

nunciations on the floor of Congress against banks and banking; the chosen cover to the shame of repeated and signal disgraces from new-fangled and shallow projects of tempering with a currency which these projectors had found in the soundest condition, and with a system of finance approved by half a century of sage experience, and, when first subjected to empirical treatment, flourishing beyond all former example. It has been also said openly on the floor of Congress, by men who, in our case, have been found potent in evil, that Congress, in dealing with the district banks, should exhibit a model fit for the States to follow in relation to their own banks. How soon the modesty of merely proposing models may yield to the temptation of actually modelling State legislation or the creatures of State legislation, evidently depends on the contingency of power and means. Specie circulars have run their round; sub-Treasury, yet in its cradle, and a bankrupt law, aimed specially at the banks, remain to be tried; and what other devices time and opportunity may develop, it would be vain to conjecture. One thing is certain, there has not been a pretext devised for suppressing the District banks, that does not apply with equal, indeed, greater force to the State banks. The suspension of specie payments, the main pretext and the only one having any show of plausibility, came from the State banks to the District banks, who took it up at second hand; and if the accessory is to be thus punished, what is in store for the principal?

We desire to be understood as by no means imputing either the motives or acts of these oppressive measures in relation to the banks, indiscriminately to *all* the members composing the political *party* upon whom *collectively* such motives and acts are justly charged. We readily admit some individual exceptions, which a reference to the journals and debates will enable you easily to distinguish.

We come now, fellow citizens, to the second head of our complaint—an attack upon the privileges of the people of Washington, and upon the most indispensable safeguards to the peace and security of the city, so outrageous as to be incredible, unless it had been brought under our personal cognizance and experience, and vouched to the country by evidence enough to silence the most willing skepticism. In this instance the sway of party-spirit, in its most concentrated essence, was undisguised and evident in every thing, except in the disingenuous and deceptive means by which it pursued its darkling way to its undeniable end. We proceed to a succinct history of the origin and progress of this attempt, leaving the simple facts to bespeak the motives and objects of its authors.

On the first of June last, the regular election of Mayor, Alderman, and Council, for the stated term of *two years*, took place under the existing charter of the city. This election seemed, by common consent, to have been made the test of the relative strength of parties in the city in relation to the questions of general politics which divide the People of the Union; and persons entertaining opinions openly and firmly opposed to the course of the present Administration were elected by a clear majority of two to one.

No sort of complaint—no whisper—no murmur, bringing any way in to question the perfect regularity and fairness of this election, was heard

from any quarter. Disappointment and regret at the political result, with the usual sense of mortification in the few personally interested in the event of the contest, was the only feeling ever *manifested* by those who had desired and endeavored to bring about a different result. They imagined not the folly of attempting, for any purpose of party spite or political effect, to raise any controversy about an election so clearly unexceptionable; far less the atrocity of appealing to Congress to interfere and annul it by the sheer force of legislative enactment—by the force of law, no less lawless, in the eye of natural and constitutional justice, than the most brutish force which the law ever punished. If such an atrocity was ever contemplated by any of our citizens, it must have been confined to a very few; and those dark conspirators, carrying on secret intrigues which they took care to hide from the general indignation and disgust which, at the first promulgation of such a design, would have burst in one united voice from the mouths of all our citizens, with little or no distinction of political or municipal parties.

In a few days after the election, however, a petition was got up and presented to the Senate, under circumstances which, taken in connexion with the subsequent action on it, raise well-grounded suspicions of some dark intrigue, of which the agents have never been clearly developed. This petition specified several alterations desired in the charter, the whole of which were against the decided wishes of the great mass of the people, and some of them against the wishes of many whose signatures were obtained by gross misrepresentations. But it contained not the remotest hint against the late election, or intimation of any design to bring it into any sort of question. It set out with a misrepresentation so gross and palpable to every one acquainted with the provisions of the existing charter as to make it altogether incredible that the framers and promoters of the petition expected to deceive by it any member of Congress who would examine the charter, or that the mass of the members could be deceived by it, without the *connivance* of the committee to whom the subject might be referred, and who could not proceed a step in the examination without discovering the imposture. It might well serve the temporary purpose of entrapping subscribers, careless as they are generally about such matters, and without the ready means of detecting the misrepresentation in question, even if they had thought of the matter at all.

The misrepresentation alluded to consisted in this: that the city charter expired, by its own limitation, in *May*, 1840, and, therefore, a *renewal* of the same must, from the necessity of the case, be asked for. The obvious and necessary *consequence* from the strange circumstance of an election under a charter expired the month before, is not insisted on, nor, in any sort, alluded to; all that matter is left, and, it is clear from all the circumstances, studiously and artfully left, to silent implication and inference, to have its effect, without divulging the cause of such effect.

We have said the grossness of the deception must necessarily be palpable to any committee that should go into any examination of the subject; though with the connivance of the committee, it might pass on the mass of members who seldom examine into these local matters. If this were not a thing of course, it is made more clear by the nature of

the examination made necessary by the terms of the petition itself; which is not for a mere extension or renewal of an expired charter, but for renewal with many important alterations incorporated into it, which could not be effected without examination and comparison of the original charter; and at the first glance it would be discovered that the charter, so far from having any limitation of time, partook more of the character of a *permanent* law than any to be found in the statute book; it was to "continue in force for and during the term of twenty years, [from May 15, 1820,] and *until* Congress shall, *by law*, determine otherwise;" equivalent to declaring it irrevocable during that term, and of indefinite continuance after.

The promoters of this petition, with all their exertions, fair and foul, to give it the imposing appearance of numbers, obtained less than 400 signatures out of a population known to be 25,000 or more.

When this petition was presented to the Senate by the member selected to patronize it, a novel and extraordinary course was taken with it. Instead of being referred to the standing committee on the District of Columbia, as had invariably been the case with all petitions for local objects from any part of the District, it was referred to a *select* committee, whereof Mr. Norvell, of Michigan, was chairman.

The bill reported by this select committee was very voluminous and elaborate, containing some five or six sections more than the original charter; which, however, is taken for the frame of the new one, with the alterations stated in the petition, and several others originating with the committee, all elaborately interwoven with the substance of the existing charter; a comparison between the two demonstrates an elaborate and minute examination of that charter by the committee or its chairman who framed the new bill; the very section declaring its continuance for 20 years, with indefinite continuance afterwards till otherwise determined by law, is taken up in the new bill, and altered to 10 years, with a reservation to Congress of the power to alter or repeal it at any time. Yet this bill is entitled "to amend and *continue in force* the act to incorporate the inhabitants of Washington;" a strange title for a bill merely *amending* an existing act yet in full force, and requiring no other act to continue it in force; only subject, like all other laws, to be altered or repealed by the Legislature that enacted it: still stranger, as the act, instead of being *continued in force*, as the title of the bill says, is expressly *repealed* by the very terms of the same bill: a very suspicious title, too, when taken in connexion with the palpable imposture, on that very head, in the petition; which should rather have been denounced than thus implicitly countenanced by the chairman of the committee.

After some merely formal provisions in the first and second sections of the bill, the third comes at once to the matter of the election, and, without any cause or reason assigned, proceeds, without ceremony, to set that election aside, and direct a new one on the first Monday of October next.

Here, fellow-citizens, facts speak; the wrong, the insult to this people, the motives to that wrong, all stand out manifest, if not confessed. It is unnecessary to enlarge upon the circumstances or suspicions of low and discreditable artifices and deceptions that, if made out ever so clear, could

go but to aggravate and inflame superfluously what, upon great public grounds of natural justice and constitutional right, ought alone to be sufficiently detestable to every good citizen of the Republic.

This bill was called up in the midst of the press and hurry of business, three or four days before the adjournment; and, notwithstanding the general interdict laid upon District business in general, was pressed upon the Senate by the chairman of the select committee and his friends of the majority, and passed to a third reading. Notwithstanding the remonstrances of the minority, who urged the want of due deliberation on its voluminous provisions, the small number of applicants for a new charter, and the manifest surprise upon the great mass of the people interested, repeated motions from the minority to postpone it and lay it on the table, were rejected. The party for the bill seemed organized for the occasion, and is well understood that the party in the other House was equally prepared for its reception: how it was, the next day, arrested in its progress, on the motion of a member who had voted for it, will presently be shown.

The bill was introduced with a high flourish of encomium. A Senator from Ohio undertook to rally his party around it, as the symbol of their principles, and the test of their fidelity to their principles; and confidently predicted the event, which doubtless he knew was held under the thumbs of himself and his friends; namely, that on this measure, involving fundamental principles, there would not be found the difference of a hair among his party. Accordingly it was voted to a third reading by the unanimous voice of that party, comprehending all of them in their places.

We now ask your serious attention to another feature of this bill, practically, perhaps, more mischievous in its design, tendency, and effects, than the attack upon the freedom of elections, and of more fearful import to all the slave-owning States, in common with this city and District, standing in the midst of them, with like interests and subject to like perils. This feature originated with the select committee itself. So far from being asked for or any wise intimated in the petition, we believe there is not one of its signers or promoters, good or bad, who would not, in common with the mass of his fellow-citizens, have spurned at it if proposed.

In the existing charter there is a long section (the eighth) conferring many and miscellaneous powers on the Corporation. Among others, a power to draw lotteries; and, above all, very large powers for the institution of an effective police over disorderly and dangerous persons of various descriptions, comprehending *slaves* by name. The section discriminates with care the different modes in which slaves and free persons, white or black, are to be dealt with and punished. In one part of the section the Corporation is empowered "to restrain and prohibit the *nightly* and other *disorderly* meetings of slaves, free negroes, and mulattoes," and to punish the slaves by whipping and imprisonment, the free negroes and mulattoes by pecuniary fines. In a distant and distinct part of the same section, towards its end, is a distinct clause providing for the *corporal* punishment of slaves for the breach of such municipal ordinances as impose pecuniary fines, unless the master will come forward and pay the

This section is taken up in the new bill, and re-enacted with certain alterations. One of the alterations takes away the power to draw lotteries; other alterations consist in expunging every provision relating to *slaves*: every clause and part of a clause where the word *slave* appears is studiously culled and picked out, here and there, throughout the section. In short, upon comparison of the two sections, it appears to demonstration that this was designedly and industriously done by the framer of the new bill.

