mentioned period per cwt.*
"	1762 to 1763,	"	"	101,059	44	50s.
"	1763 to 1764,	"	"	101,842		
"	1764 to 1765,	"	to Sept. 14th,	107,292		50s.
"	1768 to 1769,	10th Oct.	to 24th Aug.	116,715		65s.
"	1770 to 1771,	1st Nov.	to 10th Oct.	130,500		

As follows:—

To great Britain,	73,325
To Portugal	14,439
To Spain,	1,760
To Italy,	222
To Foreign West India Islands,	975
To British " "	30,305
To Ports on this Continent,	9,665
In the year 1770, from the Colonies,	150.529—$1,530,000*

From the Carolina Gazette.

	Bbls.	*Price at last mentioned period.*
From the port of Charleston, South Carolina, from 1772 to 1773, from 1 Nov. to 2 Aug.	112,469	£3 10s.
From 1773 to 1774, from 12th Nov. to 7 Nov	118,482	
From Beaufort same time	3,630	
" Georgetown	2,964	
Crop of 1773 Exported	Total, 125.076	

From Hunt's Merchant's Magazine, Vol. 9, *No.* 1.

				Tierces.	*Value on ship-board.*
In the year	1791,	from the	United States,	96,980	
"	1792,	"	"	141,762	
"	1793,	"	"	134,611	
"	1794,	"	"	116,486	
"	1795,	"	"	138,526	
"	1796,	"	"	131,039	
"	1797,	"	"	60,111	
"	1798,	"	"	125,243	
"	1799,	"	"	110,599	
"	1800,	"	"	112,056	
"	1801,	"	"	94,866	
"	1802,	"	"	79,822	
"	1803,	"	"	81,838	$2,455,000
"	1804,	"	"	78,385	2,350,000
"	1805,	"	"	56,830	1,705,000
"	1806,	"	"	102,627	2,617,000
"	1807,	"	"	94,692	2,367,000
"	1808,†	"	"	9,228	221,000
"	1809,	"	"	116,901	2,104,000
"	1810,	"	"	131,341	2,626,000
"	1811,	"	"	119,356	2387,000
"	1812,‡	"	"	77,190	1,544,000
"	1813,	"	"	120,813	3,021,000
"	1814,	"	"	11,476	230,000

* Pitkins Statistics.

†The year of the embargo.

‡ War with Great Britain,

			Tierces.	*Value on ship board.*
In the year	1815,	from the United States,	129,248	2,785,000
"	1816,	" "	137,843	3,555,000
"	1817,	" "	79,296	2,378,001
"	1818,	" "	88,181	3,262,697
"	1819,	" "	76,523	2,142,644
"	1820,	" "	71,663	1,714,923
"	1821,	" "	88,221	1,494,923
"	1822,	" "	87,089	1,553,482
"	1823,	" "	101,365	1,820,985
"	1824,	" "	113,229	1,882,982
"	1825,	" "	97,015	1,925,245
"	1826,	" "	111,063	1,917,445
"	1827,	" "	133,518	2,343,908
"	1828,	" "	175,019	2,620,696
"	1829,	" "	171,636	2,514,370
"	1830,	" "	130,697	1,986,824
"	1831,	" "	116,517	2,016,267
"	1832,	" "	120,327	2,152,631
"	1833,	" "	144,166	2,774,418
"	1834,	" "	121,886	2,122,272
"	1835,	" "	110,851	2,210,331
"	1836,	" "	112,983	2,548,750
"	1837,	" "	106,084	2,309,279
"	1838,	" "	71,048	1,721,819
"	1839,	" "	93,320	2,460,198
"	1840,	" "	101,660	1,942,076
"	1841,	" "	101,617	2,010,107*

The following statement of exports from South-Carolina, derived from the journals of the day, is given from the year 1832, the period from which has been kept an account of the *receipts* of Rice at the port of Charleston. The exports coastwise being rarely cleared, cannot with accuracy be given.

The foreign exports of Rough Rice are included in the foreign exports of tierces, at the rate of twenty-one bushels to the tierce—and so with the exports coastwise.†

October to October.	Receipts.	Foreign Exports.	Coastwise.	City Consumption.	Foreign Exports of Rough Rice.	Coastwise.
	Tierces.		Exports.		Bushels.	Exports of Rough Rice.
1832 and 1833.....	143,473	90,246	47,003	7,776		
1833 and 1834.....	117,403	80,089	30,918	6,330		
1834 and 1835.....	121,898	74,868	42,501	5,600	317,594	41,288
1835 and 1836.....	133,633	79,007	47,226	6,200	356,752	63,235
1836 and 1837.....	119,961	63,396	40,614	5,500	512,808	39,609
1837 and 1838.....	90,384	51,514	30,837	6,600	336,442	44,733
1838 and 1839.....	106,001	63,617	36,295	6,850	470,412	43,950
1839 and 1840.....	107,108	68,795	31,591	6,800	431,306	10,342
1840 and 1841.....	107,052	75,265	25,970	6,200	455,592	37,166
1841 and 1842.....	118,004	75,739	34,174	7,200	445,685	15,770
1842 and 1843.....	136,732	71,575	58,011	7,300	294,018	33,493

* Hunt's Merchant's Magazine, vol. 9, No. 1.

† This statement is furnished by Mr. J. W. Cheesborough.

The exportation of Rough Rice to foreign countries commenced about the year 1823,* as appears from the following (amongst other testimony,) "account of the quantity of Rice imported into, and re-exported from the united kingdom of Great Britain and Ireland, for ten years, ending 5th January, 1828. Ordered by the House of Commons." Extracted from the *Southern Agriculturist*, volume 1, p. 461.

CLEAN RICE.

IMPORTS.	1819.	1820.	1821.	1822.	1823.	1824.	1825.	1826.	1827.	1828.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
British Possessions,	322,986	375,461	192,982	73,831	12,871	30,648	24,772	18,918	50,380	107,325
Foreign,.....	102,532	95,763	89,085	56,720	107,388	94,056	123,194	35,779	40,774	43,897
Total,....	425,518	471,224	282,067	130,551	120,259	124,704	147,966	54,697	91,154	151,222
Exports,.....	142,880	150,552	100,403	105,249	139,600	79,370	92,897	50,463	35,445	51,620

ROUGH RICE.

IMPORTS.	1820.	1821.	1822.	1823.	1824.		1825.		1826.		1827.		1828.	
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.
British Possessions,	758	2,093	781	259	298	193		3,272		4,839		2,855		10,322
Foreign,.....						13,053		92,480		111,646		113,526		171,893
Total,.....	758	2,093	781	259	298	13,246		95,752		116,485		116,381		182,215
Exports,.....														
Rice cld. fm. Paddy,							676		2,717		5,435		1,070	

DUTY.

On British clean, 7s. 6d.; in 1820, reduced to 5s.; in 1828, to 4s.; subsequently to 6d. per cwt.
On Foreign clean, 20s.; in 1820, reduced to 15s.; in 1842, to 6s. per cwt.
On British Rough, 2s. 6d. per cwt.; in 1823, to 7 1-2d. per bushel; in 1827, to 3d.; in 1842, to 1d. per quarter.
On Foreign Rough, 10s. per cwt.; in 1823, to 2s. 6d. per bushel; in 1842, to 10 1-2d. per bushel.

* The first cargo of Rough Rice was shipped to England from Charleston by J. Lucas, junr., in the year 1823.

APPENDIX A.

The Chinese, who pay the greatest attention to the cultivation of rice, manure their lands with all sorts of filth, dung, &c.

In order to make the rice grow the better, they are careful, in certain places where they sow, to bury bolls of hogs hair or any other sort of hair, which, according to them, gives strength and vigour to the land and makes the rice better; those whose business it is to shave the head are very careful in saving the hair till the inhabitants of these parts come to purchase it for about a half-penny a pound, carrying it away in bags, and you may often see barks loaded with nothing else.

When the plant begins to ear, if the land be watered with spring-water, they mix quick lime with it, pretending that it kills worms and insects, destroys weeds, and gives a warmth to the ground very much tending to make it fruitful.—2. *Du Halde's History of China*, (1741,) *p*, 109.

"Account, geographical, statistical and historical, of Orissa proper, or Cuttach," a territory in India lying on the river Hoogly, and the sea.—"*Asiatic Researches*," *or transactions of the Asiatic Society, instituted in Bengal*, 15, 171.

Rice is the great article of produce and consequently of food, throughout Orissa proper. In the Pergunnahs north of the Byterini it is almost the sole object of agricultural labor. The grain is in general large and nutritous but coarse, and is considered inferior to the average produce of Bengal and Behar.

The crops of Cuttach are called Sared and Beali. Of these, the first and principal one is sown in May and June and reaped in from the middle of November to January, (a 2nd crop rare.) The second in importance, called the Beali, is sown about the same time on the higher lands, and reaped from end of August to end of September.

Also an inferior description of rice, which is sown in low marshy spots, at the opening of the cold weather, and by frequent transplantation and irrigation is rendered fit for cutting in the following April. The cultivation of the latter sort is called Dalo, takes place chiefly in the Pergunnahs between Khundah, the Chilka Lake and the sea.

"Report of the London Society of Arts." Journal of the Asiatic Society for 1836, vol. 5, 366–8.

"The Soomla or Himalaya Paddy, or Mountain rice, received from Mr. Hodgson, resident of Nepal, appears to be of the same kind as a sample (comprising five varieties) sent to the Society of Arts, in 1821, by Dr. Wallach." * * * *

"The high-rice is nearly of the same quality as the latter kind," (East India rice inferior) being dark coloured, opaque, and not at all calculated for the English market.

After being cut down, the *Malsi* Rice is stacked on the field and left to become heated and to ferment six or eight days, after which the stacks are pulled to pieces and the grain separated from the straw, (by shaking the sheaf and beating it a few times on the ground,) is winnowed by being shaken to the wind from a shallow platter made of matt and bamboo, and dried in the sun. The grain thus treated is called hukwa, and is much liked.

Another mode is to beat out the rice with a long stick as it lays upon the ground. All the grain in the valley is separated from the straw on the field, and carried home after being winnowed, in bags and baskets. It is reaped with a sickle. * * *

The *Chusa* is made thus; the rice in husk (dhan) being steeped in water for a day and night, is toasted for a short time on a stone or large tile heated for the purpose; when thus parboiled, and while still soft, it is thrown into the wooden mortar and bruised into thin flat flakes, in which state, having been seperated from the husks and dried, it is sold in the shops and eaten by the people. A native of Nepal or of Bengal and Behar, will be satisfied to live on this substance alone for many days together; a small quantity of *Sukur* (unpurified, partially crystallized sugar) added, gives it a most grateful relish, to the rarely stimulated palates of these poor and primitive people.

Kuti (*Newori*) the machine for converting the (dhan) into eatable rice, by husking it, is the same as that for making *Surki* from bricks (hence called the *Dhenki?*)—*Ibid.* vol. 6, 1836, 962–3.

Capt. Charles Wilkes, of the U. S. Navy, the intelligent and able commander of the recent exploring expedition, informs me that except at Manila, no specimens of rice were obtained by the expedition, the crops not being in a state to furnish specimens—he has obligingly furnished the following remarks: "In Brazils you have the result of Mr. Brackenridge's actual observation; he was Horticulturist to the expedition. I may add that the rice of Brazil, as an article of commerce, is not esteemed in comparison with our best rice, and does not keep well; this is also the case with the rices of the Philippine Islands. Of the latter you have an account handed me for you by Mr. Rich, our Botanist, which he obtained from the best authorities. Speaking well the Spanish language, he was enabled to obtain much information and had much intercourse with several distinguished gentleman of Manila who are well acquainted with this branch of cultivation.

"Instead of the word *Paddy* being applied to Mountain Rice exclusively, as Loudon has it, in the Phillippine Islands and at Singapore they apply it to all Rice with the husk on: this I found invariably their practice. The Rice fields of the Phillipine Islands (the Water Rice) both before and after it is growing, yield a large supply of fish for the inhabitants; some, it is said, much over a pound in weight and a foot in length! The only mode they have of cleaning the Rice of the husk is to beat it in a wooden mortar by hand; this each family does for itself, it being sold as Paddy.

"All the aquatic kinds are planted in July and August by hand, and are reaped in December. The upland Rice comes much sooner to maturity, and is much esteemed, though they do not raise any great quantity.

"Near Singapore, there are no Rice fields yet; the country is better adapted for sugar; it is imported from Cochin China and China. We have had no opportunity of getting the information you desire, relative to the Rices of Sumatra and Java. The specimens of Rice obtained at Manila are small and not in such a state as to be preserved for usefulness. Any description of those mentioned by Mr. Rich may be obtained from our Consul at Manila, immediately after the crop is gathered; it will afford me pleasure to be instrumental in procuring such as you may desire."

Remarks of Mr. W. D. Brackenridge, Horticulturist, attached to the U. S. Exploring Expedition, under the command of Charles Wilkes, Esq., U. S. Navy.

"*In Brazil*, towards the base of the Organ Mountains, where the country is rich and flat, the cultivation of Rice is carried on to a considerable extent. At one place, on the banks of a small river, we observed not less than seventy acres sown with Rice.