This would clearly have amounted to a deliberate and express *repeal* of so much of the now existing charter as brings slaves under the cognizance of the municipal police; a repeal of every word in the charter going to recognize the possible existence of any such being as a *slave*—of any thing like *property* in a slave—of any difference between a *slave* and a *freeman*.

Why, and for what object, was this designed repeal, (evidently designed and industriously elaborated, as it appears,) is the question.

Certainly we must acquit the framer of the bill, its chairman, and the select committee of the malignant and horrible design (that is, as a primary and principal design) to expose the people of the city, and all sojourners here, the committee themselves, to the appalling dangers like to ensue from the total exemption of slaves from all supervision and restraint of a conservative police, as this bill would have exempted them; to give them, by repealing a provision prohibiting and punishing "*nightly and disorderly meetings*," a clear license to hold "*nightly and disorderly meetings*," without any possible control from the municipal police; whilst the nightly and disorderly meetings of free negroes and mulattoes were still to be prohibited and punished.

What other motive, design, or consequence, then, can be assigned to this most extraordinary procedure?

Surely no other than such a motive or design as the act itself imports; no less consequences could have been intended than such as necessarily or naturally would have followed the act itself.

This repeal, then, would have amounted to a *disclaimer* or renunciation by Congress, of any such condition as *slavery*, of any such *property* as slaves: it would have been equivalent to an admission of the most ultra doctrines of the most ultra abolitionists; and have left the door of Congress wide open for enunciating the theoretical proposition, and giving to it all the effect of law—that slavery cannot, in the nature of things, be established or permitted by any *human* institutions, however positive, no matter how high or imperative soever the authority whence they are derived: that the force of all human laws, whether fundamental constitutions or ordinary enactments, all yield to the paramount force of natural and divine law.

No motive or design worse than this need be imputed; none better can possibly be inferred, if any motive or design whatever is to be inferred from a solemn, deliberate, and carefully weighed act of legislation.

Here also, fellow-citizens, we leave the facts to speak; and if what they speak is to be gainsaid, most certainly it must be by other *facts*, or by a contradiction of these, not by argument.

This bill was passed to a third reading, as we have said, by the unanimous vote of the party, rallied and specially invoked to its support. Among them were several Senators from slaveholding States. These, doubtless, were kept in the dark as to these most dangerous and far-reaching implications of the bill they were voting for. It would have required a minute and critical comparison between the corresponding sections of the existing charter and the bill to discover them; and it may be well supposed they did not give themselves the trouble, in the hurry and confusion of the moment, to institute such a comparison, and had no preconceived suspicions leading them to it. What apology or explanation, if any, they received from their colleagues and associates in the party convoked to the support of the bill, for palming such a measure upon them, we know not.

So it is that, the next day after the passing of the bill to a third reading, a southern senator, who had voted for it, renewed a motion, before made by one of the minority without success, to lay it on the table, and there it was laid accordingly. But for this, the bill would have passed; and if there had been time for the amendments necessary to quiet the particular scruples of the southern Senators, it would still have passed, with all its other and no less enormous transgressions against conscience, and against every principle of natural justice and constitutional right, on its head.

The same Senator who was so sensitive, and justly sensitive, to such vices in the bill as he discovered, and ought to have known from the first, trenched upon the peculiar interests and principles of himself and his state, recoiled not from the summons of party to perpetrate positive injustice upon us, and to trample in the dust all the principles necessary to have invested with any transcendent merit the pride or the patriotism that led him, at the last hour, to recant an inadvertent error against the interests and principles of his own State. The bill, in all other respects, yet hangs over our heads, like a sword suspended by a hair; and at the next session is doubtless to be again made the touchstone of party strength and predominance, unless rebuked by you in the meantime.

We might go on to point out other provisions in this bill, militating, and we fear designed to militate, against the peace, good order, and prosperity of the city. But with these we must be content to wrestle as we may; we have designed to trouble you only with such matters as, in point of practical importance, and the value of the principles involved, may well claim the serious regard of the nation.

We deem it unnecessary, fellow-citizens, to say any thing in vindication of our original, inherent, and absolute title to all the privileges of freemen—of republicans, in a land of law and liberty; our title to restrain the Government, placed over us, within all the limits proper for freemen and Republicans in a land of law and liberty; within the strictest limits of the Constitution; within the limitations of the Government from which we were taken when transferred to this; within the necessary and understood limitations imposed by natural right and universal justice, in cases not reached by any of the positive provisions of a written Constitution. Any contrary notion of the power implied by the grant of “exclusive legislation” in the Constitution, leads to endless absurdity, or, what is worse,

to a virtual dispensation, not only here but everywhere, from all the most indispensable restraints and limitations of power in the same instrument. Could any rational man expect that the selfsame Government could act the despot and tyrant, reign over abject slaves, disenthral itself of all constitutional restraints, in one place, and, in every other place, be the subdued, moderate, and circumscribed creature of the Constitution; submissive to the reserved rights and authority of the States, fearful of overleaping any constitutional boundary, and sensitive to the will of its constituents? Then let him expect to see Scripture falsified; to see the Ethiopian change his skin, and the leopard his spots.

Let such a man imagine such a state of things at *the seat of Government* as new-fangled treasons, bills of attainder, ex post facto laws, and general warrants; habeas corpus and jury trial taken away; patents of nobility and an established church, with a suppression of all dissenters in religion; and all other of the abominations upon which the Constitution has placed the mark of indelible reprobation: then let him think with himself, no matter of what State or Territory he be citizen, with what alacrity and ardor he would march to the overthrow of a Government *so seated*, no matter how inoffensive its conduct might happen, for the time, to be out of the immediate sphere of its prescriptive tyranny.

Take another hypothesis rather nearer to the matter in hand: *liberty of speech* and freedom of the press, put down and extinguished at the seat of Government; your *local* despot shrouded from all observation, within a dark cloud, extending its murky reign ten miles round; impassable to the light of the press: overshadowing poor awe-struck slaves, who dare not utter one word above their breath displeasing to their masters; then say what would be the value of liberty of speech and freedom of the press out of the bounds where they were proscribed, and where alone liberty of speech and freedom of the press can obtain the most necessary materials for their functions to operate on.

No: if there be one place within the wide bounds of this Republic where, more than in any other, the deepest interests of the Union call for the most active spirit of liberty, for the habitual cultivation of the most heightened and manly independence, that place, above all others, is the *Seat of Government*.

We have no fear, fellow-citizens, of your falling into speculative errors so monstrous; and as little of your failing to perform with good faith the duties dictated by your relations to the Constitution and to us. In that confidence, we, for the present, remit our cause to your hands.

Signed by order of the Convention.

WALTER JONES,
Chairman of the Convention.

HENRY J. BRENT, *Secretary.*

Mr. Johnson offered the following resolution, which

On his motion,
Was read and adopted, to wit:—

Resolved, That the Clerk be directed to have five hundred copies of the Governor's Message printed for the use of this House.

Mr. Higgins laid on the table the following resolution, viz:—

Resolved, That a committee of three on the part of the House of Representatives, and two on the part of the Senate, be appointed whose duty it shall be to wait on His Excellency, the Governor, and respectfully invite him to take a seat on the floor of the Senate Chamber, and of the Representative Hall, at pleasure, during the present session; and also to wait on His Honor the Secretary of State, and the members of the Judiciary of this State who may be present during the session, and extend to them a similar invitation.

On motion of Mr. Wright,
The said resolution was adopted.

Ordered to the Senate for concurrence.

The committee on the part of the House consists of Messrs. Higgins, Collins and Waples.

On motion of Mr. Wright,
The House then adjourned until three o'clock this afternoon.



Eodem Die, 3 o'clock, P. M.

The House assembled pursuant to adjournment.

Mr. Huffington laid on the table the following joint resolution which,

On his motion,
Was read and adopted as follows, to wit:—

Resolved by the Senate and House of Representatives of the State of Delaware in General Assembly met, That the members of the Senate and the members of the House of Representatives assemble in the Hall of the House of Representatives at eleven o'clock, A. M. on Monday next, the eleventh (instant,) to be present at the opening and publishing, according to the constitution of this State, of the returns of the elections holden in the several counties of this State, on the second Tuesday of November last for Governor, and that two tellers be appointed, to wit: one on the part of the Senate, and one on the part of the House of Representatives, to make a list of the votes as the same shall be published from said returns.

Resolved, That upon opening and publishing the returns of the said elections by the Speaker of the Senate in the presence of both Houses of the Legislature, assembled as aforesaid, two certificates shall be made according to the following form, viz:

“DELAWARE, SS.

BE IT KNOWN, *That the General Assembly having met at Dover*, Charles Polk, Esquire, Speaker of the Senate, on the eleventh day of January, in the year of our Lord one thousand eight hundred and forty-one, did open and publish in the presence of the members of the Senate, and of the members of the House of Representatives, according to the constitution of the said State, the returns of the elections holden in the several counties of the said State, on the second Tuesday of November, for Governor, and by said returns it is manifest that was on the said second Tuesday in November last, duly chosen Governor of the State of Delaware, according to the constitution and laws of the said State, to hold his office during four years from the third Tuesday of January (instant,) agreeably to said constitution;” and that the said certificates be signed by the Speaker of the Senate, and by the Speaker of the House of Representatives; and that one of the said certificates be deposited by the Speaker of the Senate, in the office for recording of deeds in and for Kent county, to be there recorded by the Recorder of Deeds for said county; and that the other of said certificates shall be transmitted by the Speaker of the Senate to the Governor elect, with information that the members of the Senate and the members of the House of Representatives will attend him on Tuesday the nineteenth day of January (instant,) while he shall take the oaths of office required by the constitution of this State and of the United States.

Ordered to the Senate for concurrence.

Mr. Chamberlain was appointed teller on the part of the House.

Mr. Fisher, Clerk of the Senate being admitted, informed the House that the Senate had concurred in the passage of the preceding joint resolution, and that Mr. Spruance had been appointed teller on the part of the Senate, and he presented for the concurrence of the House a joint resolution which had been adopted in the Senate.

And he withdrew.

On motion of Mr. Hill,

The said resolution was read as follows, to wit:—

“IN SENATE, *January 6, 1841.*

Resolved by the Senate and House of Representatives of the State of Delaware in General Assembly met, That the Legislature of this State will, on Tuesday the 12th of January, instant, at 3 o'clock P. M., in joint meeting in the chamber of the House of Representatives, hold an election by ballot for the purpose of choosing a Senator from this State in the Senate of the United States, for the term of six years from the third day of March, one thousand eight hundred and thirty-nine; and for choosing a Senator from this State in the Senate of the United States for the term of six years from the third day of March next.

Extract from the Journal.

G. P. FISHER, *Clerk Senate*

For concurrence.”

On motion of Mr. Hill,
The said resolution was then concurred in by the House.
Ordered, To be returned to the Senate.

On motion of Mr. Huffington,
So much of the Governor's Message as relates to the subject of the abolishment of imprisonment for debt, was referred to a committee of three members.

That committee consists of Messrs. Huffington, Higgins and Hill, with leave to report by bill or otherwise.

Mr. Barr moved,
That a committee of three members be appointed on the unfinished business of the last session.

Which motion *Prevailed.*

And Messrs. Barr, Frazer and Jefferson were appointed that committee.

Mr. Huffington presented to the House the annual report of the Auditor of Accounts, of the finances of the State.

Mr. Black offered the following resolution, which

On his motion,
Was read :—

Resolved, That a committee of claims to consist of five members, be appointed on the part of this House.

On motion of Mr. Higgins,
The said resolution *Was adopted.*

The Speaker then announced as the members of that committee, Messrs. Black, Dale, Wilds, Clements and Wright.

On motion of Mr. Huffington,
The bill entitled "An act directing the time, place and manner of holding elections for Senators from this State in the Senate of the United States," was read a third time by special order by paragraphs and
Passed the House.

Ordered to the Senate for concurrence.

Mr. Fisher, Clerk of the Senate being admitted, informed the House that the Senate had concurred in the joint resolution adopted on the part of the House, appointing a committee of both Houses, to wait on the Governor, Secretary of State and Judges, and invite them to take seats on the floor of either House at pleasure during the session, and he informed the House that the Senate had appointed Messrs. Stansbury Jacobs and Dupont as the committee on the part of the Senate.

And he withdrew.

Mr. Barr laid on the table the following resolution, which

On his motion,
Was read as follows, to wit:

Resolved, That a committee of three members be appointed on so much of the Governor's Message as relates to the distribution of the proceeds of the public lands among the several States, with leave to report by resolution or otherwise.

On motion of Mr. Wright,
The said resolution

Was adopted.

The committee appointed on the foregoing resolution consists of Messrs. Barr, Huffington and Hill.

On motion of Mr. Johnson,
The House adjourned until to-morrow morning at 10 o'clock.



THURSDAY, 10 o'clock A. M., January 7, 1841.

The House assembled pursuant to adjournment.

Mr. Dale laid on the table the following joint resolution:—

Resolved by the Senate and House of Representatives of the State of Delaware in General Assembly met, That a committee, to consist of three members on the part of the House of Representatives, and two members on the part of the Senate, be appointed to examine the accounts of the State Treasurer, count the cash on hand, and make report to the General Assembly.

On motion of Mr. Dale,
The said resolution was then

Adopted.

And Messrs. Dale, Collins and Marshall, were appointed by the Speaker as the committee on the part of the House.

Ordered to the Senate for concurrence.

Mr. Huffington presented the petition of Foster Donovan, of Sussex county, praying the Legislature to divorce him from his wife Avis Donovan, which

On his motion,
Was read and referred to Messrs. Huffington, Chamberlain and Waples, with leave to report by bill or otherwise.

Mr. Chamberlain laid on the table the following resolution, which

On his motion,
Was read.

Resolved, That a committee of three members be appointed to take into consideration so much of the Governor's Message, with the letters of Doctor Couper, the Port Physician of New Castle, as relates to the health laws of this State, and that they be at liberty to report by bill or otherwise.

On motion of Mr. Chamberlain,
The said resolution was then

Adopted.

And Messrs Chamberlain, Sudler and Frazer, were appointed by the Speaker, members of that committee.

Mr. Virden, chairman of the committee appointed yesterday to draft rules and regulations for the government of the House at the present session, made the following report of rules, which was read, to wit:—

Rules for the government of the House of Representatives.

1. Every member shall be in his place at the time to which the House stands adjourned.

2. Every day, before the House proceeds to business, the Clerk shall call the names of the members in alphabetical order, and shall read the Journal of the preceding day; which may be corrected by the House.

3. All motions or resolutions (except the reading of bills, the daily adjournment of the House, or any motion to refer any subject, or to postpone the same,) shall, if requested by the Speaker or any member, be reduced to writing by the mover, and if seconded, shall be repeated to the House by the Speaker, before a decision or debate thereon; and a motion or resolution may be withdrawn by the mover, with the approbation or the member who seconded the same.

4. Every committee shall report within four days (Sundays excepted,) from the time of their appointment, or furnish sufficient reason why report has not been made.

5. The unfinished business in which the House was engaged at the time of the last adjournment, shall have the preference in the order of the day.

6. Every bill shall be introduced by motion for leave, by order of the House, or by report of a committee.

7. Every motion either in the House or in committee of the whole, shall be entered on the Journal, with the name of the mover.

8. One day's notice, at least, shall be given of an intended motion for leave to bring in a bill.

9. No member shall be interrupted when speaking, but by a call to order by the Speaker, or by a member through the Speaker; nor shall any member speak to any matter or thing more than three times without leave from the House, except in committee of the whole.

10. Every bill shall receive three several readings, no two of which shall be on the same day, except by special order of the House.

11. Before any petition or memorial addressed to this House shall be received and read at the Clerk's table, whether the same shall be introduced by the Speaker or a member, a brief statement of its contents shall be verbally made by the introducer.

12. All bills shall be amended at the second reading, and no amendments shall afterwards be made so as materially to alter or change their meaning or nature.

13. No question which has been decided shall be reconsidered, but on a motion made and seconded by a member in the majority on the original question, except when there was but one majority on the original question, in that case the seconder may be in the minority.

14. No member shall be referred to by name in debate.

15. Questions of order either before the House, or in committee of the whole, shall, in the first place be determined by the Speaker or Chairman, from whose decision an appeal may be made to the House or committee, on the request of a member; but no debate shall be allowed thereon, till the appeal is taken.

16. The rules of proceeding in the House, shall as far as may be applicable, be observed in committee of the whole.

17. All committees unless the House shall otherwise direct, shall be appointed by the Speaker.

18. The names of the members shall be arranged by the Clerk in alphabetical order, which order shall be preserved.

19. The Speaker or Chairman shall put every question, and if necessary for a fair decision, may of his own accord, or at the request of a member, require those in the affirmative to rise, and reverse the question.

20. Any question shall be taken by the yeas and nays if requested by the Speaker or a member.

21. All messages from the House to the Senate, shall be conveyed by the Clerk or a member, as the Speaker may direct.

22. Messages to the House shall not be admitted while the House is voting on a question.

23. No member shall absent himself from the House during the session, without leave thereof.

On motion of Mr. Wright,
The report of the committee was

Adopted.

On motion of Mr. Huffington,
Thirty copies of the rules just reported were ordered to be printed.

Mr. Huffington gave notice that he should to-morrow ask leave to introduce a bill the title of which he mentioned.

Mr. Fisher, Clerk of the Senate, being admitted, informed the House that the Senate had concurred in the passage of the joint resolution appointing a committee to settle with the State Treasurer, and that Messrs. Spruance and du Pont had been appointed on the part of the Senate as members of the joint committee.

And he withdrew.

On motion of Mr. Wright,
The House adjourned until 3 o'clock this afternoon.



Eodem Die, 3 o'clock, P. M.

The House assembled pursuant to adjournment.

Mr. Huffington, chairman of the committee to whom was referred the petition of Foster Donovan praying a divorce from his wife, Avis Donovan, reported a bill entitled

“An Act to divorce Foster Donovan and his wife Avis Donovan, from the bonds of matrimony,” which,

On his motion,
Was read.

Mr. Huffington presented the petition of Theodore B. Hearn, of Sussex county, together with sundry papers accompanying the same, praying the Legislature to order the State Treasurer to refund to him the caution money of a tract of vacant land situate in said county, which he alleges has been twice paid.

On motion of Mr. Huffington,
The said petition and papers were read, and referred to the committee of claims.

Mr. Johnson, chairman of the committee of elections, reported to the House that the Committee had discharged the duties assigned them, and had found all the members to be constitutionally elected and entitled to their seats.

On motion of Mr. Barr,
The House adjourned until to-morrow morning at 10 o'clock.

FRIDAY, 10 o'clock, A. M., January 8, 1841.

Mr. Higgins, chairman of the committee on the part of the House appointed by joint resolution to invite the Governor, Secretary of the State and Judges, to take seats on the floor of both Houses of the Legislature, at pleasure, during the present session, reported that the committee had discharged the duty assigned them.

On motion of Mr. Barr,

Resolved, That a committee of three members be appointed on so much of the Governor's Message, as relates to the controversy between the States of Virginia and New York, and report by resolution or otherwise.

The Speaker appointed Messrs. Barr, Huffington and Jefferson, members of the committee.

Mr. Marshall presented the petition of sundry citizens of Sussex county, praying the Legislature for an alteration in the law for the protection of shell fisheries in this State, which

On his motion,

Was read and referred to Messrs. Marshall, Betts and Johnson, with leave to report by bill or otherwise.

In pursuance of notice given yesterday, Mr. Huffington asked, and

On motion of Mr. Clements,

Obtained leave to introduce a bill entitled "An act to repeal certain acts therein mentioned," which

On motion of Mr. Huffington,

Was read.

Mr. Betts presented the petition of Catharine Johnson, of New Castle county, praying the Legislature to revive a certain act therein referred to, which was passed at the last session of the General Assembly, and which for a specified reason had become inoperative.

On motion of Mr. Betts,

The said petition was read and referred to Messrs. Betts, Wilds and Wright, with leave to report by bill or otherwise.

Mr. Huffington presented the petition of Coard Warrington, of Sussex county, praying the Legislature to compensate him for services rendered the State, in arresting and bringing into the State a fugitive from justice, by order of the Executive. Accompanying the said petition was a list of his expenses.

On motion of Mr. Huffington,

The said papers were referred to the committee of claims.