"The following, apparently, was the mode of cultivating it there. Dikes or dams, in breadth three or four feet, enclosed from two to three acres. These enclosures were either square or oblong, as suited the nature of the ground, which had been ploughed, made fine and level, with several furrows or runs through the centre of each (for the purpose of draining the surface?) In the dikes were two or more gaps or sluices, to flood or let off the water at will. The young Rice plants, when we saw them, were from two to three inches high; the ground was moist to saturation, but not flooded. We were told that water would be let on in a few days, and allowed to remain till the plants were in flower. The soil was a deep rich black earth. This culture on the part of the Brazilians resembles very much that of the Westphalians.

Several patches of Rice were seen at the Sandwich Islands, near Honolula."

Remarks by Mr. Rich, the Botanist attached to the U. S. Exploring Expedition, under the command of Charles Wilkes, Esq., U. S. Navy.

"The varieties of Rice cultivated at the Phillippine Islands are very numerous; the natives distinguish them by the size and shape of the grain; the following are some of the most esteemed varieties:

Binambang—With the leaves slightly hairy, glumes whiteish, grows to the height of about five feet, flowers in December. Aquatic.

Lamnyo—Greatly resembles the above, is more extensively cultivated, particularly in Batangas, where it is the principal article of food among the inhabitants of the coast.

Malagequit—This variety derives its name from its becoming very glutinous after boiling; it is much used by the natives in making sweet and fancy dishes, but is consi-

dered unwholesome; it is also used in making a white-wash,* which is remarkable for its brilliancy and for withstanding rain, &c. Aquatic.

Bontot Cabayo—Common in Ilocos, where it is cultivated both upland and in water; it produces a large grain, and is therefore much valued, but it has rather a rough taste.

Dumali—Or early Rice. This variety is raised in the uplands exclusively, and derives its name from ripening its grain three months from planting; the seed is rather broader and shorter than the other varieties; it is not extensively cultivated, as birds and insects are very destructive to it.

Quinanda—With smooth leaves. This variety is held in great estimation by the people of Batangas, as they say it swells more in boiling than any other variety. It is sown in May and gathered in October. Upland.

Bolohan—This variety has very hairy glumes; it is not held in much esteem by the natives, but is cultivated on account of its not being so liable to the attacks of insects and diseases as most of the other upland varieties.'

Malagequit—Smooth leaves, glumes red, (in all the above they are whiteish,) it possesses all the qualities of the aquatic variety of the same name, that of becoming very glutinous after boiling, &c. This Rice is said to be a remedy for worms in horses, soaked in water with the husk on. It is given mixed with honey and water.

Tangi—Leaves slightly hairy, glumes light violet color. This upland variety is much esteemed for its fine flavor."

APPENDIX B.

The following methods of preparing rice in the Cuisine, though common with us, may not be found in all the manuals of house-keeping. They are deemed not unworthy of being noticed in this Appendix:—

To boil Rice.—Pick all the specks and gravel from the rice, then wash it thoroughly in cold water, have your pot of water boiling, add salt, and then put the rice in and stir it while boiling, let it boil four minutes, then pour off the water as close as you can, without stirring the rice, set the pot on some coals and cover it; let it remain twenty minutes, then dish it up for use. Prepared thus, it is the most simple among vegetables, is palateable, nutritious and light. When boiled, rice is increased in bulk some 150 per cent. and in weight over 100 per cent. For dyspeptics, there is no vegetable so innocent.

Rice Breakfast Bread.—Mix a spoonful of butter with some hot hominy, very thoroughly, and spread it to cool, then beat up an egg very light, add some milk, then mix in the hominy with rice flour† until it is a thick batter, add salt *q. s.*, stir it well, then drop it from a spoon into an oven and bake quickly.—*Vaux.*

Another Rice Bread.—Have a bucket for the special purpose—mix over night some hominy, or the eyes of the rice, boiled soft, with milk and rice flour, (having added salt, *q. s.*,) into a stiff batter, so that it will just pour—set it where it will not get warm, which injures it: in the morning stir it, pour it into the pan and set it to bake.—*Gallavant.*

Griddles for Breakfast.—Mix a thin batter with milk and rice-flour, adding salt, *q. s.* have your griddle-iron hot, grease it with lard, pour some batter on, spread it thin, turn it and brown it both sides.

Rice Glue.—There is also a very good glue made from rice, by boiling the ground rice in soft cold water till it acquires the consistency of a thin jelly.—*Ency. Am.* This is one of the best cements for china-ware, shells, &c.

Starch from Rice.—This is said to be finer, whiter, and better, inasmuch as a given quantity will go further than that produced from wheat. The manufacturers, however, allege that the material is too costly to justify their using it in making starch. Moreover the difficulty of separating from it the gluten contained in this grain, is an obstacle in the way of its use. It is to be hoped that some of our chemists will yet discover a more ready and certain method of completing this process.

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* Small Rice is used in the lower parts of Carolina for making white-wash with lime; and with good effect.

† Rice flour is obtained by pounding into powder in a hand mortar the requisite quantity of milled rice, (two quarts of rice will make nearly three quarts of flour.) This is the best way to prepare it for immediate use; if kept, it soon becomes acid. It is sometimes ground by the mills. This keeps very well, but the rice cannot be so completely pulverised when ground. It is prepared thus at the New York Steam Rice Mill, and packed in barrels for exportation.

APPENDIX C.

Mount Arena, Nov. 8, 1843.

Col. R. F. W. Allston.

Your queries respecting the varietes of rice, &c., remind me of my promise to give you the result of some of my experiments with rice straw and tailings, as manure to rice land. Whenever they have been put upon my fields which had been making small crops, the effect has been satisfactory, and it has become a part of the system of my plantation.

In the month of Nov. 1839, I caused the stubble of two fields, one fifteen the other ten acres, to be listed four feet apart, and parallel with the drains; after which a furrow was made on each side with a large plough; the land unbroken in the centre was then drawn upon the beds with hoes—during the time of threshing, the straw and tailings were carried in a large flat, and each load was distributed between the beds of one acre, until the whole was covered. In this state they were left until the last week in June, when all the volunteer rice and grass was hoed down, and the beds reversed with ploughs and completed with hoes. The ditches and drains were then cleaned, and the fields were planted in peas, set in chops about a foot apart—the land was in good order, and the peas grew luxuriantly and made a fine crop—no volunteer rice, and as little grass as possible was allowed to go to seed.

In the first week of April, the vines were cut down, and the beds levelled with ploughs and hoes. This was very easily done, as the land was dry and remarkably loose—they were then trenched in the usual way thirteen inches from centre to centre—two bushels and twelve quarts of rice were planted to each acre, and the seed was well covered with earth. During the cultivation, the common plan was pursued, i. e. sprout, point, long, and lay-by flow—two hoeings between point and long-flow, two after, and one picking in the water. The crop was well saved, and produced within a fraction of seventy-three bushels to the acre. The straw and chaff of this rice was of a much brighter color than any other made upon the plantation, and the grain was of superior quality—1970 bushels of rough rice, made from land treated in the manner described, was pounded at the Georgetown Steam Mill last winter, and turned out

Tierces, 600 *lbs. nett.*

98,157 lbs. prime rice,
5 barrels middling, and
3 ditto small, with
193 ditto flour.

I cannot say what had been made upon these fields for the three or four previous years, but on reference to the plantation book, where an account had been kept, I found the average crop from them to have been thirty-three bushels and a fraction to the acre.

In some of my fields I have planted oats upon the beds, one and sometimes two rows, and these have, in some instances, been followed by potato slips, which succeed remarkably well; and it may be worthy of notice, keep fully as well, if not better, than those made upon high land.

Although the rice thus made received as much work as is usually bestowed under the best cultivation, yet it was not bestowed from its seeming to require it, but from the fact of its being convenient to do so in turn with other fields of the plantation. I believe as much might have been made with two workings, as the grass had been so completely destroyed, and the land so thoroughly opened previously, that but little remained to be effected by the hoes. From subsequent observation, this land is much more easily cultivated, and with proper care some years must elapse before the volunteer rice and various grasses regain their standing.

Which of the three means employed in this plan is of most importance, is to be determined—thoroughly breaking the soil, with the destruction of volunteer rice and grass seed, change of crop and culture, or the application of the rice-straw.

The work laid out in this manner ought not to be considered as altogether additional, but very much as given in advance, and at a time well suited to it—as when the rice planting season arrives, it will be found, as before remarked, to require very little more—after

which, its state of preparation for a good crop will far exceed any condition that could be brought about by the means at command during the winter season.

From the observations which I have made since my attention was first drawn to this matter, it appears that it would be profitable for such persons as plant weak or impoverished land to subject one fifth of the quantity annually planted, to this mode of treatment. From the increase which might be obtained in the first crop, a considerable return, if not all, would be made for the loss of a rice-crop on the land for one year, and the balance, if any, would be soon made up by the succeeding crops—besides the advantage gained from the increased fertility of the fields for some years; the enhanced value of their production from the superior quality of the grain, and the diminished labor during the cultivation of the succeeding crops.

Impoverished rice land is particularly susceptible of improvement from manure, as may be often seen when fields are so situated as to receive the washings, by rain, of adjacent corn or potato fields annually manured with rice straw; and it is more lasting in its effect than might be supposed, as is proved by the marked difference in rice growing in fields where cattle-pens or feeding troughs had been placed, often many years before.

With great regard,

EDWARD T. HERIOT.

APPENDIX D.

The following is a list of patents obtained by citizens of South Carolina, together with the Emmons' of New York, for their respective inventions or improvements of a *Threshing machine.* There are no models for these to be found, and only three are illustrated by drawings. The originals were, doubtless, destroyed by the fire of the 15th Dec. 1836; and those marked thus† have not been restored.

† Benjamin S. Hort, Georgetown, S. C.	patent	21st Feb.	1812
† Elias B. Bort, Charleston, S. C.	"	18th "	1828
† Calvin Emmons, New-York,	"	17th April	1828
† Jehiel Butts, Georgetown, S. C.	"	20th May	1830
Calvin Emmons,	"	27th July	1829
William Emmons	"	7th Feb.	1831
William Mathews, Charleston, S. C.	"	27th Aug.	1835

Here follows a description by Mr. Emmons, of his machine of 1831, with his improvements thereon.

New-York, 16th Sept. 1843.

To R. F. W. Allston, Esq.

Dear Sir:—Your letter of the 3d Aug. is received—my rice-thresher, when I first introduced it into your State in the winter of 1830–1, was constructed as follows, viz. a rectangular frame, across and near the one end of which was placed, in suitable boxes, an iron shaft, on which shaft were hung circular heads (or wheels,) to the periphery of which circular heads, and parallel with the said shaft, were attached, by joints or hinges, six toothed beaters, the length of which beaters being nearly equal to the width of the frame in the clear. The teeth of every second beater ranging alternately with the spaces between the teeth of the others; the teeth were made of 5-16ths iron rod, one and a half inches long, and set in the beaters 5-8ths of an inch apart from centre to centre of each tooth. The centrifugal force causing the said toothed beaters, when revolving, to extend themselves as far from the axis as the joints by which they are secured will permit, and thus when in motion forming a cylinder.

Underneath the beaters was placed a circular frame or bed, formed of slats parallel with the axis of the cylinder, the front edge of which frame, where the grain is received, being raised nearly to the height of the axis of the cylinder; directly in front of which is placed a pair of feeding rollers, to which the sheaf-rice was conveyed by a revolving feeding apron, the bands of the sheaves being previously cut.

The required speed of a cylinder of 18 inches diameter was found to be about 750 to 800 revolutions per minute—much over that speed would break the rice, or much under would not thresh so perfectly clean. The feed at about 60 feet per minute.

The principal improvements and alterations which I subsequently adopted, are the using of cast-steel teeth 2 inches long, of 3–8ths rod, flattened and hardened at the outer ends, (iron teeth having too rapidly worn away by the action of the Rice upon them,) and steel plates in the concave bed, which plates project 3–4th of an inch above the surface of the bed, and incline towards the feeding rollers, about 30 degrees from the radius; and which I found to protect the bed from too rapidly wearing as before, and to aid in separating the foot stalk.

Also as the feeding apron was found to wear out too rapidly by the roughness of the Rice, an inclined feeding-board was substituted.

By steam power the machines have each threshed 700 bushels per day, though ordinarily from 450 to 500 bushels per day each, and by horse power, (as you well know) much less.

I was first induced to introduce the machine in the Rice planting districts, by the urgent solicitation of Genl. Jas. Hamilton, who had seen a model or hand machine an agent of mine had in Savannah, Georgia, and which Genl. Hamilton had taken over to his plantation near that city, and with the operation of which he was so well pleased that he at once sent me a bale of rice in the sheaf, that I might further experiment with it here; and wrote me, offering every facility for trying the experiment by animal power on his plantation, if I would bring out a machine and driving geer the following fall or winter, to which I acceded; and after the erection of which machine, Genl. Hamilton invited the neighboring planters to witness the experiment, the result of which proved satisfactory. My patent is dated 27th July, 1829.

Very respectfully yours,
CALVIN EMMONS,
86 White-street, New-York.

APPENDIX E.

The first Toll Mill built in this country, was "Middleburg Mill," on Cooper River, which was finished in 1801, by J. Lucas, the son.

The first Brushing Screen used, was put into that mill in 1803.