Mr. Huffington gave notice that he would on Monday next, ask leave to introduce a bill to regulate the drawing of lotteries and the sale of lottery tickets within this State.

Mr. Huffington laid on the table the following resolution:—

Resolved, That so much of the Governor's Message as relates to the appeal of the citizens of the District of Columbia, to the several States of the Union, remonstrating against certain acts of the General Government, detrimental to their rights and interest, be referred to a committee of three members, with leave to report.

On his motion,

The said resolution was then

Adopted,

And Messrs. Huffington, Black and Hill, appointed the committee.

Mr. Higgins moved,

That a committee of three members be appointed on so much of the Governor's Message as relates to the establishment of a penitentiary system in this State.

Which motion

Prevailed.

And Messrs. Higgins, Clements and Waples, were appointed, with leave to report by bill or otherwise.

Mr. Wright presented the claim of Messrs. Sipple & Cannon of Georgetown, against the State, for printing, which

On his motion,

Was read and referred to the committee of claims.

On motion of Mr. Huffington,

So much of the Governor's Message as relates to the disfranchisement of the State of New Jersey at the last session of Congress, was referred to a committee of three members, with leave to report by resolution or otherwise.

That committee consists of Messrs. Huffington, Chamberlain and Jefferson.

On motion of Mr. Huffington,

The House then adjourned until three o'clock this afternoon.



Eodem Die, 3 o'clock, P. M.

The House met pursuant to adjournment.

Mr. Virden gave notice that he would, on Monday next, ask leave to bring in a bill to extend the time for recording of deeds.

On motion of Mr. Huffington,

So much of the Governor's Message as relates to the restriction of the eligibility of Presidents of the United States to one term of four years, was referred to a committee of three members, with leave to report.

That committee consists of Messrs. Huffington, Dale and Wright.

Mr. Collins presented the petition of James Scott of Seaford, in Sussex county, praying the Legislature to perfect his title to two tracts of vacant land therein mentioned, which

On his motion,

Was read and referred to Messrs. Collins, Hill and Barr, with leave to report by bill or otherwise.

Mr. Higgins moved,

That the House do now adjourn until Monday morning next, at ten o'clock.

On the question being put, the House was divided.

Whereupon,

The Speaker ordered the yeas and nays, which were taken, and are as follows, to wit:—

Yeas—Messrs. Barr, Betts, Black, Chamberlain, Collins, Dale, Higgins, Hill, Huffington, Jefferson, Johnson, Marshall, Virden, Waples, Wilds, Wright, and Mr. Speaker—17.

Nays—Messrs. Clements and Frazer—2.

So the question was carried in the affirmative, and the House adjourned until Monday morning next at 10 o'clock.



MONDAY, 10 o'clock A. M., January 11, 1841.

The House assembled pursuant to adjournment.

Mr. Barr, chairman of the committee on unfinished business, reported the following bills unfinished upon the files of the last session, to wit:—

“An Act prohibiting the construction and use of certain traps in the county of Sussex.”

“An Act to amend the Act entitled ‘an Act providing for the recovery of small debts.’”

“An Act to encourage the raising of sheep,” and

“An Act to provide for the reformation of the system of free schools.”

Mr. Huffington, in pursuance of notice given on Friday last, asked and,

On motion of Mr. Wright,

Obtained leave to introduce a bill entitled, “An Act to regulate the institution and drawing of lotteries, and the sale of lottery tickets within this State.”

On motion of Mr. Huffington.

The said bill was read.

Mr. Betts presented the claim against the State of Messrs. Porter and Naff of Wilmington, for printing, which,

On his motion,

Was read and referred to the committee of claims.

On motion of Mr. Huffington,

The Clerk was then directed to inform the Senate, that the House would be ready in the course of five minutes, to receive the members of the Senate, in the hall of the House of Representatives, for the purpose of being present at the opening and publishing of the returns of the election for Governor, agreeably to the Constitution of the State, and the joint resolution of both Houses.

At the expiration of which time, the members of the Senate, preceded by their Speaker, and attended by their Clerk, came into the chamber of the House of Representatives, and took the seats prepared for their reception.

The two Houses being thus convened,

On motion of Mr. Frazer,

The resolution for convening them was read.

Charles Polk, Esq., the Speaker of the Senate, thereupon opened and published the official returns of the election in the several counties of this State: from which it appeared, that on the second Tuesday in November, in the year of our Lord one thousand eight hundred and forty, there were given,

For William B. Cooper

In New Castle county	2320 votes.
Kent “	1563 votes.
Sussex “	1967 votes.
Total.	5850 votes.

For Warren Jefferson

In New Castle county	2204 votes.
Kent “	1144 votes.
Sussex “	1676 votes.
Total.	5024 votes.

For Howard Ogle

In New Castle county	1 vote.
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Majority for William B. Cooper,

826 votes.

William B. Cooper, having the highest number of votes, was declared by the Speaker of the Senate to have been duly elected Governor of the State of Delaware, on the second Tuesday in November last, for the constitutional term of four years from the third Tuesday of January, (instant.)

The Speaker of the Senate and the Speaker of the House of Representatives then signed two certificates of the election of Governor.

On motion of Mr. Spruance,
The joint proceedings of both Houses were read and compared.

On motion of Mr. Huffington,
The members of the two Houses separated, and the members of the Senate returned to their chamber.

On motion of Mr. Huffington,
The House then adjourned until 3 o'clock this afternoon.



Eodem Die, 3 o'clock P. M.

The House met pursuant to adjournment.

Mr. Huffington presented the petition of Josiah Carey, of Sussex county, praying the Legislature to pass a law to authorise him to locate certain vacant land therein mentioned.

On his motion,

The said petition was read and referred to Messrs. Huffington, Black and Marshall, with leave to report by bill or otherwise.

Mr. Barr, chairman of the committee to whom was referred so much of the Governor's Message as relates to the controversy between the States of Virginia and New York, asked leave, on behalf of the committee, for further time to report.

On motion of Mr. Clements,

Leave was granted.

Mr. Virden, in pursuance of notice given on Friday last, asked leave to introduce a bill entitled

"An additional supplement to the act entitled 'An act to extend the time for recording of deeds.'"

On motion of Mr. Wright,

Leave was granted, and

On motion of Mr. Virden,

The said bill was read.

Mr. Huffington, chairman of the committee on so much of the Governor's Message as relates to the subject of imprisonment for debt, reported a bill entitled,

"An act to prevent unnecessary imprisonment in the execution of judgments in civil cases," which,

On his motion,

Was read.

On motion of Mr. Huffington,
Fifty copies of the said bill were ordered to be printed.

On his motion also,
The said bill was made the order of the day for Monday next, in committee of the whole.

Mr. Fisher, Clerk of the Senate being admitted, presented for the concurrence of the House, a joint resolution for the appointment of Bank Directors on the part of the Farmers' Bank.

And he withdrew.

On motion of Mr. Black,
The same was read as follows:—

"IN SENATE, *January 11, 1841.*

Resolved by the Senate and House of Representatives of the State of Delaware in General Assembly met, 'That the following persons be, and they are hereby appointed Directors of the Farmers' Bank of the State of Delaware, on the part of the State, agreeably to the act of the General Assembly, in such case made and provided.

For the principal Bank at Dover—Hunn Jenkins, James S. Buckmaster and George M. Manlove.

For the branch at Wilmington—John Evans Young, Elisha Huxley and George Craig.

For the branch at New Castle—Thomas Stockton, George Platt and Geo. B. Rodney.

For the branch at Georgetown—William D. Waples, Lewis West and Henry Little.

Extract from the Journal.

G. P. FISHER, *Clerk Senate.*

For concurrence."

On motion of Mr. Black,
The said resolution was then concurred in.

Ordered to be returned to the Senate.

Charles Marim, Esq., Secretary of State, being admitted, presented a written communication from his Excellency, the Governor.

And he withdrew.

On motion of Mr. Johnson,
The said communication was read, as follows:

*To the General Assembly
of the State of Delaware:*

By the 9th section of the 3d article of the amended constitution, the Governor is required "to set forth in writing, fully the grounds of all repleves, pardons and remissions, to be entered in the register of his official acts and laid before the General Assembly at their next session."

In pursuance of said provision, I herewith lay before you the grounds of the reprieves, pardons and remissions, which I have granted since the last session.

Though, perhaps, out of place, I will remark that I neglected to mention in my biennial message, the name of Coard Warrington, among the agents employed by me to bring fugitives from justice into this State. From the information which I have received, Mr. Warrington performed the required service with exceeding trouble and at great hazard. He is, of course, entitled to a generous allowance for the duties connected with his appointment, and I hope will receive, at your hands, the most ample remuneration.

As equally out of place, allow me to say that at the date of my late message, I overlooked the fact that there were two acts passed at the last session, supplementary to the "Act for the punishment of crimes and misdemeanors." The act of which I recommended a repeal, was that which imposed a penalty for unlawfully cutting down or barking mulberry trees, or destroying or injuring any building used for feeding silk-worms, &c., on page 271 of the printed session acts of 1839.

C. P. COMEGYS.

Dover, January 11, 1841.

A List of the pardons, reprieves, remissions, &c., which have been granted by the Governor, since the last session of the General Assembly.

1839. April 12. At the late term of the Court of General Sessions, &c. of the State of Delaware, held at Georgetown, in and for Sussex county, William Tull was convicted of petty larceny and sentenced to pay the restitution money and costs, to be whipped with twenty-one lashes, and to wear a Roman T of a scarlet color for six months on the back, between the shoulders, outside of the outermost garment.

A petition signed by all the petit jurors in attendance on the court, and a recommendation from the judges being received, a pardon was issued for that much of the sentence, beyond the payment of the restitution money and the costs of his prosecution. The recommendation of the judges was for the remission of so much of the sentence as directed the infliction of the corporal punishment.

April 15. At the same court John T. Cannon was convicted of larceny, and sentenced to pay the restitution money and costs, to be whipped with twenty-one lashes, and to wear a Roman T of a scarlet color for six months, on the back between the shoulders, on the outside of the outermost garment.

A pardon was granted by the Governor for that much of the sentence beyond the restitution money and costs, for which he assigns the following reasons:—

1. The prisoner was recommended to mercy by the Attorney General and by 231 respectable citizens of Sussex county, including the grand and petit jury in attendance on the court.