The patent granted Mr. Jonathan Lucas by the British Government, expired three or four years ago. One of the most important advantages secured to Mr. Lucas, was getting the duty on Paddy reduced in England to 2s. 6d. per bushel.

Steam was first applied to Rice Mills in the year 1817, by Mr. Lucas and Mr. Norton.

The first cargo of Paddy was shipped to England in 1823 by J. Lucas, jr. In that year the export of Rice from this State was equal to 90,000 barrels, while in 1843 it has reached 130,000 barrels.

Among the numerous patents recorded at Washington for hulling grain, (Wheat and Rice,) the following are noted as associated with the names of citizens of South-Carolina, viz.:

Winnowing Screen Pendulum—Lewis Dupre, South-Carolina, 1st April, 1807.
Hulling and cleaning Rice—Jonathan Lucas, jr., 12th July, 1808.
Hulling and pounding husks—Jacob Read, S. C., 9th June, 1809.
Hulling Rice and polishing—Jonathan Lucas, jr., 6th November, 1819.
Hulling Rice by steam—John L. Norton, 16th December, 1823.
Hulling Rice—John Ravenel, 17th May, 1828.
Hulling Rice—Asa Nourse, South-Carolina, 19th July, 1828.
Hulling Rice—Asa Nourse, South-Carolina, 3d April, 1829.
Hulling Rice and separating grain—Peter Broughton, South-Carolina, 5th August, 1831.

The models and plans illustrating these inventions respectively, were doubtless destroyed by the fire of 1836, and have not been since restored.

There is a mill on Savannah River, (Mr. Gibbon's.) carrying eleven pestles, which, as I learned from himself, can pound fourteen barrels the tide. The pestles are shod with cast-iron about one foot in length, and secured to the wood by a long bolt driven from the bottom, and fastened by a screw and nut. The mortars are of cast-iron, weighing 600lbs., cast by Allaire, of New-York, and cost $30. They are constructed to contain five bushels of rough.

APPENDIX F.

Georgetown, Nov. 16th, 1843.

To Col. R. F. W. ALLSTON,

Sir:—I have received your communication, requesting information in relation to the preparation of Rough Rice for market, and have to say, that three thousand bushels fair quality, has turned out at the steam Rice Mill here, one hundred and forty-four and a half barrels prime Rice, and seven barrels middling, and six barrels small Rice, and three hundred and twenty bushels flour. The time of pounding, with twenty pestles, sixty hours.

I would remark, that Rice threshed on floors with flails, turns out much better than mill-threshed.

Your obedient servant.

BENJAMIN KING.

Charleston, 21st Nov., 1843.

To Col. R. F. W. ALLSTON,

Dear Sir:—In reply to your favor of 14th ult., I beg to say that the following is, to the best of my belief, an accurate statement of the turn-out from my mill of 2,000 bushels of what I consider prime Rough Rice.

To your first inquiry,

1. In what time will this quantity be preparing? One day.
2. How many tierces weighing 600lbs. nett? 105.
3. How many of second quality? None.
4. How many of middling Rice? Two barrels.
5. How many bushels of small Rice? Twenty bushels.
6. How many bushels of Rice flour? Two hundred and fifty.

With great respect,

I remain your obedient servant,

A. W. CHISOLM.

P. S. The above statement is made from Rough Rice threshed with the flail. Rice done by a threshing mill, would take from a bushel to one and a half more—owing to the quantity of straw and foot stalk not being taken out properly before sent to the mill.

A. W. C.

Results of three different parcels pounded at Chisolm's Mill, 1843.

1. 3,000 bushels Rough Rice from Waccamaw, threshed *by mill*, made
   142 barrels whole Rice of 600 nett.
   3 barrels middling.
   3 barrels small.
   330 bushels flour.

2. 3,000 bushels Rough Rice from Sandy Island, threshed *by flail*, made
   155 barrels whole Rice of 600 nett.
   3 barrels middling.
   3 barrels small.
   330 bushels flour.

3. 3,512 bushels of Rough Rice from Pon Pon, threshed *by machine*, turned out,
   In whole Rice, 164 tierces 600lbs. nett.
   In middling, 4 "
   In small, 3 "
   In Flour, 375 bushels,

From Thomas Bilby.

New-York Rice Mill, Oct. 12th, 1843.

I have made sundry trials to ascertain the several products of rough rice or paddy, a few of which I give below. In 1835 I made three trials, as follows:

1000 bushels paddy, from Savannah, produced

19,995	lbs.	of best quality,
10,145	"	of second do.
853	"	of small rice (or chitts,)
8,140	"	of flour or douse.

1000 bushels Paddy, from Charleston, produced

16,078	lbs.	of best head rice,
596	"	of " prime,
9,190	"	of good to fair,
3,243	"	of broken,
570	"	of Chitts, or small rice,
5,210	"	of flour or douse.

1000 bushels paddy, from Wilmington, produced

18,015	lbs.	of best quality,
9,989	"	of second do.
1,307	"	of small rice,
5,760	"	of flour or douse.

The above were trials of different modes of screening, so as to ascertain which would produce the most money; all the trials that I have made since the above, I have not kept any of the small and douse, and I find than every year's rice differs in its proportions as to prime and broken, as also to the whole product. This year it has averaged thirty pounds to the bushel, and about one tenth broken; last year the turn out was something less.

From J. P. Deveaux, Napier's Mill.

Charleston, 4th Nov. 1843.

Our mill differs from the pestle mill; we clean by wire cards; we have four of the rubbers in operation, which clean an average of 72 barrels in twenty-four hours. In answer to your interrogatories, I will give you an exact account of some rice bought, cleaned, and sold by us, (that is through our factors.) 1,291 bushels rough rice, from the plantation of Mr. Thos. Lowndes, formerly Mr. Charles Rowand's, in St. Paul's parish, which yielded 41,075 lbs. merchantable rice, at 600 lbs. per barrel, is 68 1-2 barrels, or 19 bushels to the barrel, or 39,150 lbs. whole, 1,925 lbs. middling, 990 lbs. small, 136 bushels flour. The above was cleaned in about twenty-three hours. The above parcel of rice was purchased 1st December, 1840, at 84 cts. per bushel, and was sold at $3 1-8th on the 10th Dec. The next parcel that I am able to inform you accurately upon, is 1,952 bushels rough rice, from the plantation of Mr. Henry Deas, which yielded 56,270 lbs. whole, 240 lbs. middling, 600 lbs. small, and 147 bushels flour. The above was purchased 2d Nov. 1841, at 90 cts. per bushel, and sold at $3 7-16ths, and took 20 3-4ths bushels to the barrel. I have given you above the result of two parcels, one from Santee, and one from St. Paul's parish. I should like to furnish you particulars of the results of rice further South; not being able to give you the number of pounds, I will give you the result in barrels of rice from Georgia; say 5,248 bushels rice, received 12th Nov. 1842, from the plantation of Dr. Daniel, near Savannah, which yielded 250 barrels whole, 12 middling, 11 small, and about 400 bushels of flour. This day we have just finished a parcel of 5,375 bushels from the same plantation, which resulted in 219 1-2 barrels whole, 38 middling, 10 1-2 small, and about 400 bushels flour; you will perceive that the above parcels took a little over 20 bushels to the barrel. The last parcel was very much broken in threshing, which was done by machinery, which will account to you for the unusual quantity of middling rice; we did not come up to our average of 72 barrels per day on this last parcel, as the machines were new, and required some little time to work to advantage; but I think we may safely calculate upon cleaning three barrels per hour to the four machines.

APPENDIX G.

The following, together with much other interesting and useful information for the foregoing memoir, has been furnished by the intelligent and obliging gentlemen constituting the firm of *Robertson & Blacklock*, of the city of Charleston, factors.

Rice is consumed in England and France as an article of luxury, except a small quantity annually made up into ornaments in both countries, consisting principally of rice paper, beads, clock cases and chimney ornaments. In the north of Europe, it is used as an article of food, but cannot be afforded at a sufficiently low rate to be substituted for potatoes or grain grown upon the spot. In the time of war, its value is appreciated—it has been found to contain the greatest quantity of nutriment in the smallest compass, portable and least liable to damage: and was consequently much used by the British troops in the lengthy Peninsular war.

In Cuba, it is used as a bread stuff in preference to any other kind of food. The consumption of Carolina rice begins however to be much interfered with by the rice grown in and exported from Spain, as well as the rice now grown in the Island of Cuba itself; also a very good quality of rice is now imported from Campeachy. The present duty on Carolina rice in Cuba, is $2 1-4 per 100 lbs. while the duty on that from Spain is almost nominal. From Campeachy the duty may be considered one third less, as it is brought in Spanish vessels, which enjoy that discriminating advantage in favor of their flag. The high duty on rice from this country also operates very much against its consumption.

APPENDIX H.

The following note is found in 2d Vol. Ramsay's Hist. of S. Carolina, p. 206.

"South Carolina is indebted to Gideon Dupont, of St. James, Goose Creek, for the water culture of rice: he was an experienced planter, of discernment and sound judgment, who, after repeated trials, ascertained its practicability.

"In the year 1783 he petitioned the Legislature of the State on the subject. A committee of five was appointed to confer with him. To them he freely communicated his method, relying on the generosity of the public. The treasury being then empty, the committee could only recommend granting him a patent. This he declined. His method is now in general use in river swamp lands, and has been the means of enriching thousands, though to this day his own family have reaped no benefit whatever from the communication of his discovery. Thomas Bee, now Federal Judge for the district of S. Carolina, was one of the above committee; and on his authority, these particulars are stated."

The last summer I instituted an enquiry to ascertain whether any of the family of Gideon Dupont were living, and could furnish me with an account of the water culture alluded to as the result of their ancestor's experience and observation. The enquiry was fruitless; none of the family of Gideon Dupont could be traced in this State.

I noticed the memorandum of the historian no further until coming to Columbia. Here, through the kind attention of the Clerk of the House, I have obtained from the journals of the House of 1784, not only a confirmation of the fact that a committee was appointed to consider the subject, but also the report of the committee enclosed, of which the following is a copy.

In the Senate, March 18th, 1784.

The Committee to whom Mr. Gideon Dupont's petition was referred,

REPORT:

That they have considered the same, and are of opinion that every encouragement ought to be held out for the improvement in agriculture, and the staple commodities of this State.

Mr. Dupont intends to make two experiments the ensuing crop to improve the practicability of his undertaking, viz. one in river swamp, at the plantation of Col. Morton Wilkinson, and the other in Black Swamp, at the plantation of Mr. John Deas.

Your Committee therefore recommend that Col. Morton Wilkinson, Roger P. Saunders, Esq., and Mr. John Deas, be appointed commissioners to attend the said experiments, and if they should be carried into effect, and will be of general utility, and shall certify the same under their hands and seals, to the General Assembly, that then the said Mr. Dupont be entitled to a liberal reward."

From the journals of the succeeding year, it does not appear that this commission ever reported on the subject. It may be presumed that Mr. Dupont's method of cultivating rice without the use of the hoe, and with water only, did not, upon further test, prove to be of as great general utility, as he himself supposed. In new land, just cleared of wood and drained, a good crop of rice can be made *the first year* without the use of the hoe.* But under no other circumstances that I am aware of, except, perhaps, after a good fallow, which, if properly treated, restores the soil almost to its primitive purity.

Report from the Wateree Agricultural Society, in reply to the queries addressed to the Agricultural Societies of the State by the Agricultural Surveyor.

No. 1.

Geographical character of the particular Agricultural District or section of country under consideration.

Subdivision 1. *Situation and extent, and natural divisions.*

The section or division of the State, to which the following remarks particularly allude, is known as Sumter and Kershaw Districts. It is bounded on the west, by the Santee and Wateree Rivers and a part of Richland District; on the north, by Lancaster District; on the east, by Lynch's Creek, and Darlington District; and on the south by Williamsburg District. Its whole length from north to south is bout seventy-five or eighty miles; and breadth from east to west, twenty-five or thirty miles. The only natural division known, is occasioned by the Black River and its tributary streams which separate Claremont county from Salem, and runs directly through Clarendon. Sumter District is divided into two election districts; Claremont and Salem counties constituting one, and Clarendon the other.

Subdivision 2. *Climate, and especially any peculiarities thereof, and the causes.*

As to the climate of this portion of the State, it is mild and temperate, and there is no cause known to exist, that is calculated to make it vary from other parts of the State, running in the same parallel of latitude; to be sure, our climate and seasons are more or less variable in different years; sometimes in summer the heat is more intense, and in winter the cold is more piercing than the succeeding ones, but to what cause this is to be attributed, we are unable to account.

Subdivision 3. *Surface and face of the country.*

The face of the country, upon general observation, is what might be termed level, yet this is not the fact in regard to the whole of it, for there are many places that are more or less undulating, but not so much so as to render it unfit for cultivation wherever the

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* The writer has made such crops repeatedly between the years 1828 and 1836, when clearing new land, with a comparatively small laboring force.

soil is of sufficient depth to warrant an undertaking of that kind; and there is a ridge of hilly broken country, commencing somewhere about the junction of the Wateree and Congaree Rivers, and running in a north-easterly direction until it strikes Lynch's Creek, or the Darlington line. This ridge of country in its extent may be thirty miles, and its average breadth not more than four or five; and it has long been known by the name of the High Hills of Santee, and may be considered the backbone of Sumter District, for the water which rises on the south-east side, falls into Black River and its tributary streams, and that from the north-west side, falls immediately into the Wateree river; the part of this ridge adjoining or being nearest the Wateree river, is known as Oak and Hickory lands, interspersed with the short leaf pine, and was originally very fertile; but the better portions have long since been cleared, worn out, and partially abandoned; the balance of this ridge is of a coarse, grey, sandy soil, and its principal growth that of the long leaf pine. It has long been notorious for the purity of its water, and the salubrity of its air, and will no doubt remain as a place of retreat for many of the inhabitants of this State, who have to abandon their homes for a large portion of the year, in order to evade the effects originated by the action of a hot sun upon a damp soil and an impure atmosphere.