2. Letters and oral communications, expressing doubts of his guilt, were received from the county.

“ 25. At the April term of the Court of General Sessions, &c., for Kent county, Hester Griffith was convicted of larceny and sentenced to receive twelve lashes. The court recommended her to mercy on account of her pregnancy, and the Governor remitted the corporal punishment for that reason.

May 30. This day the Governor directed a full pardon to issue to Michael Millman, who was convicted at the April Sessions in Sussex, in 1838 of kidnapping, and sentenced to pay a fine of a thousand dollars, to be set on the pillory for one hour, to be whipped with sixty lashes, and suffer three years' imprisonment in solitary confinement; and who heretofore received a pardon of so much of the sentence as respected the whipping and confinement in the pillory.

The Governor assigns the following reasons for issuing the full pardon.

1. The prisoner was warmly recommended to mercy by petitions signed by several of the most respectable citizens of Sussex county, some of whom expressed a belief of his innocence.

2. It was represented by sundry letters and oral communications of some of the leading men in Sussex county, that he was unable to pay the fine—that he had a wife and children dependent on him for support, who were suffering from his confinement—that he had already suffered more than a year's imprisonment, at the expense of the county—that his support in prison was a burthen to the county—that his health was impaired by confinement—that he was penitent, and that he was, if guilty, sufficiently punished. In fact, the Governor was solicited, importuned and almost *persecuted* in his behalf, repeatedly and from time to time, by citizens of Sussex county.

June 4. This day the Governor directed a full pardon to issue for John Kennedy, confined in the public jail of New Castle, under a sentence of the Court of General Sessions, &c., in and for that county, at the May term 1838, for the crime of robbery, he (the Governor) having received petitions, signed by a very large number of respectable persons in New Castle, and said Kennedy having suffered more than a year's imprisonment, in solitary confinement.

“ 6. This day the Governor remitted to David Hall, James Chambers and William E. Perry, a fine of fifty dollars, imposed on them by the Court of General Sessions, &c., in and for New Castle county, for neglecting, as road commissioners of Appoquinimink hundred, to transmit a statement of their accounts to the Clerk of the Peace.

The reasons assigned are first, the fact set forth in the petition of said commissioners, that they were unable to effect a settlement with the tax collector, who had removed from the county, and of course could not transmit the required statement to the Clerk of the Peace. Secondly, they were warmly recommended to the Executive clemency, by a large number of respectable citizens of New Castle county.

September 14. This day the Governor pardoned Margaret Rock of the crime of larceny, of which she had been convicted in the Mayor's Court of Wilmington.

The reasons assigned are, that she was recommended to mercy by both the court and jury.

October 16. This day the Governor remitted to Jeremiah Eskridge, of Sussex county, a fine of \$65 47, imposed by a justice of the peace, for swearing and getting drunk.

The reasons assigned are his utter inability to pay the fine, and for months past he has given evidence of his reformation—matters stated in a petition signed by a large number of respectable citizens of the county.

“ 21. This day the Governor remitted to Jacob Hitchens of Sussex county, a fine of fourteen dollars, imposed on him by the Court of General Sessions, &c., for selling liquor by the small measure.

The grounds for the remission were, principally, his inability to pay the fine, as set forth in the petition, signed by a large number of respectable persons in the county.

November 2. At the late October term of the Court of General Sessions of the Peace and Gaol Delivery of the State of Delaware, in and for Kent county, Minus Brown, n., was convicted of larceny, and sentenced to receive thirty lashes.

A petition, signed by a number of the most respectable citizens of Kent county, utterly discrediting the witness on whose testimony he was convicted, being received and considered, the Governor directed a pardon to issue for the whipping.

1840. April 18. This day the Governor remitted to John Marvel, of Sussex county, a fine of fourteen dollars, which had been imposed on him by the Court of General Sessions, &c. for keeping a tavern, without license. The grounds of this remission were the utter inability of Marvel to pay the fine; and the fact that he was recommended to the Executive clemency by many respectable citizens of Sussex county.

“ 24. At the late term of the Court of General Sessions, &c., in Sussex county, George P. Conwell was convicted, in two cases, of selling liquor by the small measure and sentenced, in each case, to pay a fine of fourteen dollars. A petition signed by a number of the citizens of the county represented that Conwell had in his possession a receipt from the Clerk of the Peace for the sum necessary to procure a tavern license, and that he supposed said receipt was sufficient authority to sell by the small measure, till the license could be procured. This being considered by the Governor, he directed a remission to issue.

At a session of the Court of General Sessions, &c. in Kent county, on the 27th instant, Robert Freestone was convicted of keeping an ale-house without license, and fined fourteen dollars. A petition signed by a large number of respectable persons represented that Freestone supposed he had authority to sell ale under the license he had received to keep a victualing

house. The Governor, having considered said petition, directed a remission of the fine to issue.

May 7. At a late session of the Court of General Sessions, &c., in and for Kent county, Samuel Dickson was convicted of an assault with intent to murder William Harrington, and sentenced to pay a fine of five hundred dollars, to be set on the pillory for an hour, to suffer six months' imprisonment and to pay the costs of prosecution.

The Governor directed a pardon to issue for all the sentence, except the payment of costs, for which he assigns the following reasons:—

First. The facts set forth in the petition of Dickson, signed as it was, by a very large number of respectable citizens—that he had great provocation, being first knocked on the head by Harrington, several times with a loaded whip and severely wounded,—that before his passion had time to cool he committed the assault—that though he acknowledges he has done wrong, he declares, solemnly, he had no intention to commit murder—that he had a family, consisting of a wife and six children—that his means were limited, and that to pay the fine and costs would ruin him.

Second. The former good conduct of Dickson, he having generally behaved himself as a good citizen, enjoying the respect and confidence of his neighbors, and so far recommending himself to public notice, as to receive and now hold the appointment of postmaster in the village of Camden.

Third. The strong doubts, entertained by many persons, present at his trial, of his being guilty of more than a simple assault and battery.

Fourth. The very large number of petitioners who invoked the Executive clemency in his behalf, including several of the grand jurors who indicted him, and *all* of the petit jury who convicted him.

Fifth. The expressed opinion of several of his neighbors, that a pardon would tend more to his total change for the better than the execution of the sentence of the court.

At the late term of the Court of General Sessions, &c. in and for Kent county, James Whitaker was convicted of aiding and assisting with an intent to kidnap a certain William Clarkson, and sentenced to pay a fine of fifteen hundred dollars, to be set on the pillory for an hour, to be whipped with sixty lashes, and suffer four years imprisonment in solitary confinement.

The Governor pardoned so much of the sentence as respected the whipping and confinement in the pillory, and therefor, assigns the following reasons:—

First. The hardship of the case as set forth in the petition that it was the first offence—that the negroes were not sold but were returned into the county and are now free, and that the degrading nature of the punishment would reflect, more or less, upon his unoffending children and relatives, who were considered respectable and well-meaning persons.

Second. The Governor was appealed to by letters and oral communi-

cations, from some of the most respectable and conscientious citizens of the county, for the remission of the corporal punishment.

Third. A petition, signed by a number of his neighbors, and one by his aged mother and female relations, invoking in the strongest and most pathetic language the Executive clemency was received and considered.

Fourth. All the jury who convicted him, some of the grand jury who indicted him, and many of the most respectable citizens of the county, signed petitions in his behalf—all for the remission of the whipping and confinement in the pillory, and many also for the remission of the imprisonment and fine, or a part of the same.

Fifth. Although the Governor appreciates, most sensibly, his duty, in regard to a faithful execution of the laws, and would not be understood as assuming a dispensing power over them, yet, he cannot forbear a candid expression that the exceeding severity of the criminal code inclined him in this, as it has in other instances, to lean strongly to the side of mercy, and consider, as favorably as possible, all circumstances urged in behalf of the convict.

At the late term of the Court of General Sessions, &c., in Kent county, William Harrington was convicted, in two cases, of assault and battery, and sentenced in each case, to be imprisoned twenty days—in one to pay a fine of twenty, and in the other of ten dollars.

A petition, signed by Harrington and many respectable citizens of the county being received, stating that he was fifty-three years old, that he was very poor, that his family were suffering, during his confinement, and warmly recommending him to mercy, the Governor directed a pardon to issue, for all the sentence in each case.

May 30. The Governor this day pardoned Nancy Caulk, a colored woman, convicted at the late term of the Court of General Sessions, &c., in New Castle of larceny, and sentenced to be disposed of as a servant for a term not exceeding seven years, of so much of the sentence as respected her disposition as a servant.

The grounds for granting the pardon are principally the facts set forth in the petition, signed by several of the jurors and other respectable citizens of the county, that she was far advanced in pregnancy, that she had, with all her family, heretofore sustained an unblemished reputation—that she had borne from childhood an excellent character, as proved on her trial—that the larceny was the result of temptation, the money having been carelessly left in her way by the owner who had himself employed her, in confidence, for many years—and that the owner had, by his admission, been paid, within a trifle, by the prisoner, of the whole amount of the sum (\$20) proved to have been stolen.

June 6. This day the Governor respite the execution of Joseph Jackson, convicted of burglary at a late Court of Oyer and Terminer in New Castle county, and sentenced to be hung on the 23d instant, till Tuesday the 31st of July next.

The grounds of this respite were, principally, the strong interest which

was exhibited in behalf of the convict and the fact of his being recommended to mercy by three of the four Judges, and nearly if not quite all the jury who sat on his trial.

July 3. This day the Governor remitted to James Whitaker a fine of fifteen hundred dollars, imposed on him by the Court of General Sessions &c., in and for Kent county for being an accessory in kidnapping.

The grounds for granting the remission are the same as are assigned for remitting the corporal punishment, together with the fact of his inability to pay the fine, and his recommendation to mercy by petitions signed by upwards of fourteen hundred petitioners.

July 31. This day a full pardon was granted to Joseph Jackson, who was convicted of burglary at the late term of the Court of Over and Terminer in New Castle, and whose execution was respited to this day.

The grounds of this pardon are those, principally, which are assigned under the record of the respite, namely, the strong interest manifested in his behalf, and the fact of his recommendation to mercy by three of the four Judges, and nearly if not quite all the jury who sat on his trial.

August 7. This day the Governor directed a full pardon to issue to James Whitaker, who was convicted of being an accessory to kidnapping, at the late term of the Court of General Sessions, &c., in and for Kent county, and who was sentenced to pay a fine of fifteen hundred dollars, to be set on the pillory one hour, to be whipped with sixty lashes, to suffer four years imprisonment and to pay the costs of prosecution.

That part of the sentence, relating to the whipping and confinement in the pillory was remitted by a pardon on the 7th of May. The fine was remitted on the 3d of July, and this last pardon refers to the remaining portion of his sentence—his imprisonment in solitary confinement for four years.

The grounds of this pardon were, principally, the earnest and important petitions which were from time to time presented the Governor, signed as they were by more than *fifteen hundred* persons.

October 30. Sarah Rias, a negro woman, was convicted at the present term of the Court of General Sessions, &c., in and for Kent county, of larceny and sentenced to be whipped with twelve lashes, to pay the restitution money, and to be disposed of as a servant in the State for such term not exceeding seven years, as shall be necessary to raise the restitution money and costs, &c.

The Governor pardoned that much of the sentence which required her to be whipped with twelve lashes, and assigns his reasons—first, her recommendation by the court, who represented that they were dissatisfied with her conviction—secondly, her recommendation to mercy by some of the jurors who rendered the verdict, and several other citizens of the county.

November 12. This day the Governor remitted to Francis Johnson, a fine of eight dollars imposed by N. Stockley, Esq. a Justice of the Peace

in Kent county, for an assault and battery on the body of Rachael Summers, negro.

The reasons assigned are the strong recommendations of sundry citizens of the county of Kent who urged the exceeding poverty of Johnson in his behalf.

December 22. Nathaniel Dasey was convicted at the late Court of General Sessions, &c., in Sussex county, in one case of an assault and battery, and another of an assault with intent to murder—and sentenced in the first case, to pay a fine of twenty-five dollars and in the other, a fine of five hundred dollars with the costs of prosecution; to suffer three months' imprisonment and to be set on the pillory for an hour.

A petition signed by a very large number of the people of Sussex county, praying the exercise of the Executive clemency being received and considered, the Governor directed a pardon to issue—particularly as it was represented that Dasey had suffered the infliction of the corporal punishment, was in very bad health, was miserably poor, with a family almost destitute of the means of subsistence.

At the same term of the said court, William Rose was convicted of an assault and battery in two cases and sentenced in one to pay a fine of ten dollars, and in the other of twenty dollars. The fine and costs in both cases amounts to \$102 92.

The Governor remitted the fine and costs to said Rose, on account of his exceeding poverty and the numerous applications he received for the exercise of the pardoning power in this case.

1841. January 11. The Governor directed a pardon to issue to George Hayes and his son John Hayes, of Kent county, of the felony consequent on their convictions, respectively, at the spring term of the Court of General Quarter Sessions, &c., in and for Kent county, in 1830, of receiving stolen property in several cases.

The reasons assigned are the subsequent good conduct of both, and the expressed opinions in their favor of several citizens of Kent county.

The Governor pardoned James Whitaker of the felony of which he was convicted at the Court of General Sessions, &c., of Kent county, at the spring term, 1840.

The reasons assigned are the same as appear under the record of his pardons heretofore entered.

On motion of Mr. Wright,
The House adjourned until to-morrow morning at 10 o'clock.



TUESDAY, 10 o'clock A. M., January 12, 1841.

The House met pursuant to adjournment.

Mr. Barr, chairman of the committee to whom was referred so much of the Governor's Message as relates to the subject of the distribution of the sales of the public lands, asked on behalf of the committee for further time to report.

On motion of Mr. Clements,
Leave was granted.

Mr. Huffington, chairman of the committee on so much of the Governor's Message, as relates to the appeal made by the citizens of the District of Columbia, to the people of the United States, against the oppressive legislation of Congress, asked on behalf of said committee, for further time to report.

On motion of Mr. Barr,
Leave was granted.

Mr. Chamberlain, chairman of the committee on so much of the Governor's Message as relates to the health laws of this State, also on behalf of said committee, asked for further time to report.

On motion of Mr. Barr,
Leave was granted.

And Mr. Higgins, chairman of the committee to whom was referred so much of the Governor's Message as relates to the establishment of a penitentiary system in this State, asked also for further time to report.

On motion of Mr. Betts,
Leave was granted.

On motion of Mr. Higgins,
The House then adjourned until 3 o'clock this afternoon.



Eodem Die, 3 o'clock, P. M.

The House met pursuant to adjournment.

Mr. Fisher, Clerk of the Senate being admitted, informed the House that the Senate had concurred in the passage of the bill entitled

"An act directing the time, place and manner of holding elections for Senators from this State in the Senate of the United States."

And he withdrew.

On motion of Mr. Huffington,

Ordered, That the Clerk do now proceed to the Senate and inform that body, that the House will be ready to receive them in five minutes in the hall of the House of Representatives, for the purpose of electing by

ballot, two Senators from this State, in the Senate of the United States, in obedience to the joint resolution heretofore passed.

Which was done.

At the expiration of which time, the members of the Senate preceded by their Speaker and attended by their Clerk, entered the Hall of the House of Representatives, and took the seats prepared for their reception.

The two Houses being thus convened,

On motion of Mr. Spruance,
The joint resolution for convening them was read.
Thereupon,

Mr. Barr, moved,

That the two Houses proceed to elect by ballot a person to represent this State in the Senate of the United States, for the constitutional term to commence on the fourth day of March next.

Which motion

Prevailed.

The votes were then received by the Sergeant-at-arms of the Senate, and by him taken to the Speaker of the Senate, who read them out in the presence of both Houses of the General Assembly.

They were tallied by the respective Clerks, and were as follows:—

Thomas Clayton,	27 votes.
Blank,	1 vote.

The Speaker of the Senate then declared that Thomas Clayton, having a majority of the whole number of votes, was duly elected a Senator from the State of Delaware, in the Senate of the United States for the constitutional term to commence on the fourth day of March next:—and thereupon three certificates of the election of Thomas Clayton to the Senate of the United States were made out agreeably to the act of the General Assembly in such case made and provided:—which certificates were signed by the Speaker of the Senate, and the Speaker of the House of Representatives, and attested by the Clerks of the respective Houses.

Mr. Huffington, then moved,

That the two Houses proceed to elect by ballot a person to represent this State in the Senate of the United States for the constitutional term, from the third day of March, in the year of our Lord one thousand eight hundred and thirty-nine.

Which motion

Prevailed.

The votes were then received by the Sergeant-at-arms of the Senate, and by him taken to the Speaker of the Senate, who read them out in the presence of both Houses of the General Assembly.

They were tallied by the respective Clerks and were as follows:

For William D. Waples,	9 votes.
“ Richard H. Bayard,	15 votes.
“ James Booth,	4 votes.

The Speaker of the Senate then declared, that Richard H. Bayard, having a majority of the whole number of votes, was duly elected a Senator from the State of Delaware, in the Senate of the United States, for the constitutional term from the third day of March in the year of our Lord one thousand eight hundred and thirty-nine; and thereupon three certificates of the election of Richard H. Bayard, to the Senate of the United States, were made out agreeably to the Act of the General Assembly in such case made and provided; which certificates were signed by the Speaker of the Senate and the Speaker of the House of Representatives and attested by the Clerks of the respective Houses.

On motion of Mr. Spruance,

The proceedings of both Houses in joint meeting were read and compared.

Whereupon,

On motion of Mr. Sudler,

The members of the two Houses separated, and the members of the Senate returned to their chamber.

On motion of Mr. Wright,

The House then adjourned until to-morrow morning at 10 o'clock.



WEDNESDAY, 10 o'clock, A. M. January 13, 1841.

The House met pursuant to adjournment.

Mr. Huffington presented a petition from sundry citizens of Sussex and New Castle counties, praying the Legislature to pass an act to incorporate the Wesleyan Female Seminary of Wilmington, Delaware, which,

On his motion,

Was read and referred to Messrs. Huffington, Betts and Sudler, with leave to report by bill or otherwise.

Mr. Marshall, chairman of the committee to whom was referred the petition of sundry citizens of Sussex county, praying the Legislature to pass a bill making alterations in the law for the protection of shell fisheries in this State, reported a bill entitled

"An Act to repeal so much of the act entitled 'An act supplementary to an act for the protection of certain shell fisheries in the State,' " which,

On his motion,

Was read.

On motion of Mr. Huffington,

The bill entitled

"An act to repeal certain acts therein mentioned," was taken up for consideration.

On his motion,
The said bill was then

Indefinitely postponed.

Mr. Huffington gave notice that he would to-morrow ask leave to introduce a bill to repeal the act entitled

“A supplement to the act entitled ‘An Act providing for the punishment of certain crimes and misdemeanors.’”

Mr. Chamberlain also gave notice, that he would to-morrow ask leave to bring in a bill to repeal certain acts which he mentioned.

Mr. Betts, chairman of the committee to whom was referred the petition of Catharine Johnson, reported a bill entitled

“A supplement to the act entitled ‘An Act to enable the owners and possessors of the meadow, marsh and cripple, lying on both sides of the Northwest branch of Duck creek, emptying into the main branch of Duck creek below the Eagles’ Nest Landing, effectually to embank and drain the same, and keep the banks, dams, sluices, canals and other works in repair, and to raise a fund to defray the expense thereof,” which,

On his motion,
Was read.

Mr. Higgins, from the committee of enrolment, reported the following bill as duly and correctly enrolled, and presented the same to the Speaker for his signature, to wit:—

“An Act directing the time, place and manner, of holding elections for Senators from this State in the Senate of the United States.”

Mr. Betts gave notice, that he would to-morrow ask leave to introduce a bill entitled

“A supplement to the act entitled ‘An act providing for the punishment of certain crimes and misdemeanors.’”

Mr. Black from the committee on the petition of Josiah Carey of Sussex county, in relation to the patenting of vacant land, reported a bill entitled

“An act to enable Josiah Carey to locate certain vacant lands situate in Baltimore hundred, Sussex county, State of Delaware, and to complete his title to the same.”

On motion of Mr. Black,
The said bill was read.

On motion of Mr. Huffington,
The bill entitled

“An act to regulate the institution and drawing of lotteries, and the sale of lottery tickets within this State,” was read a second time.

The same gentleman then gave notice that he would call up the said bill on Saturday next for final passage in the House.