The space of country between this ridge and the Wateree River, is in extent about twenty-five miles, and is of different breadth. Its growth is about one half oak and hickory, and the balance pine, and a considerable portion of it is what may be termed a perfectly level surface. It is divided off into farms of various sizes and descriptions, and is in as high a state of cultivation and improvement, perhaps, as any portion of the State. Its durability and production is equal, if not superior, to any other portion of the State within the same parallel of latitude. At the termination of the hills on the south side of this ridge, the country becomes perfectly level, and to a superficial observer or one not acquainted with its character, it would appear to be nothing more than a pine barren waste; but such is not the fact, for a large portion of it is very thickly inhabited, and the whole, with the exception of the bays, creeks, &c., is fit for cultivation. It is divided off into farms or tracts of various sizes, from one hundred to five or ten thousand acres. Some of these lands are also in a high state of cultivation and improvement, and although they are not so productive as those more immediately on the river, yet, from the fertility of their nature, the planters are able to produce as much to the hand as those of any other part of the State, particularly of cotton, peas, and potatoes. There is, however, a portion of these lands lying immediately on the Santee river, which are of a different kind from those already described. They are mostly of a brown or mulatto color, with a growth of oak and hickory, and are thought to be equal, if not superior, to any other lands in the State in the production of cotton. The upper part of this section of country, being the northern part of Kershaw District, is more broken and hilly than any yet described; and with the exception of those immediately on the river, and the large creeks which empty themselves into it, are more barren and less fit for cultivation, than those of the same appearance in the district below.

SUBDIVISION 4. *Minerals, especially such as may be valuable for agricultural or economical uses.*

In this section of country, very few minerals of any description have as yet been discovered. There are, however, in the upper part of Kershaw District, some mines of gold; and in the lower part of Sumter District, some beds of limestone. No marl or green sand has been found, and consequently no application with the substances of that description has been made. There have been, however, some few experiments made by making a compost from caustic lime and rough litter from the forest; the manner in which this was done, was by building pens three or four feet high, then putting in litter about one foot thick, then sprinkling over with lime, then litter again, and so on until the pen was full. This substance remained in this situation some five or six months, and at the expiration of that time, it was carted out and placed under the cotton, in the same manner that other manures are generally applied. The kind of soil to which this application was made, is of a fine, black, close description, with very little or no sand at all; but generally better known in this country as being a part of an open savannah, without any growth whatever, except broomgrass. From four or five years continued application of the same course, the result, in production, has been from almost nothing, to one thousand or twelve hundred pounds of seed cotton to the acre. Whether the same course and application will have the same effect upon a higher and more sandy soil, is a question yet to be ascertained; or whether the expense arising, may not exceed the profits to all planters, except it be those who are immediately in the neighborhood of the

lime-stone region, or those whose situations are such as to enable them to obtain it at a very low price.

SUBDIVISION 5. *Water, in reference to uses of navigation, propelling machinery, irrigation, &c.*

The only navigable streams in this part of the State are the Wateree and Santee rivers. On these, pole boats have been operating ever since the first settlement of the country, and the planters, all within reach, have availed themselves of this mode of conveyance to send their produce to Charleston, and receive their supplies in return; within the last few years, however, some experiments have been made in running steamboats on the Wateree river, but I believe that the undertakers have not succeeded according to their expectations. Lynch's creek is a smaller and more crooked stream than the Wateree river, and is thought by many to possess a sufficient depth of water for the operation of pole boats for the greater part of the year; but owing to its crookedness and the narrowness of its channel, it is easily filled by logs, which are collected into rafts, through which it is with much difficulty that boats can get along at all. Some few persons, however, have undertaken to operate upon this stream with boats, but after a few years of unsuccessful trials, they have abandoned it altogether.

As to water for propelling machinery, we have that in abundance, all through this section of the State. From the higher or more broken parts, there arise a great many springs, which, after running some distance, unite and form themselves into streams of sufficient magnitude, not only for propelling the saw and grist mill, but any other machinery to which such power may or can be applied; and some of these are never failing streams, and afford sufficient supplies of water for all necessary purposes throughout the dryest seasons we have. And as to irrigation, I believe that this is a system which has never been adopted and pursued by any class in this country, except the rice planters. In this section of the State rice is not planted at all, except in small parcels, which are usually planted on a damp moist soil, and that is sufficiently supplied with water from the showers that occasionally fall. For our crops, such as we do plant, we always have had a sufficient supply of rain, to make very fair ones every year, provided we have discharged our own part properly.

No. II.

GENERAL DESCRIPTION AND MANAGEMENT OF LAND.

1. Quantities of arable, of meadow, of wood, of swamp, of marsh, and other waste lands. About one-half of arable land; of meadow, none; of wood land, one-half; of swamp or marsh, one-fourth; and but a small portion of other waste lands.

2. *Soils and sub-soils, and the actual productive value of Lands, in reference thereto.* The highlands are chiefly of a fine light grey soil; the other quality of them being a red or mulatto color; the sub-soils being yellow or red clay; the yellow being often mixed with gravel or sand; but the red always fine, close and hard. The mulatto soil is the best for cultivation; the swamp soils are commonly of a dark brown color—near the river are mixed with fine sand and isinglass; which latter makes the best soil. The greatest part of these lands are stiff; the subsoil of those near the river is yellow, but usually the sub-soil is of a light blue color—always injurious to the soil, when turned up and mixed.

3. Sizes of Farms or Plantations vary from one hundred to two thousand acres.

4. The usual crops, both of large and small culture, and rates of product—Corn, Cotton, Oats, Sweet Potatoes, Peas, Pumpkins, and some Rye. High land improved, will average from four to five hundred pounds of Cotton in the seed; in Corn, about ten bushels; from seventy-five to one hundred bushels of Sweet Potatoes; seven to eight bushels of Oats; five to six bushels of Rye; Peas in corn, two bushels. The swamp lands unimproved, will average, when not destroyed by water, 700lbs. seed Cotton to the acre, and about twenty bushels of Corn, (if changed from Cotton to Corn); Oats, fifteen or twenty bushels; Rye, ten to fifteen bushels; Peas in Corn, two to four bushels; but are not good for Sweet Potatoes.

5. *Rotations or successions of Crops.*—They usually are Cotton, Corn and Oats, and ought to be.

6. *Application of Manures, kind and quantity used.*—Cotton seed is applied on each side of Corn when planted, or on top when the Corn is covered; from forty to fifty bushels

to the acre; or compost, used in the same way for Corn, if good, two wagon loads per acre; when applied to Cotton, it is broad cast in the alleys and the beds made on it; from four to five loads to the acre.

7. *Depth and manner of Ploughing.*—We are governed by the soils and sub-soils; if the soil be too sandy, it is the best course to sub-soil it; but if it be stiff soil, we avoid the sub-soil; but in all cases, plough down to the clay. Uplands are improved by sub-soiling, if manured with any vegetable manures. Our lands are generally put in good order before planting. Corn on the high lands is planted usually at a distance of three or three and a half feet by five feet; if on light dry land, below the level of the surface; if on hard stiff land, level with the surface. The first work, is, when the Corn is up large enough to thin, to plough close each side with a small plough; finishing with a large plough; the hoes following, and thinning to a stand, and levelling the earth around the stalks. The second working is the same; the third working is with the wing shovel, the first furrow run shallow and the bed thrown up. The fourth and last, is with the skim and shovel ploughs; a cut on each side, and the bed dressed with the hoes; the Corn to be laid by, when it begins to shoot or tassel. Cotton is planted on the high lands in rows of about three and a half feet distance, on beds previously thrown up with the plough and dressed with the hoe, in drill, but most usually in chops, at twelve or fifteen inches distance. The first work is, after the Cotton is well up, to shave down the bed close, and run round and lap the earth in the middles with the plough; this is the most usual and best way. The second working is to plough out the middle, thin to one, two, three or four stalks, according to the weather and healthiness of the stalks, drawing up the bed with the hoes at same time. The third working is, if the weather be dry, to run the skim, thin out a stand of one stalk, and dress the beds with the hoe; but if the weather be wet and the land grassy, shave down, and lap up in the middle with the ploughs. This work to be continued every fifteen or twenty days, according to the state of the weather, till the middle or last of July, when the crop should be laid by, and topped the last of July or early in August; planters differ in opinion as to the system of topping. Potatoes are planted on beds of from three and a half to five feet distance, about four feet being most common and best, on a light sandy soil, broke up deep and close, and the beds made up in dry weather with hoes high—planted at from ten to fifteen inches, on the bed drill or chops. The first work is, after they get up well, to shave off close and hand-pick the grass and lap in the middles with the plough. The next work is when the vine begins to run, to hand up a full bed. Oats are sowed broad-cast and ploughed in.

In the swamp, Corn is planted above the level of the surface, as the best way to insure a stand, at five feet one way, to four or five the other way, leaving two stalks in a hill. The swamp does best when planted at five feet one way by two feet the other way, leaving one stalk in a hill, and worked one way. The first work is to plough with a small plough close to the Corn, and the rows complete, so as to give the water a channel to lie in, followed with the hoe; level and pulverize the earth completely; this is done just as the Corn comes up. The other workings are similar to those on high land Corn.

In the swamp, the vegetable matter is listed in early in the fall, if possible, if they have been in Oats, and the Cotton beds made up at four or five feet distance, most commonly at five feet; the Cotton is planted in chops or drill at from fifteen to twenty-four inches, leaving one stalk when thinned. The first working after the Cotton gets up, is, if in light land and grassy, to shave down; if in stiff land and the weather dry, to scurf and chop up and loosen the bed; in both cases lap off with a wing plough. The second working is to run the skim and split the middles and throw up a full bed; the other workings are similar to those on the high land Cotton; to be topped from the 10th to the 20th of August.

Oats are sowed broad-cast, the land being first levelled, and beds of five feet are then thrown up with the plough, which covers the seed. This is considered the best way.

The expenses of cultivation about to the head. There is no foreign grain or hay purchased. The foregoing observations are applicable to the scope of country lying between Camden, Stateburg, the Wateree river, and five miles east of it.

No. III.

OBSTACLES TO AGRICULTURAL IMPROVEMENT AND PROFIT.

1. *Obstacles opposed by natural and unavoidable circumstances.* 2. *Obstacles caused by erroneous governmental policy, or by want of proper legislation.* 3. *Obstacles caused by individual action.*

It is proposed to confine the answer to the foregoing heads, to the state of things in the immediate neighborhood of this Society.

1. The difficulties and obstacles from natural causes, which the river planter and the highland planter encounter, are essentially different.

The river lands, when fresh, are composed of a rich alluvian porous, and easy of cultivation, with a fine subsoil; but when successive crops for many years are made upon them, they become stiff and hard, breaking into clods and lose all their friability, causing great difficulty in their cultivation, in either very wet or very dry springs; and frequently upon such old stiff lands, the cotton dies off or does not grow more than six inches high, producing nothing, with a single stalk every 25 or 30 feet, growing to half size. But presenting this peculiarity, that the same land, in the same season, would produce a full crop of corn. The remedy for these stiff lands is in the planter's power, to wit; a crop of oats, turned in if possible; ample experience has tested this truth. These remarks apply only to a portion of the river lands; another class of them denominated "isinglass" lands, never become stiff, are much more sandy, and are filled with minute particles of mica, forming a generous, warm, rich soil, easy of cultivation, and producing well, whose chief obstacle is a wet season, which affects the crop on them more seriously than on the first class; the due admixture of the two, forms the finest river soil. Both these classes of lands are subject to inundation; accurate accounts show that three crops out of the last nine, have been chiefly destroyed by the freshets. The high land planter meets none of these obstacles to successful culture. His difficulty lies in the thin, sandy, and sometimes white soil, which requires manuring every year for a full crop, which the want of time does not permit him to effect on all his lands every year. With only the compost of the barn yard at his command, which shews its effect fully but during the season when applied, he finds many obstacles and almost impossibilities, under our present system of culture, in forming compost sufficient to apply to all his lands every season.

The shortness of the season, the cold winds of April and the early frosts of October, form a combination of natural obstacles to agricultural profit, which we have frequently to lament as unavoidable. (Besides the abominable low price of cotton,) the tariff, fluctuations of trade and the high price of bread to the European operatives.

2. It is not known that the policy of the Government of South Carolina has thrown any obstacles in the way of the planter; nor has he been materially affected by the want of legislation on her part, save by the want of the survey, which she has now commenced. In fact, since the period when the government purchased the patent right of the Cotton Saw Gin, and threw it open to her citizens, she has lost sight of the planter in her legislation, for good or evil.