The Speaker laid on the table the following communication from the Secretary of State, which,

On motion of Mr. Huffington,
Was read, to wit:—

Secretary of State's Office, Dover, Jan. 13, 1841.

SIR:—I have the honor to inform you, that pursuant to the directions of an act passed at the January Session of 1837, directing a Geological and Mineralogical Survey of the State, I have this day laid before the Senate, as one branch of the General Assembly, a communication from Thomas Stockton, Esq., the chairman of the board of commissioners, accompanying the contract between them and the State Geologist, together with an account of their expenses in procuring the survey, and also a Memoir of the Geology and Mineralogy of the State, which has been compiled by J. C. Booth, Esq., the State Geologist.

With the utmost consideration,

Your obd't servant,

CH. MARIM, *Sec'y of State.*

HON. ROBERT HOUSTON,
Speaker of the House of Representatives.

Mr. Huffington, from the committee on the petition presented this morning for the incorporation of the Wesleyan Female Seminary in the city of Wilmington, reported a bill for that purpose entitled

"An Act to incorporate the Wesleyan Female Collegiate Institute," which,

On his motion,

Was read.

Mr. Fisher, Clerk of the Senate, being admitted, communicated for the information of the House the following papers, composing a letter from the Chairman of the Geological Commissioners to the Secretary of State, the contract with the State Geologist, an account of the expenses of the Geological Survey of the State, and the Report and Memoir of the same.

And he withdrew.

On motion of Mr. Frazer,

The said papers were read as follow, to wit:—

Dover, January, 12, 1841.

CHARLES MARIM, ESQ.

Dear Sir:—I am directed by the commissioners appointed by "An act of the Legislature of the State of Delaware, passed at Dover on the 18th day of February, 1837, to procure to be made a Geological and Mineralogical Survey of the State," to transmit to you in pursuance of the provisions of said act, a Memoir of the Geology and Mineralogy of the State, compiled by Mr. J. C. Booth, the State Geologist, and to request that you will have the same laid before the Legislature.

I also transmit the contract entered into by the commissioners with Mr. Booth.

The map which was to accompany the Memoir, is still in the hands of Mr. Booth, but will be forwarded to you in a few days.

The specimens of ores, marls and other mineral substances are in Phi-

Philadelphia, and will be forwarded as early in the spring as the navigation opens.

I also transmit a statement of the expenses of the survey, leaving a balance of two hundred and ninety-nine dollars and eighteen cents of the appropriation unexpended.

I have the honor to remain,

Your ob't. serv't.,

T. STOCKTON.

Chairman.

ARTICLES OF AGREEMENT, made this 1st day of June, in the year of our Lord one thousand eight hundred and thirty-seven, between Thomas Stockton, Jonathan Jenkins and Dr. Henry F. Hall, commissioners appointed by an act of the General Assembly of the State of Delaware, entitled "An act to provide for a Geological and Mineralogical Survey of this State," of the first part, and James C. Booth, of the city of Philadelphia on the second part: It being the duty of the said commissioners in virtue of the said act, to procure to be made a Geological Survey of the State of Delaware, and for that purpose they are required to appoint a State Geologist.

Now therefore, this agreement witnesseth, That the said commissioners have, and by these presents do appoint the said James C. Booth State Geologist, and do agree to pay, or cause to be paid to him, at the rate of twelve hundred dollars a year, so long as he may remain in the service of the State; the said commissioners reserving to themselves the right to terminate that service for any reasonable or just cause. And the said James C. Booth undertakes and agrees on his part, the duties of State Geologist, to the best of his skill and ability, observing and performing on his part, all the injunctions and requirements of the said Act of Assembly. *And further,* That if, in his survey of the State, he shall make any useful discovery on the land of any person, he will give information of such discovery to the owner of the land: *And further,* That he will collect and deposite with the commissioners, for the use of the State, and for each of the counties in the State, specimens of all the minerals he may discover in the State.

In witness whereof, the parties have hereunto set their hands the day and year first before written.

T. STOCKTON,	}	<i>Commissioners.</i>
JONA. JENKINS,		
H. F. HALL,		

JAS. C. BOOTH, *Geologist.*

Witness present,

THOMAS MARTINDALE.

SAMUEL WISE,

Witness to Dr. Hall's signature.

The State of Delaware in account with Thomas Stockton, Jonathan Jenkins and Henry F. Hall, Commissioners, to superintend Geological Survey.

DEBTOR.

					<i>Dolls. Cts.</i>
1837.					
October	24	To draft of T. Stockton, Chairman of commissioners in favor of J. C. Booth, State Geologist for one quarter's salary due 1st Sep.		300	00
Dec.	25	To do do due 1st Dec.		300	00
1838.					
March	12	To do do due 1st March		300	00
	"	To draft on State Treasurer for amount of T. Stockton's attendance on survey, 24 days, three dollars per day.		72	00
	"	To do do H. F. Hall's do 9 days.		27	00
	14	To do do in favor of J. Couper Treas. of New Castle Manufacturing Com. for augur.		16	00
April	9	To do in favor of R. and J. B. Porter for sundry printing.		16	85
	13	To do in favor of T. Stockton for a horse and Dearborn for Geologist		110	00
June	1	To do in favor of J. C. Booth, State Geologist, one quarter's salary due this day.		300	00
Sep.	1	To do do do do		300	00
Dec.	1	To do do do do		300	00
1839.					
March	1	To do do do do		300	00
June	1	To do do do do		300	00
Jan.	3	To draft on State Treasurer for T. Stockton's account for 9 days' attendance	\$27	00	
		For Doughton and Miller's account for repairing Dearborn.		2	60
		I. H. Register for horse food.		75	
		J. Bojias account for repairs of Dearborn.	4	12	
		Two quires of paper.	50		
		To draft on Treasurer for amount of J. Jenkins' account for 11 days' attendance.		33	00
		To do do for H. F. Hall's account for 10 days' attendance.		30	00
Jan.	12	To cash paid J. Jenkins per account and receipt		3	00
		do do H. F. Hall, do.		27	00
		do do T. Stockton.		21	00
		To balance unexpended.		299	18
					<u>\$3090 00</u>

CREDITOR.

1837.		<i>Dolls. Cts.</i>
	By the amount of the appropriation.	3000 00
1839.		
	By amount of sale of horse and Dearborn.	90 00
		<hr/>
		\$3090 00

Respectfully submitted to the General Assembly, by

T. STOCKTON,

Chairman.

January 13th 1841.

Dr. *The State of Delaware,*

To Jona. Jenkins, one of the State commissioners for
making a Geological and Mineralogical Survey of said State.

To 1 day's services in meeting commissioners on the 12th
January, 1841 - - - - \$3 00

January 12th 1841. Allowed by the board.

T. STOCKTON,

Chairman.

Received payment of T. Stockton.

JONATHAN JENKINS.

January 12, 1841.

Dr. *The State of Delaware,*

To H. F. Hall, one of the State commissioners for
making a Geological and Mineralogical Survey of said State.

To nine days' service in attendance on the duties of said
survey - - - - \$27 00

January 12, 1841. Allowed by the board.

T. STOCKTON,

Chairman.

Received of Thomas Stockton the sum of twenty-seven dollars, for the
above services.

Dr. *The State of Delaware,*

To Thomas Stockton, one of the commissioners for
making a Geological and Mineralogical Survey of the State.

January 12, 1841. To seven days' attending on said survey \$21 00

Allowed by the board,

H. F. HALL, *Secretary*.

January 13, 1841. Thirty-nine dollars deposited in the Farmers' Bank at Dover, to the credit of the State Treasurer, by

T. STOCKTON, *Chairman*.

Memoir of the Geological Survey of the State of Delaware: including the application of the Geological Observations to Agriculture. By James C. Booth, A. M., Mem. of Amer. Philos. Society; Acad. Nat. Sciences; and Prof. of Technical Chemistry in the Franklin Institute of Philadelphia.

PART I.

GENERAL VIEW OF THE GEOLOGY OF THE STATE.

CHAPTER I.

PRIMARY FORMATIONS.

§ 1. THE geological formations of the State of Delaware may be conveniently divided into four classes, according to their structure or the organic remains they may contain; but such an arrangement having no reference to superficial strata or soils may be regarded only as one of convenience in aid of description, and for the sake of identifying the locality of particular minerals comprised by the several formations. Were it required to view the State solely with regard to its agriculture, a different classification would become necessary, dependent on the character of the soil; but since the object of research has been to investigate the mineral deposits on or beneath the latter, with more especial reference to their application to agriculture, and since these are not necessarily connected with the soil in their character, the division of the State into four groups, consistent with received geological theories, may be regarded as most convenient and suitable to our purpose. When alluding therefore to the several formations, the soil must be kept wholly out of view, and those mineral substances understood, which are contained beneath it at variable depths.

§ 2. By an attentive examination of the surface from the northern, or curved boundary of the State, to a line crossing the State on and a little north of the Wilmington and Susquehanna Rail-road, and in the same direction, we observe rocky masses protruding through the soil of a sufficiently marked character, to distinguish them from sandstones and slates. Where artificial excavations are made of sufficient depth, as for the con-

struction of roads, in the digging of wells, &c., the same rocks are always met with, and no termination of the solid mass has hitherto been found. Therefore, independently of loose masses and fragments of stone detached from their adjacent beds, the whole of the district in question is underlaid by a continuous bed of rock. The term Primary has been applied to these rocks, indicative of the age sometimes attributed to them in geological theories, but this view may be demonstrated to be incorrect in the present more advanced stage of the science, as some of the rocks supposed to have been primarily formed may be found overlying those admitted to be of later origin. Since, however, a particular class of rocky formations is generally understood by the term Primary we shall adopt the same, and apply it to the region under consideration.

§ 3. The primary region of the State is characterized by the unevenness of its surface, by an apparently confused mass of beautifully moulded hills, with a bold and rounded outline, always elevated and often rising several hundred feet above tide water, and affords an outlet to the waters of rain, springs and creeks, through deeply cleft valleys, with rounded or abrupt rocky sides. The soil, though varying in particular localities, is generally uniform in its character, being argillaceous and mingled with a greater or less quantity of gravel, while an alluvial deposit of a similar character covers the rocks to the variable depth of from one to sixty feet, and perhaps still more. A cursory view might lead to the conclusion that the whole region contained one, or, at most, two kinds of rock; a more minute investigation, however, enables us to distinguish five different kinds, four of which are stratified: viz, Gneiss, Felspathic rock, Limestone, and Serpentine, and the remaining formation is of a veined and granitic character. The first and second of these constitute about ninety-nine hundredths of the whole series. They are all characterised by their crystalline structure, and the variety of simple minerals with which they abound.