For many years, while our chief marketable product, cotton, bore a high price, many of us were in the habit of raising that almost exclusively, and depending upon supplies of bread and meat from abroad, which the cotton crop had to pay for—as well as for the animal power necessary on the plantation; a most pernicious practice, which has impoverished the State by millions, and been the ruin of many planters. It is believed that stern necessity has forced the planter to abandon this system, measurably. It is unusual for any one in this neighborhood to purchase either meat or bread; and we are rapidly becoming raisers of our own animal power on the plantations.

It is believed that we are as successful as any body of planters in the State, on the same character of lands, in the mode of our culture. Certainly we have pressed too far the old, and seemingly well established doctrine; to wear out the land by cropping without manure, and then open new lands. But this system is also giving way to the sober light of experience; which teaches, that one acre well manured and taken care of, will produce more, in the average of years, than two acres, even of fresh land, not manured. Possibly, some of us err, also, in not throwing out some hands and wagons from the crop, to form compost, as a crop.

The value of the oat crop, as a renovator, to be turned in, if possible, uncut, has not been sufficiently estimated heretofore, and we have been slow in reducing it to practice. The practice of attempting to resuscitate old lands, simply by allowing them to lie fallow, without the plough or other aid, has materially assisted to keep our lands impoverished.

No. IV.

MANURES.

1. *Sources and supplies of Manures of all kinds.*—We have no Calcareous Manures as yet discovered, our country being nearly nine-tenths woodland, which will in all probability remain so for many years; our supply of vegetable manures is inexhaustible, on or near every plantation. We have marsh, swamp mud, or alluvial soil, sufficient to change the entire nature of our high lands; our cotton seed has heretofore been considered our most important manure, but the supply not being sufficient to improve the soil alone, attention has recently been turned to the vegetable deposits of the woods, composts and ashes.- I am unable to say whether it would be profitable to burn wood to ashes for a stimulant to the soil; should it prove so, we have large bodies of wood land too far from market, which could be made use of in that way.

2. *Preparation and application of stable and yard manures, and composts, the quantity and effects.*—Our Stables and Pens for all animals, are littered with pine straw, leaves and any other vegetable matter convenient, as often as they become foul or well trodden by the hoof; this manure remains in the stable and lots until three or four weeks before we are ready to haul out, say the 1st of February; we then make a compost of the different pens, applying alternate layers of yard with what comes out of the stable. These compost heaps are put up in a form to resist as much as possible the rain that falls. From three to four four-horse wagon loads are usually applied to cotton land, distributed between the beds of the previous year; which is covered with two furrows, the bar of the plough running against the bed—lapping the manure in the alleys. This system increases the crop one-third; although some seasons and upon some soils, the increase will vary. The above manure is also applied to a portion of our corn crop, usually in the hill, which is covered at the same time the corn is planted; one-half the quantity applied to cotton to the acre, the increased product is generally one-fourth. But cotton seed is our main manure for corn; fifty bushels is usually applied to the acre, sometimes upon the ground, but more generally beneath; we see very little difference in the manner of application in the yield; where it is covered with the corn, the plant grows off more rapidly in the spring. The above application of cotton seed will increase the yield one-third, and upon old worn cotton lands, some seasons one-half; it is usually applied to the hill.

3. *Marsh or Swamp Mud as Manure.*—Marsh or Swamp mud has not been used generally in this section; some planters have made small experiments with it, and are satisfied with the result; but it will never be used generally, unless we adopt a temporary rail track to carry it upon our lands; the effects of this manure alone, we are not now able to report, as the mud has not incorporated itself with the soil.

No. V.

NEW AND RECENTLY INTRODUCED VALUABLE PROCESSES, OR IMPROVED PRACTICE IN AGRICULTURE.

1. *Marling and extent of applications before* 1843, *and subsequently.*—It is thought that the pervading spirit of improving our exhausted fields, by more extensive manuring—better draining—and neater cultivation, may be considered an improved practice in our Agriculture. The subject of marls had long been dormant, till revived by Mr. Ruffin. Marl is thought to exist in great quantities in the creeks passing through what is called the Sand Hills, below Manchester; it has been found on Lynch's creek, and used successfully.

2. *Liming or any other calcareous application before* 1843, *or subsequently.*—The high price of lime, and the difficulties of transportation, has hitherto prevented its general use. Many experiments have been made, however, and all successful. It is usually mixed with litter and trash—it is too expensive to be applied alone. One individual thought himself well remunerated after paying boat freight to Wright's Bluff, to wagon it thirty miles; his most successful experiment was on a bald savannah, which originally grew cotton not more than a foot high; in a few years it produced a bag to the acre. Many experiments are now in progress, and the results are already beginning to develope themselves. Lime is found in large quantities in the lower part of Sumter district, near the Santee River; its quality has been long known, but not duly appreciated. Since the revolutionary war, it has been used for domestic purposes, particularly during the culture of indigo; and for the little plantation tanneries. The proprietor of one of the Quarries on Potato creek, (a specimen from which is submitted) is now making

prepreations for burning it; its valuable properties have already been tested in its natural state.

3. *Clover.*—There is none cultivated in this section of country.

No VI.

Your Committee beg leave to report, the usual mode of fencing and enclosing in this part of the country, is the worm fence; rails of the pine, red oak and other trees, measuring eleven feet long. The height of the fence varies from nine to eleven rails, or about five to seven feet.

Every section of country adapts itself to the means at hand, that can most easily be procured for fencing and enclosing. For instance, at the North, where timber is scarce, stone walls and hedges are substituted. Your committee would suggest, that in this portion of the country, where timber is getting comparatively scarce, and the trouble and expense of renewing fences every three years is great, that a more permanent mode be adopted for enclosing. Ditches should be cut from four to five feet apart, and the earth thrown up about three feet; a post and rail or plank fence two feet and a half high, put upon the top of it, will make quite a durable fence, and will last twice as long as the common worm. The measure now proposed, is practised to a small extent by a few, upon public roads, and boundaries of estates.

No. VII.

I. Local sources of malaria, their extent and operation, and comparative malignity; as rapid streams, some overflowing their borders; tide-water marshes, fresh or salt—swamps, whether in their native state or under culture; millponds, and the passage of transient and irregular floods of fresh water over salt marshes.

In this particular section of country, which is either pine land, or land within the influence of the river, and as such, affected by malarious diseases, the river, and its attendant swamps, may be esteemed almost the only cause of such disease; that such is the case, the great exemption from diseases of that nature enjoyed by the negroes—where their settlements have been moved from the bank of the river into the pine land, proves, compared with their former unhealthiness, and with the amount of sickness upon plantations similarly situated; the swamps contiguous to the river are not, generally speaking, in a state of themselves to give rise to poisonous exhalations in very eminent degree, such as were practicable having been drained and brought into cultivation; being not more productive of disease in that state than other low grounds upon the river; or when their situation forbids their being reclaimed, as unsuited to the culture of corn or cotton, they are protected by a native growth, thick enough to prevent, to a *considerable extent*, the ill effects of an August sun upon dampened vegetable matters. The mill-ponds, fed by sand-hill streams, are in every case free from those diseases that owe their origin to malaria, seeming to lack the due quantity and quality of vegetable matter requisite for the production of the poison. The cases of fever are generally of a manageable type, when taken at an early stage—accidental and immediately local-causes may increase the intensity of the disease and the number of cases; such as a crowded, ill-ventilated, decayed and low negro-quarter; in such a one, in the seasons suited for the due development of this disease, the cases often assume a typhoid character, and of course are oftener fatal.

The overflow of the low grounds upon the river, followed by a hot dry season, is most favorable for disease; every rich bottom then reeks with it, every thing vegetable being thoroughly moistened, is heated readily into semi-putrescence, and becomes a fruitful source of malaria—but if the rainy season continues until frost, the numerous pools are kept fresh, and millions of animalculæ alive, that would otherwise, in their stagnation and death, have engendered poisonous gases.

The influence of the river as regards malaria, is felt at a distance varying from one to two miles, and in exposed situations, perhaps farther—less felt as there may be the intervention of wood-land, which serves as the most complete barrier to its approach. Swamps, when first cut down, must certainly engender malaria, in much greater quantities than before—and unless they be thoroughly drained, will continue to do so, as the surface is exposed to the heat of the sun, and the water only sufficiently taken off to leave a stagnant marsh; but when thoroughly dried by good ditching and sun-shine, not more productive of disease than other cultivated lands.

2. Increase or decrease of extent and virulence of malarious diseases in past time; and the supposed causes of either.

There has been a diminution of diseases dependent upon malaria, arising from two

causes:—The greater one, that a majority of the plantations have their settlements off from the bank of the river, in the pine land, and that numberless marshes and exposed swamps have been converted into corn and cotton fields; adding much to the general healthfulness. Yet, though the malignaty of the disease has been lessened by the draining of the swamps and ponds, the opening of such immense bodies of land, directly upon the river, has, beyond a doubt, extended the evil influence of the river much beyond its original limits, by removing trees which served as a barrier to its progress; and localities before healthy, are now, since such clearing, within the reach of malarious affections.

3. Means of diminution of such diseases, within the reach of the separate action of individual proprietors; such as require combined action—and such as require legislative direction.

As the localities favorable for engendering malaria seem to have their noxious effects the most part at night, the most certain means of shunning its effect would be, by getting a situation in the pine land, which, generally speaking, is near enough; and if that be not practicable, as near as possible—have the site as high and dry, and the water as good, as may be. These precautions, and a strict attention to ventilation and cleanliness, have been found, in every case, to produce the most satisfactory results.

Statements of the most extensive (and also continuing) marling operations in South Carolina.

The several operations which are the subject of the following three communications were referred to at page 48 of the foregoing Report Lately commenced as all these were, so far as known and believed in them are presented the only cases of marling (or liming) practised on a large scale in this State, and of which, previous to the present year, the results were sufficiently satisfactory to induce their continuation and extend their practice. And though these results are deemed quite satisfactory by the operators, (as they ought to be, under the existing circumstances,) the increase of production, in most of these cases, fell far below what would have been obtained from land previously at rest, and well supplied with vegetable matter from its own growth. This conclusion is established by even the few, though small, experiments thus made in South Carolina, this year and previously, as well as by the large marlings and general mode of procedure in Virginia. E. R.

From the Southern Agriculturist.

To the Agricultural Society of St. John's, Berkley.

Gentlemen.—I have been urged by Mr. Ruffin, who lately visited our neighborhood, to lay before you the result of our experiments and progress in the use of marl.

It may not be in our power to submit such exact statements as would be desirable on a subject of so much importance, yet if we can show you, that so far as we have tried the system, it is not only practicable, but highly satisfactory, we trust it will be an inducement to many who are now hesitating, to commence forthwith, and satisfy themselves by actual experiments.

Dr. Robt. M. Gourdin, (whose plantation, at Lenud's Ferry, lies partly in Georgetown and partly in Williamsburg district,) has been good enough to furnish me with the following statement:—A field of fifty acres of flat, sour pine land, which had been belted in 1838, and roughly listed in 1839, was prepared for planting in 1840, by changing the course of the beds across. Upon this new list, he brought marl one mile and a half, and applied it at the rate of one hundred bushels to the acre—excepting six acres, running the whole length of the field, one half acre in width. No memorandum was kept this year of the field and no difference was perceivable in the growth or product of the cotton. In 1841, it was again planted in cotton. Throughout the whole of the season, the marled looked decidedly superior to the unmarled. An accurate account was kept of the respective portions of the field.

The marled produced an average of one hundred and twenty-eight pounds of clean

cotton to the acre, the unmarled but sixty-three. In 1842, no account was kept of the difference of product—but so manifest was the advantage of the marled over the unmarled, that it was a matter of serious regret, that the actual difference could not have been ascertained. Dr. Gourdin has no doubt that the marled portion was considerably better this than the year previous. He is so well convinced of the benefit to be derived from marl, that he has applied it to twenty acres more this year, and contemplates a more extensive use of it hereafter.

My brother (Col. Samuel J. Palmer,) commenced in 1839 to marl—on a field of 24 acres, which had been cleared about five years previous, and the preceding year had rested—after listing in the weeds, he applied marl at the rate of 100 bushels to the acre. One portion of the field was a flat, whitish clay soil, the remainder, what may be termed a free, open soil, and more elevated. In 1836, this field had been planted in cotton, and produced one hundred and forty pounds clean cotton to the acre. In 1837, in oats, which, although not measured, yet the general appearance of the crop did not promise exceeding 10 bushels to the acre. It was then thrown out to rest, as before observed. The product of this field in 1839, was two hundred and seventy pounds of clean cotton to the acre—and exceeded the general average of the whole crop. In 1840, it was assisted with trash and leaves under the list. The June freshet destroyed the whole of the first planting—it was replanted on the 15th of the same month; no account was kept of its product this year; but, as far as could be judged by the eye, it did as well as any other part of the field which had not been drowned. In 1841, it was again planted in cotton, and produced two hundred and twenty pounds to the acre. It was, unquestionably, the best field of cotton on the place. In 1842, it was planted in oats; eleven acres were reserved for seed, and yielded when threshed upwards of twenty bushels to the acre. The color and character of the clay-land which was marled, has materially changed—and no one who remembers its appearance in 1836, will doubt the efficacy of marl. My brother has now one hundred and five acres marled, sixty of which was applied this year.

I proceed now to give you the result of my own experience in the use of marl, but regret that no account was ever kept of the difference between the products of the marled and the unmarled fields. In September, 1838, I commenced digging it out. In two wet days, with all my hands employed, I had about two thousand five hundred bushels heaped ready to be hauled out the winter following. This, however, was the only occasion on which I got out the material before the carts were ready to take it to the field.

It is a saving of time to apportion only so many diggers and loaders to each cart, as will, taking into consideration the distance and roads to the field, keep the work steadily and regularly progressing. In 1839, I applied marl on about 50 acres of land, at various rates. From 80 to 100 bushels was the usual quantity, but in some spots as much as 150 bushels were tried. Thirty-six acres had been in cotton the year before, and fourteen in oats.

The marl on these thirty-six acres was applied *under the list*, and I could discover no advantage this year from it. The season was one of the most propitious for cotton, and will be long remembered as such throughout this country. The fourteen acres which had been in oats, and where the weeds and stubble had been listed the autumn preceding, showed an improvement the first year that the marl was applied. It was land which originally must have been of the best quality, but had been sadly scourged by hard cropping before I got possession of the place. In 1840, it was planted in oats, and exhibited a most striking contrast to the crop which was on it in 1838. In 1841, it was again planted in cotton, and it was 50 per cent better than it ever was. The last year I planted it in oats, and on such parts where hitherto the crop would be supposed good for 10 to 15 bushels to the acre, I am confident from 20 to 25 bushels were made. The growth of crab-grass and weeds which succeeded the oats, induce me to believe that this land will do better another year than a great deal of much fresher that has not yet had the benefit of the marl. In 1842, the 36 acres which had not since 1839 exhibited any material change, was planted in cotton after oats. The crab-grass was so fine in 1841, that I was induced to cut a large quantity for fodder before it was listed.

This field, from the lightness of the soil on some parts of it, I feared much would disappoint me in 1842; besides, except the occasional rest it had when planted in oats, it had been in cultivation seven years consecutively. On some of the thinnest land, compost manure from the cow-pen was scattered, and if any doubt had existed previously of the capacity of marl to fix other manures in the soil, the growth and product of the cotton on these spots would have entirely dissipated them from my mind. On one half acre, selected on account of its unproductiveness previously, about 100 bushels had been applied in 1839; the quantity visibly mixed up with the sandy soil, I apprehended would have

proven injurious; but the beautiful growth and early maturation of the cotton on this spot last year, induces me to think we do not apply half enough in general to our land. Last year I applied from 120 to 200 bushels to the acre on all the land marled; but, being satisfied with the gradual, but certain improvement, which a moderate quantity will effect, I have the present season fixed as a rule, to give to every acre 120 bushels, and no more.

From the frequent interruptions from freshets, I have failed this year in marling as much as I intended, and have in all now little more than 100 acres. If I had no other evidence of the good effects of calcareous manures, than what has been furnished accidentally on my place, that alone would be conclusive.

In clearing some fields six or seven years ago, I found some spots heavily coated with lime, thrown out from the pits, made no doubt 40 or 50 years ago by the old Indigo planters. I was not surprised at first to see the cotton, or other crop, growing luxuriantly on these places—but up to the last season, I cannot perceive any falling off in fertility. The long period which has elapsed since the lime was thrown out, must have given time to the soil to accumulate a large quantity of fertilizing matter, and the probability is, that its character is permanently established. These facts are cheering, and we may flatter ourselves that a new era has commenced in the agricultural improvements of every section of the State within the reach of marl. In the course of a few years, we may look to see marl made an article of internal commerce, and those who are now afraid to carry it 100 yards upon their own soil, may, when they shall have covered every foot of arable land in their possession, be found supplying it at a profitable rate to their neighbors five miles distant. It is to be hoped that a fair trial will be given to marl by many of the members of this Society, and that our next meeting will furnish abundant testimony from all quarters on this subject.

N. B.—The marl used in our neighborhood contains from 90 to 95 per cent. carb. lime, as ascertained by analysis.

JOHN S. PALMER.

From the Farmer's Register.

RECENT AND EXTENSIVE MARLING IN SOUTH CAROLINA.

COLUMBIA, S. C. Nov. 30, 1842.

Dear Sir:—It affords me great pleasure to comply with your request, to furnish you with a statement of my marling operations during the first year, and the result of them, so far as it has been ascertained.

I commenced in November last, to marl my plantation, at Silver Bluff, on Savannah river. There is no marl on the place. I procured it from Shell Bluff, on the same river, and had to boat it twelve miles up the stream. It requires eleven prime hands to man the boat I use, and when the river is not too high, they make two trips a week, loading and unloading themselves. They bring about 1100 bushels at a load. The marl is landed at a spot below high-water mark, and during the whole crop season, two other hands and two carts are constantly engaged in hauling it to a place of security on the top of the bluff. At other times, it is hauled directly from the landing to the fields. There are, however, thirteen hands and two mules lost to the crop. My boat, which is a common pole boat, was built chiefly by my own people, and cost me about $600, including their labor. There have been incidental expenses to the amount of about $200 this year. During the year, ending on the 8th of November, there were 85 trips made, and about 93,000 bushels brought up. I think I can safely calculate on bringing up 100,000 bushels per annum hereafter, with the same force. I mention these facts, that every one may form his own estimate of the cost of procuring marl under similar circumstances. My calculation is, that it costs me about two cents a bushel, delivered on my bluff. To one having marl on his own premises, nearly the whole of this expense would be saved. I am enabled, by omitting to open new land, to haul out and spread this marl, without interfering with other plantation work, or lessening the number of acres planted per hand. In hauling out, I have not been able to do as much as they do in Virginia. Mr. Ruffin, the author of the marling system, hauled 24 loads of 5 3-4 bushels, with each cart, per day, a distance of 847 yards; I have done but little over half as well. I use mules, however, and the land being level, carried 6 1-4 bushels at a load. I found the mules could not stand trotting back with the empty cart. The marl weighs about 105 lbs. per bushel. My land was laid off in squares, so many to an acre, and a

load dropped in each square. It was spread by hand: each negro taking his square, and carrying his marl on a board or in a small tray. A prime fellow can spread an acre in a day. But it is a hard task, and counting the gang round, I have not averaged over half an acre for each worker. The marl spreads best when damp. It will then yield to the hand, and lumps are, in general, easily crushed.

Shell Bluff is a bold cliff on Savannah river, over 200 feet high, and, in some places, more than 100 feet perpendicular. Professor Vanuxem, who examined it some years ago, (see Farmer's Register, vol. vii. p. 70, and also, vol. x. p. 487,) discovered fourteen varieties of marl, varying in quality from 37.2 to 93.4 per cent. of carbonate of lime. In using the marl, I have excluded the inferior as much as possible, and have not found the very best in any great quantity. I tested the quantity of carbonate of lime in one specimen, taken at random from each boat load brought up this summer, and found the average of thirty-four loads to be 62.8 per cent., varying from 51 to 77. In every specimen, there was a small proportion of oxide of iron and clay and sand, usually in about equal quantities. There were, no doubt, other component parts which I did not ascertain; but I satisfied myself that there was neither gypsum nor magnesia. The marl presents various appearances, being in color, white, brown, olive, yellow and violet, and in consistence from sand to soft stone. Some of it appears to be a concretion of shells, from a size scarcely visible to the naked eye, to an inch in diameter. There is no hard limestone, and it is doubtful whether any of the marl here will make lime, though it is an excellent cement. Much of that which I have used has been cut from the face of the cliff with pick-axes. It falls down sometimes in fine grains, sometimes in masses. At every handling, it breaks up finer, and exposure to the air assists disintegration. I do not burn or pound it. Where it was spread last winter, an observer would readily discover it, and lumps as large as an egg, and occasionally much larger, are to be seen. A mere passer by, however, would not notice that the land had been marled. At every working, it is more and more mixed with the soil. But I imagine it will be several years before it is completely combined with it, and until then, the full effect of the marl cannot be known. A difference was apparent in this crop, between the effects of that spread early in February, and that spread in the latter part of April.

By the 22d of April last, I had marled 175 acres, at the rate of 200 bushels to the acre. Of these, I planted 50 acres in corn, on the 17th of March, 50 acres in cotton, on the 10th April, and 75 acres in cotton, on the 22d April. These three cuts are in the same field, and adjoining, being separated only by turn-rows, yet the soils vary considerably. In the corn, I laid off four separate acres along the turn-row, as nearly equal in quality as possible. The one supposed to be the best, was left without marl. The others were marled with one, two and three hundred bushels respectively. It was all of the same boat load, and contained 54 per cent. of carbonate of lime. This land has been in cultivation more than one hundred years. I have planted it myself eleven of the last twelve years, and sowed it in oats the other year. I have given it three light coats of manure, the last in 1839. It is a light, gray, sandy soil, of which the following was the analysis before marling, viz:

Water lost at 300 degrees,	2 per cent
Vegetable matter	3 "
Silica	80 "
Alumina	11 "
Oxide of Iron	2 "
Loss	2 "
	100

This cut was in cotton last year, and my expectation was, that with common seasons, it would produce twelve bushels of corn per acre. And had I not kept the unmarled acres as a test, I should have set down all over that quantity to the credit of the marl. The corn came up badly, and suffered by the birds. The four experimental acres were cultivated precisely as the rest of the cut, and were distinguished only by the posts which marked the corner of each acre. From the first, however, the marled corn exhibited a different appearance. It was stouter, and of much deeper color. As the season advanced, the difference became greater. The marled corn was as dark a green as swamp corn usually is. The fodder was pulled on the 3d of August, and after hanging two days and a half on the stalk, in dry and rather windy weather, weighed as follows:

		Increase.	Per cent.
Unmarled acre,	250 lbs.		
Marled at 100 bushels,	285 "	35 lbs.	14
" " 200 "	314 "	64 "	25,6
" " 300 "	261 "	11 "	4 4

The corn was gathered on the 24th of October, being thoroughly dry, and having shrunk as much as it would in the field. There appeared to be little or no difference in point of soundness. It was shucked clean and measured in a barrel. The unmarled corn shelled out two quarts less to the barrel than the marled. The following was the result:

		Increase.	Per cent.
Unmarled acre,	17 bushels.		
Marled at 100 bushels,	21 "	4	23,5
" " 200 "	21 "	4	23,5
" " 300 "	18 1-2 "	1 1-2	8 8

From this it would appear that 100 bushels of marl was as efficacious as 200, and perhaps in like land such may be the fact. It appears also probable that 300 bushels to the acre is too much. I ought, however, to state, that this last acre had a slight sink in the centre, and that the slopes around it are much thinner than the average land. These constitute about one fifth of the acre, and were evidently injured by the marl. It was a bad selection for the heaviest marling; but at the time it was made I did not suppose, judging by the rates at which they marled in Virginia, that 300 bushels would injure any land. My fear now is 200 bushels may prove too much for soil like this; and I have accordingly determined to put only 150 bushels on the acre hereafter, until I see its further effects. This has been a remarkably productive season for corn. I think the unmarled acre in this cut made at least five bushels more than it would have done on an average year. I presume the marled acres have done so likewise. But whether it would be fair to attribute any of the four bushels increase to the peculiarity of the season operating on the marl, I am wholly unable to decide. Supposing the increase from the season to be the same on the marled and unmarled land, and deducting five bushels from the produce of each acre, there will be 33 1-3d per cent. in favor of the two best marled acres. This, however, is all conjecture. The average per acre of this whole cut was eighteen bushels. The measurement of all but the experimental acres was made, however, by wagon loads, according to the usual plantation estimate, in which there is a liberal allowance for shrinking, &c. Had the whole been measured in the same manner as the experimental acres were, the produce would have appeared greater. I have had this cut planted in corn once before, but having been absent the whole year, no account of it was preserved, and I do not know what it produced.

I selected also and laid off separately four acres of cotton along the turn-row of the seventy-five acre cut of cotton. At the time I thought them nearly equal in quality, and the one supposed to be the best of these was left unmarled, and 1, 2 and 300 bushelsof marl spread upon the other three. It turned out, however, that the acre with 100 bushels was inferior to the average of the cut, and that with the 200 bushels about equal to it, while the other two were far superior. I was deceived by the stalks grown the year before. The two first named acres being somewhat rolling, and the year a wet one, they produced as good cotton as the other two which were flat. The unmarled acre was not much if any superior to the one marled with 300 bushels, save that there was a spot where the fodder stacks had stood in 1838–9, which produced nearly double the cotton of any other spot of the same size in either acre, and added probably 30 lbs. to the amount gathered from that acre. The marl on these acres contained, like that on the corn cut, an average of 54 per cent. of carbonate of lime. This land is of the kind commonly known as *mulatto* soil, and was cleared at least as early as the corn cut. It was certainly planted by the Indians in 1740. The following was the analysis of it before marling, for which, as well as for the analysis of the corn cut, I am indebted to the kindness of Professor Ellet:

Water at 300 degrees,	3
Vegetable matter,	4.5
Silica,	74
Alumina,	14.5
Oxide of Iron,	4
	100

This cut was not planted until the 22d April, because it could not be marled before. A dry spell occurring immediately after, at the end of two weeks very little cotton had come up except in the unmarled acre, in which there was about half a stand. My overseer becoming alarmed, in my absence replanted the whole, and threw out the old seed wherever it had not come up. This was done on the 6th of May, so that the crop of this

cut dates from this period, which is at least a month later than I should have preferred. For my experience is that early cotton, like early corn, is almost always the best. I consider the two weeks start which one half of the unmarled acre ootained in this instance as of considerable consequence to it. These early stalks could be distinguished until the bolls began to open. The difference in color between the marled and unmarled cotton was as obvious as it was in the corn. The leaf too appeared broader and the stalk stouter from the first. The following was the production of these four acres. I state the production of all, though that of the 1 and 200 bushels ought not to be compared with that of the other two, on account of the relative inferiority of the soil.

The unmarled acre	1111	lbs. in the seed.
Marled do. at 100 bushels,	846	"
" 200 "	1003	"
" 300 "	1318	"

The difference between the unmarled acre and that with 300 bushels of marl, was 17,7 per cent. in favor of the latter. It would have been greater perhaps any other year than this, which has been almost as favorable for cotton as for corn. The average production of the whole 75 acres was 966 lbs. per acre. I have had this cut in cotton ten of the last twelve years, in corn one, and in oats one, and the following is a statement of its production of cotton for six of the ten years; that of the other years not having been preserved.

1833 average per acre in seed	731	lbs.	manured lightly
1834 " " "	784	"	
1835 " " "	980	"	manured lightly
1836 " " "	951	"	
1840 " " "	497	"	
1841 " " "	501	"	manured
1842 " " "	966	"	marled

The other 50 acre cut of marled land was planted in cotton on the 10th April. It came up in good time and was a fine stand. This is also a light gray soil, with less clay than the mulatto land, and less sand than the corn cut. It is probably as old as either, and has been cultivated in much the same way. Although planted ten days later than some other fields, and after all of them except the 75 acre cut, it soon appeared to be the oldest cotton, and certainly matured the earliest of any. Immediately after the cold weather, about the first of Augus', the rust commenced in it, and by the 20th of that month it had the appearance of a field after frost. Forms, small bolls and even the leaves dropped. Most persons who saw it thought it had been cut off one half. I think myself it suffered to the extent of one fourth at least. But I have made on this cut this year 840 lbs. of seed cotton, which is nearly 50 per cent. more than I ever made on it before. The following is the average of its production for four other years:

1833 average per acre in seed	569	lbs. manured.
1834 " " "	435	"
1840 " " "	368	"
1841 " " "	566	" manured lightly.
1842 " " "	840	" marled.

I think the injury from the rust nearly or quite equal to the benefit derived from the favorable season. And that the increase from the marl was greater on this cut than any other, because the earliest marled and most seasonably planted. The rust here was more injurious than in any other field, and I might have attributed it to the marl, but that the 75 acre cut, also marled, suffered least of all. I am inclined to think that the most advanced cotton was most affected, and the youngest least, and that marl had no influence one way or the other. It is worthy of remark, that while all my other cotton suffered from lice and the worm both, neither made their appearace on the marled land.

I have troubled you with this lengthy detail of my operations, because this being the first serious experiment with marl in South-Carolina, (that I know of,) it may be interesting to those who have this earth within their reach, to know the particulars. From the facts I have stated, each one can form his opinion on nearly as good data as I can my own. I can only add that my expectations for the first year have been fully answered. I did not calculate on any of those magical results which agricultural experimenters so often look for, and so seldom realize to the full extent. I regard an increase of 20 per cent. as a very handsome return, and if it only does as well another year, I shall at all events

be paid for my labor, even if the beneficial effect of the marl ceases then. But the experience of all who have used it is, that it continues to improve the soil every year, until thoroughly disintegrated and combined with it; and that with proper culture it never declines from its maximum. Under these circumstances, and with these hopes, I shall continue myself to prosecute the business vigorously. During the summer I have hauled marl over 160 acres, and have now at my landing enough to cover 300 acres more. My great regret is, that I did not engage in the business sooner. I have long known Shell Bluff, and for some years have heard of Mr. Ruffin's successful introduction of marl into the culture of Virginia. But I had not read his "Essay on Calcareous Manures," nor examined Shell Bluff, until the summer of 1841. The idea of obtaining marl from that spot was first suggested to me by my friend Major Dickinson, of Georgia; and after a careful perusal of Mr. Ruffin's Essay, and an analysis of the marls there, I determined to try the experiment. I have, during the course of it, received much encouragement and valuable practical information from Mr. Ruffin himself, to whom, in common with all other beneficiaries of this inestimable treasure, I owe a debt of gratitude which cannot be easily cancelled.

I am, my dear sir, with great regard and esteem, your obedient servant,

J. H. HAMMOND.

Hon. WHITEMARSH B. SEABROOK,
President of the State Agricultural Society.

COLUMBIA, 27th Nov., 1843.

DEAR SIR:—In fulfilment of my promise made last November, I again communicate to you the results of my experiment in *Marling*. The year has been so unfavorable for cotton, and my crop has fallen so far below the promise of July, that if I had not left some unmarled acres for a test, I should, as no doubt has often been done in other experiments, have come to the conclusion that all my labor had been in vain; and that in fact the marl had seriously injured my land. The truth, however, is very far to the contrary; and I now think that but for the marl I should have made almost no crop at all.

I planted this year 700 acres of marled land; of which 680 were in cotton, the remainder in pindars and potatoes, of which no accurate account was kept. The cotton turned out about as much per acre in the whole, as the average of the same land for the last ten crops. But believing this year to have been at least 20 per cent. more unfavorable than an average one, I attribute that much increase on the whole crop to the effect of the marl.

In my last communication I stated that I had selected four acres of good mulatto land, and four others of very light sandy soil, one acre of which in each selection was left unmarled, and the others marled with one, two and three hundred bushels respectively. For the purpose of showing the difference between the most favorable and the most unfavorable seasons I have known for cotton, as well as to indicate the progressive comparative influence of the marl, I subjoin the results of the last, as well as the present year, on these experimental acres:

EXPERIMENT No. 1.

Mulatto Land, 1842.

	Seed Cotton.	*Decrease.*	*Increase.*	*Per Cent.*
Unmarled acre,	1,111lbs.			
100 bushels do.,	846lbs.	265lbs.	——	22.8
200 do. do.,	1,003lbs.	108lbs.	——	9.7
300 do. do.,	1,318lbs.	——	207lbs.	17.7

Same Land, 1843.

	Seed Cotton.	*Increase.*	*Per Cent.*
Unmarled acre,	493lbs.		
100 bushels do.,	654lbs.	161lbs.	32.6
200 do. do.,	759lbs.	266lbs.	53.9
300 do. do.,	841lbs.	348lbs.	70.

As I remarked last year, the acres with one and two hundred bushels of marl are decidedly inferior in quality to the other two. The unmarled acre and that with 300 bushels, are as nearly equal as any two on my plantation. It is hardly necessary to say, that

these acres, lying side by side, were all planted on the same day, and cultivated in precisely the same manner.

The experimental acres of the thin light land were planted last year in corn. All the marled acres produced better than the unmarled, but I will not repeat the statement, as it does not afford an accurate comparison with the cotton crop of this year, of which the following is the result.

EXPERIMENT No. 2.

Very light sandy soil, 1843.

	Seed Cotton.	*Increase.*	*Decrease.*	*Per Cent.*
Unmarled acre,	361lbs.			
100 bushels do.,	451lbs.	90lbs.	——	24.9
200 do. do.,	384lbs.	23lbs.	——	6.3
300 do. do;,	173lbs.	——	188lbs	52.

The land, being very old, is bare of vegetable matter for marl to act on, to which, more than to the texture of the soil, inferior as it is, I attribute the failure of any great improvement from it. I make the statement, however, because it is valuable in many respects. It shows the danger of heavy marling on worn land without previous rest or manure. The acre with 300 bushels has been destroyed. There is one rich spot, the bottom of a small basin in the centre of it, which produced nearly all the cotton gathered. On the rest of it the weed mostly died as soon as it came up. 100 proves a better quantity than 200 bushels, and perhaps a little less would have been still better on this soil—at least to begin with. All the lightest land in the fields marled with 200 hundred bushels was evidently injured and now requires help. I anticipated this effect from what I saw last year, and reduced the quantity to 150 bushels on all the land then marling. I have reduced it now to 100 bushels, and shall hereafter marl at that rate. I prefer to go over it again after I have finished all, and give it what it may prove itself able to bear after resting once or twice.

The crop of this year has satisfied me perfectly that cotton will mature at least a fortnight earlier on marled than on unmarled land.

Another unexpected effect of marl it may be worth while to state. I commenced in the spring of 1842 to put it in my stable, pretty freely, for the purpose of improving my manure. I did not think of its having any material effect on the health of the mules. But I have had but little sickness among them, and have not lost one since: while previously I lost on the average four annually, and never in any year less than two. I attribute this change in a great measure to the absorption of noxious gases by the marl.

I am now marling as actively as heretofore, and I esteem it so beneficial that I have this summer marled a field of over 200 acres. the average haul to which is three miles from my landing; and being tolerable fresh land, that has rested this year, and was sowed in oats last year, which were not cut but grazed down after ripening, I have put on a hundred and fifty bushels.

The fields on which my experimental acres are will rest next year. I shall not, therefore, be able to continue my report to you. Since, however, the valuable labors of Mr. Ruffin in this State have given a decided impulse to marling, I presume that all who are in reach of marl will at least experiment for themselves; and it will be of no consequence that I should longer communicate my experience.

I am very truly and respectfully your obedient servant,

J. H. HAMMOND.

Hon. WHITEMARSH B. SEABROOK.

ANALYSES OF SOILS

From the Tide-Swamp Plantation of Col. R. F. W. Allston,

BY PROF. C. V. SHEPARD.

CHARLESTON, Dec. 11, 1843.

DEAR SIR:—I had hoped to have presented you the results of my late analyses of soils at an earlier date, but my engagements at the College have employed me so closely, as to prolong the task up to this evening. I hasten to offer you the view which my inquiries lead me to take of the subject in the following table; premising that the specimens were in the first place slowly but thoroughly dried, by being spread out in thin layers for two days under a temperature of about 90 degrees.

	SOIL NO. 10.	NO. 4.	NO. 13.	NO. 7.	NO. 10.
	From the Sub soil many feet deep.	Taken from Field No. 4, about 2 in. deep	From Field No. 13, 2 1-2 inches deep.	From Field No. 7, Exchange Plantation.	Surface Soil No. 10, two inches deep.
Water expelled by heating at 300 degrees F.,	7.00	6.00	6.00	7.20	6.80
Organic matter with remainder of water (not previously expelled at 300 degrees F.,) driven off by full ignition,	27.00	24.00	14.00	27.4	27.20
Silica,	55.00	60.00	70.00	55.00	57.00
Per Oxide of Iron,	4.00	4.00	5.00	4.00	5.00
Lime (with traces of Magnesia),	1.00	0.80	1.00	1.00	0.50
Alumina and loss, (the latter may be reckoned at from 1.50 per cent., to 0.50 per cent.),	6.00	5.20	4.00	5.40	3.50
	100.00	100.00	100.00	100.00	100.00

	Per Cent
The dry soil No. 4, on being thoroughly wetted, gained,	101.4
No. 13, " " " "	99.
No. 7, " " " "	102.8
No. 10, (top soil,) " " "	103.3

Soil No. 10 top, was picked over before analysis, to avoid the coarser roots and vegetable remains it included. These, by estimate, amounted to 9 parts in every 1,000 of the soil.

Portions of the different soils were boiled up for some time in pure water, and the filtered solutions examined for soluble matters, in which they were all found to be rather deficient. The universal ingredient of chloride of calcium (muriate of lime) was indeed present; but by no means abundant. Faint traces of sulphate of ammonia were also detected, together with a little alumina—the latter probably combined with humic (or some other organic) acid.

With the exception of No. 13, these soils are the richest in organic matters of any which have ever fallen under my notice. In destroying it by heat, the soil turns black, and emits a peaty odor, attended by a white smoke, which is slightly pungent to the smell and irritatory to the eyes, though much less so than the smoke from highly nitrogenised (manured) soils. Ammonia is distinctly recognised in this smoke.

I regard the organic matter as vegetable in its origin, and suppose it to be in the condition of what Mulder calls ulmine and ulmic acid, and humine and humic acid, chiefly the two former; and which he supposes are convertable into the two latter, simply on being brought freely into contact with the air in the process of cultivation.

If I were to suggest anything in the cultivation of such lands, it would be to recommend thorough drainage—paring the surface by fire—frequent ploughing, to effect a minute division of the soil, and to bring it in contact with the air. Add to them the use of wood ashes and well burnt lime.

The Committee on Agriculture of the House of Representatives submitted the following Report and Resolutions, in accordance with which this Survey was voted:

In the House of Representatives, December 14, 1842.

The Committee on Agriculture, to which was referred so much of the Governor's Message as relates to a Geological and Agricultural Survey of the State; also, Resolutions of Enquiry into the same subject from this House; also, Memorials from the Agricultural Society of South-Carolina, from the Wateree Agricultural Society, from the Milton, Laurens, Agricultural Society, embracing the same objects, have maturely considered the subjects committeed to their charge, and beg leave to report: That they are deeply impressed with the importance and necessity of the measures sought for, and unanimously recommend an Agricultural Survey of the State.

Your Committee were not averse to combining a Geological with an Agricultural Survey, but were deterred from the recommendation by a consideration of the expense and remote attendant advantages. The two branches of science are connected, but only to a certain extent; they then diverge to totally different purposes.

The Geologist digs into the bowels of the earth, to investigate metals, minerals and rocks, and by analytical researches, indicate the origin and distribution of substances which compose soils. The Agricultural Surveyor seldom penetrates below the surface; his science determines their nature and properties, and the means of fructifying them. To realise benefits discovered by the first, time and capital are indispensable; whilst the last are immediate in their effect, and placed within the grasp of the humblest farmer.

In prosecution of the duties of an Agricultural Survey, the Surveyor pervades every section of the State, examines, as far as practicable, the nature and quality of the soil in every district, detects calcareous manures, visits farms, corrects injudicious modes of culture, advises as to the best kinds of seed, and communicates the means of affording an increased product; he discloses the improvements of other sections of country, explains the properties and action of various manures, the necessity of a rotation of crops, and instructs in the general principles of Agriculture. His observations extend to the general features and aspect of a country, to its soil, climate, crops, markets, and manufactures; to diary husbandry, its product and expenses; to improvements in various breeds of stock; to manures, farm buildings, experiments and improvements; to machinery; to reports of farms; to agricultural statistics, in relation to the quantity of land cultivated, and in what grains; how much lies fallow, or in woods, in pasturage, or under water; to the products exported, and the supplies purchased; to Agricultural Societies their reports, and the knowledge they diffuse; with other miscellaneous matters.

The importance which modern science has attached to these investigations, admonishes us not lightly to reject their testimony, but rather examine into our own advances, and

ascertain our prospect of improvement. In accomplishing this purpose, your Committee would indulge in something of a retrospect.

In the early years of the Province of South-Carolina, the inhabitants struggled to supply their necessities by the produce of wheat, silk and tobacco. Indifferent success attended these efforts; when rice, in 1693, was casually introduced, became a staple, and gave a new impulse to industry.

Indigo, another exotic, of which 1,300,000lbs. were formerly exported, was first cultivated in a garden for amusement in the year 1742, and eventually contributed to the revenue of the needy planter, who pursued the noisome and unwholesome process, till the article was gradually superseded by a more approved quality from the East Indies.

Cotton, a native of Persia, began to unfold its profits in our State about the year 1793, and continues to spread its snowy fleece over the land.

These staples were all exotic. Competition has driven one from our market, and it is vital to consider how long we may possess the others.

Rice, in its culture, is limited to sectional portions of the State, to inland and river swamps, susceptible of irrigation by fresh water. Eighty thousand acres of land are capable of growing the whole rice crop of South-Carolina, which, on an average, may be computed at 140,000 barrels, and at $15 a barrel would amount to $2,100,000—a limited sum for a chief staple article.

The product of this grain, in the whole Union, by Congressional returns, is only 88,954,658lbs., or 148,258 barrels; of which 75,000 barrels are exported to Europe, 23,000 to the West Indies, 30,000 to various parts of the United States, and the balance consumed at home. The rice shipped to Europe has to come in competition with that from Brazil, Calcutta, Batavia, Manilla, and other parts of India, which is prepared by rice mills in London, Liverpool, Amsterdam, Copenhagen, Lisbon, and Bordeaux now, and soon to be in operation in so superior a manner as to vie in quality with the best Carolina rice; so that when the primest rice commands, in the markets of the North of Europe, $5 the cwt., that from India brings $4. In addition to this, Italy grows her own rice, and even Cuba, a large consuming market, is now producing no inconsiderable quantity. These facts prove that Carolina must experience competition in this staple.

Let us now turn our consideration to our other great staple, Cotton, of which the statistics are so exact that we can ascertain by calculation what our prospects are, as regards competition in that article. The United States produces at present, 578.012,473 lbs.—more than one-half the crop of the whole world. South-Carolina grows of this, 43,927,171 lbs., or 1-13th part of the quantity; but from this source of profit her palmy days are past. Every year opens new lands in the West, where congeniality of soil and climate to this commodity, increases the product per acre, far beyond what can be reared at home, and consequently reduces the value infinitely below the costly prices which formerly enriched Carolina. These new lands produce, on an average, 2,500 lbs. of cotton, per hand, whilst the lands in Carolina yield but 1,200 lbs., and the expenses of a laborer being about equal in either place, reduces the Carolina cotton to half its intrinsic value. We have also the declaration of Mr. Dixon H. Lewis, in a recent speech in Congress, that cotton, divested of government embarrassments, might be grown in Alabama for three cents a pound.

Your Committee will avail itself of the lucid calculations of a distinguished and talented individual,* to present another view of the subject, startling in its details, and bearing strongly on the propriety of summing up all our resources. The crop of the world amounts to 1,000,000,000 lbs., which would require, at the rate of 250 lbs. per acre, 4,000,000 of acres to grow this quantity. Now, the four States bordering on the coast of Mexico, viz., Louisiana, Mississippi, Alabama and Florida, contain 130,000,000 of acres; proving that if only 1 acre in 32 were found capable of producing 250 lbs. to the acre, these four States could, alone, supply the demand of all the markets in the world. In this calculation, the produce of Georgia, South-Carolina, North-Carolina and Virginia, with portions of other States, besides 150,000,000 acres in Texas, are entirely excluded. The lands of the Gulph States, therefore, and Texas, are sufficient to supply the demands of the world, in all time to come. Where then, is the hope or prospect of South-Carolina in competition?

Besides rice and cotton, there are no other articles of export which South-Carolina produces. All other demands of life are grown in limited quantity, and our deficiencies supplied from sources without the State. This necessarily acts as a drain to her finances, and should be checked; a glance at her products, and how the land of the State is occupied, might afford some useful reflection.

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* Gov. Hammond's oration before the State Agricultural Society.

South Carolina comprises within her borders 16,000,000 acres of land, of which only 1,300,000 are cultivated. Of this, cotton occupies 175,700 acres; rice 80,000; Indian corn 500,000; potatoes 22,612; wheat 24,079; making an aggregate of about 800,000 acres; the balance of 500,000 are taken up in oats, rye, barley, hay, tobacco, and a limited portion of other articles necessary to the supplies of life. To what use, then, is the balance of our Territory, of 14,000,000 of acres, to be appropriated. Are we forever to be supplied with stock from the West, bread stuff from the Middle States, and manufactures from the North? Is all that we can realise from our labor to be expended abroad? Nothing to be left for our own improvements, or our luxury? As one means of correcting this evil, your committee propose an Agricultural Survey of the State, to determine our natural advantages, develope our facilities of improvement, exhibit our profits and expenditures, and awaken our citizens to the importance of vieing with the rest of the human family, in all the improvements of which our location is susceptible.

The exposition which your Committee has given, showing the great competition of foreign rice with our own, and that South Carolina cannot compete with the West in the cheap production of cotton, and that she must, ere long, be driven from the market, demonstrates the necessity of looking abroad and around us for other sources of advancement and profits, than those we possess. The Agriculture of the State is the fundamental basis of her prosperity, as is attested by the fact, that whilst the property of the State is valued at $192,000,000, the Agricultural portion equals $174,000,000. What, then, are the expedients to be adopted, to secure present advantages, or counteract their loss?

We cannot expect that accident is continually to supply new staples suited to our soil and climate, and place us beyond the reach of contingent circumstances. We must resort to science to improve our agriculture, and to machinery to enlarge and prepare present articles of culture, or transplant and acclimate new products, which will again, like those we have lost, and will lose, lead off for a period in the employment of capital, amassing of wealth and diffusion of human happiness. This, however, cannot be realised by individual efforts, and where the benefits to accrue are general, the common purse should bear the burden. If in the pursui , new sources of industry cannot be marked out, policy would require that those now in existence should be perfected, so as to neutralize opposition from abroad, or counteract the advantages of other countries more favorably located.

Your Committee, in recommending an Agricultural Survey, would refer to the examples and results in Europe and our own country. Great Britain, pressed by her teeming population, scrutinises every source of increase. Under her Board of Agriculture, surveyors were appointed for, and a distinct survey made of, every county in the kingdom. In some cases more than one surveyor for one county; and each county report formed a large volume of agricultural facts. Previous to these efforts, and the aid derived from Agricultural Societies, the annual production of grain in England was but nine bushels to the acre; but through the diffusion of knowledge from the sources mentioned, it has gradually increased, and by the last report, amounts to fifty-one bushels the acre. Scotland, before comparatively barren, by the discovery and free use of lime has been rendered a wheat growing country. France and Germany, in their schools, teach the science of agriculture, both theoretically and practically. Professorships are instituted, pattern farms cultivated, Boards of Agriculture established, societies formed, geological and agricultural surveys undertaken, and all the powerful aids of chemical research made to advance the great cause of human necessity and civilization.

These examples have not been lost in our own country. Of the twenty-six States of the Union, twenty have either made, or have in progress, geological and agricultural surveys. New York has commenced her's on a magnificent scale; the surveys, and publications connected with it, will cost $104,000. Four years have been appropriated to effect it, and $26,000 voted for the first year. Massachusetts has entered in earnest in the cause. By her agricultural survey, her productions have been increased, her breed of stock improved, and the elegance and economy of her farms advanced. For several years the State has paid a bounty on wheat raised within her counties, and in 1839 expended $9,280 for premiums. Maine paid, in 1838, a bounty of $87,342 on wheat, and $66,628 on Indian corn. New Hampshire, in 1839, appropriated, annually, $2,000 for a Geological Survey. The little State of Rhode Island also, and Connecticut, have been surveyed. Virginia has established a Board of Agriculture, and all are awake to the great advantages to be secured.

The researches and investigations of other States can be of little avail in our own. The difference of soil and climate, even in the same State, renders modes and articles of culture essentially different; and we must pursue our own investigations. Nature, in beneficence, has bestowed on man a varied soil, crowned it with umbrageous forests, ar-

rayed it with fruits and flowers, and left it to his industry and intelligence to bring them to perfection. In attaining this purpose, the husbandman has not only to study the nature of the plant, but the soil congenial. In some locations he finds a soil already adapted, and in a state of natural fertility, offering, as it were, a standard of what is to be attained. In other spots, the characteristics vary, and by labor and intelligence are made to approximate and be maintained at this first or natural standard. Thus he must not only perfect the grain, but form the soil. Science here comes in aid; the chemist analyzes and instructs what are its constituents, and how to preserve its qualities, or supply its defects. He discloses the fact that some soils contain too much calcareous matter, others too little, and that modern research attests that all the Atlantic States are deficient in lime as a natural ingredient of the soil, without a certain portion of which, as a constituent, soil cannot be rendered fertile. The soil of Europe contains a more general diffusion of calcareous matter than that of the United States; and it has been supposed that the deficiency may account for the fact that tobacco has never been raised in Europe in anything like the perfection of our own country.

The developements, by agricultural survey, of the resources and statistics of a State, tend to give political position and establish credit both at home and abroad. By affording inducement to a population to locate permanently, the defensive means of a country are increased, her revenues improved, and her climate rendered salubrious. In proportion as population diminishes, the efficiency of that which remains, as well as the value of property, all become diminished, and national efforts alone can secure their durability. Ignorance in agriculture is the bane of national prosperity. The annual loss to a State, between an impoverished system of husbandry and careless cultivation, can scarcely be estimated; but some idea may be formed by comparing the rude instruments and humble efforts of the Hottentot, to those of the New England farmer, with his neat cottage, his ploughs, his machinery, his well stocked barns, and profusion of all the comforts of life. There are other attendants in the depopulation of a country, the decay of morals, of social order, and of that elevation in the scale of nations which conducts to mutual happiness and independence. Agriculture, aided by the chemical arts, has rescued us from the cavern and log hut, placed us in goodly dwellings, divested us of the fig leaf and sheepskins, and clothed us in comfortable and gorgeous apparel. We have abandoned the habits and propensities of the brute, and walk forth with the elevation and aspirations of responsible, intelligent beings, made in the image of their Creator.

Your Committee, influenced by the above considerations, unanimously recommend the adoption of the following Resolutions:

Resolved, That the interests and pursuits of South Carolina are essentially Agricultural, and should be promoted by all practicable means within our power.

Resolved, That a Geological and Agricultural Survey of the State, for the examination of our soil, discovery and application of marl lime, and developing all other resources and facilities of improvement, will prove among the most efficient means of giving value to her soil, increasing her products, multiplying her population, and diffusing national and individual prosperity.

Resolved, That as a means of testing this salutary measure, an annual appropriation of $2,000 be granted for two years, for an Agricultural Survey of the State, to be prosecuted during that period; and that the Governor be specially charged with procuring a competent individual to effect such survey, who shall report all Geological information which may be incidentally collected on such survey.

Resolved, That the result of each year's survey be reported to this House, and copies distributed to every Agricultural Society throughout the State.

R. W. ROPER, Chairman.

Resolved, That the House do agree to the Report. *Ordered*, That it be sent to the Senate for concurrence.

By Order,

T. W. GLOVER, C. H. R.

In the Senate, December 17, 1842.

Resolved, That the Senate do concur in the Report. *Ordered*, That it be returned to the House of Representatives.

By Order, W. E. MARTIN, C. S.

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Printed, the 32 first pages by A. H. Pemberton, the rest by Dubose & Johnston.

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