§ 4. I. *Gneiss*.—This rock, comprising about three-fourths of the primary region, may be observed in numberless places protruding through the soil in solid mass, while its fragments lie scattered over the surface of hill and valley, and the soil is highly charged with particles of mica. It is composed of quartz, felspar, and mica in varying proportions, the first named averaging a greater quantity than either of the two last, and these being in nearly equal proportions. The mica is not unfrequently wholly wanting, and sometimes, though rarely, replaced by scales of hornblende, which communicates to the rock a greater degree of hardness and toughness. To the mixture of these minerals, we must attribute the pervading gray color of gneiss, varying from a blackish to a very light gray, and at times deriving a reddish tinge from flesh-colored felspar. In some cases it may be easily impressed by a knife, and again the steel itself may be abraded, while in a majority of instances it presents a rock of a medium degree of hardness. Although composed of several distinct minerals, they are so firmly united, and one of them, the mica, so little frangible, that it has a decided character of toughness. Although quartz preponderates, yet we find at times the felspar in greater abundance, and when the latter is of a particular kind, the whole body of rock undergoes

a disintegration from the decomposition of felspar, which then constitutes kaolin, and mingling with quartz, sand and mica, forms a very tenacious soil. This decomposition may be observed in many parts of the primary region near the surface of the ground, and often indeed of considerable thickness, exhibiting alternating layers of mica, and the two other minerals in the same position as in the solid rock, while the mass resembles clay in its softness.

§ 5. It requires only a superficial observation to discover that gneiss possesses a stratified structure, and that its micaceous particles usually lie in the plane of stratification, thus affording us an opportunity of determining its *bearing*, or the direction in which it traverses the country, and its *dip* or inclination to the horizon. The average bearing of the rock, deduced from numerous observations, is N. 47 deg. E., and its dip 70 deg. towards the N. W.; but these conditions are not constant, for we sometimes find it bearing N. and S., or E. and W., while its position is perfectly vertical. It is always distinctly stratified, and rarely so irregular as to prevent suitable instruments from giving the bearing and dip within an error of 2 deg. to 5 deg., and hence the more striking deviations from the general direction of the strata are not to be attributed to local irregularities, but rather to those great causes of disturbance, which elevated the whole formation. We may also attribute to the same causes, those great natural joints, which traverse the gneiss in various directions, most frequently vertical, and nearly at right angles to the bearing.

§ 6. II. *Felspathic Rocks*.—These rocks occur chiefly along the shores of the Delaware from Naaman's Creek to Wilmington, and from thence may be observed at intervals to the western state-line, being indicated by projecting masses of the solid bed, or by huge boulders, scarcely rounded by attrition or disintegration. Extending over one-fourth of the primary region, and with the preceding formation, embracing nearly the whole of the same area, they leave small spaces for the limestone, serpentine, and granite. The term Trappean, sometimes applied to them has been too frequently misapplied to other rocks, to admit of its employment in the present instance, and certainly, even if they had more decided trappean characters, there are good reasons why they cannot be so considered. The conformity of their bearing and dip with those of the gneiss, throughout their whole extent, and their gradual transition into the latter seem to place them in the same rank, although circumstances have modified their external characters. They form a confusedly crystalline mass of translucent smoky felspar and quartz, with occasional plates of black mica and more rarely veins abounding in hornblende. The first named of these minerals is the most abundant, sometimes constituting the entire rock, which in that case is coarse-grained and highly crystalline; but when mingled with quartz, the result is usually a fine-grained and harder material: and hence we may adopt a convenient and practical subdivision into coarse and fine-grained, or pure felspathic and quartzose. Being very compact in their texture, these rocks possess greater specific gravity than gneiss, and while their highly crystalline structure communicates to them much greater hardness, they have at the same time an increased degree of toughness. Their density, and the

peculiar character of the felspar renders them less subject to disintegration, a circumstance more particularly characteristic of the fine-grained varieties, and hence, too, instead of finding the soil above them partaking of their constituents, it contains materials of gneiss, which is a much more decomposable rock. In many of the quarries opened in these rocks, it would appear as though it formed an irregular mass, incapable of stratification, but in a few instances by superficial and frequently by more accurate observation, its bearing and dip may be seen and measured. On the weathered surface of the rock, however, the lines of stratification are always well defined, and generally correspond with those of the gneiss. The hornblendic veins which sometimes traverse it are irregular, and appear to be incapable of measurement.

§ 7. III. *Limestone*.—Although occupying an unimportant extent of country in comparison with the two preceding formations, yet from its varied utility, the limestone holds pre-eminent rank among the mineral productions. It occurs in greater abundance at Jeanes' and Eastburn's, on Pike Creek, and in smaller quantity at Klair's, two miles W. of Centreville, and at Bullock's, near the crossing of the State line by the Brandywine. It is a pure marble, essentially composed of lime, magnesia and carbonic acid, with a small amount of foreign matter. It is a coarse and fine-grained crystalline mass, with a white color, of greater or less purity, presenting at times a bluish tinge from the presence of carbonaceous matter. It lies in heavy beds, generally disintegrated in its upper layers, and giving rise to a calcareous sand near the surface of the ground. It is regularly stratified, with an average bearing of N. 55 deg. E., and with a dip at Jeanes' to S. E. At Klair's, it is interstratified with gneiss, and dips with it to the N. W. This variation in dip, gives strength to the conclusion, that, although the two localities fall nearly in the same line and have the same bearing, they are not connected, and that the rock does not necessarily exist in the intermediate space of country.

§ 8. IV. *Serpentine*.—A limited body of serpentine occurs about six miles N. W. of Wilmington. It is of various shades of green from a very dark to a light yellowish green;—is of different degrees of hardness, and exhibits under the hammer, a moderate share of toughness. The influence of disturbing causes, probably arising from a heavy granitic vein which passes through it, has broken and shattered it to such an extent as to afford no opportunity of ascertaining the direction of its stratification or lamination with any degree of accuracy. As usual, it is accompanied by numerous veins of asbestos, talc, and other magnesian minerals. A smaller body of serpentine occurs near the State line in the immediate vicinity of Bullock's limestone quarry, sec. 40.

§ 9. V. *Granite*.—The principal vein of this rock has just been noticed as traversing the serpentine. It is characterised by its abundant content of a very pure and white felspar, unusually free from oxide of iron, a circumstance from which it derives its principal value. It also contains numerous minerals, and indeed the serpentine and granite together offer the finest mineral locality contained in the State of Delaware. Another granitic vein of considerable dimensions passes through the lime quarries on Pike Creek, and is chiefly composed of felspar of

less purity than the preceding; but beside these two, there are numberless smaller veins projected through the gneiss in various parts of the primary region.

CHAPTER II.

UPPER SECONDARY FORMATIONS.

§ 10. THE preceding chapter exhibits a condensed view of the several formations comprised within the primary or rocky region of the State. From their lower limit to the southern boundary of Delaware, and indeed to the extremity of the peninsula, the general features of the country are widely different; for instead of a constant succession of irregular and boldly rounded hills, it presents a comparatively level country or table-land, gently sloping east and west towards either bay from an elevated strip of land several miles in breadth on which the streams flowing east and west, take their rise in swamps and morasses, and scoop out their channels in the soft and yielding strata, which constitute the solid basis or geological formations of a very large portion of the State. Hence the name, water-shed or dividing-ridge, is frequently and not inaptly applied to this narrow tract, which extends through the peninsula. The deposits of the dividing ridge in the northern part of the State are argillaceous; towards the south, they are a mixture of the same with light sands, and have no connection with the subjacent geological strata. Similar clayey deposits constitute the greater portion of the neck-lands from Wilmington to Lewistown, likewise independent of the geological formations. Approaching the surface in many situations, they communicate a well characterised tenacity to the soil both of the necks and ridge, which is only relieved towards the middle and southern portions of the State by the admixture of the there abounding light sands.

§ 11. From the lower limit of the primary, and nearly to the southern border of New Castle county, we find a series of clays, sands and gravel of a heterogeneous character when examined in detail, but nevertheless presenting certain general characters, sufficient to establish their unity as a formation, such as their position relative to each other, and their organic remains. As the former class was denominated primary, so this series bearing some analogy to another class, termed in Europe the Secondary, on the supposition of its being second in the order of formation, may receive the same appellation. Whether the term be correctly applied, may reasonably admit of a doubt, but it is a matter of small moment to us, for from the general similarity of their organic remains to those of the upper portion of the secondary series of Europe: as well as to give a name generally understood, we shall designate them as the Upper Secondary Formation.

§ 12. This formation being composed of clays and sands, which are more or less loose in their texture, the surface of the country originally rather flat and level, has been scooped out by brooks, creeks, and rain-torrents into an undulating surface often presenting high hills and deep valleys, sometimes gently sloping, at others with abrupt declivities, where the formations offer a sufficient resistance to the agents of denudation. Were it not that such natural excavations penetrated and exposed the subjacent geological formations, this section of country would offer problems of very difficult investigation to the geological inquirer, and even with their assistance, the artificial excavations on the canal and roads, tend rather more to elucidate intricate points of importance. The soil of the region is decidedly argillaceous, varying from a sandy or gravelly loam to a tenacious clay, and the varieties are mainly dependent on the rise of subjacent strata to the surface. Crossing the strata from the primary range southwardly, we find almost every natural and artificial section exhibiting a series of clays, in which a red color predominates, of so characteristic a shade, in this State, New Jersey, Maryland, and Virginia, that we may appropriate to them the name of the Red Clay Formations. Below this and as far as the Appoquinimink, are a series of yellow and greenish sands, the former of which predominates, but the importance of the latter in agriculture, entitles the whole to the appellation of the Green Sand Formation.—The aggregate thickness of the formation is, probably, not less than 330 feet, including the red clay, and green, and yellow sands.

§ 13. *Red Clay Formation*.—The diluvial deposits of clay and gravel reposing on the red clay, communicate an argillaceous character to the soil, which is increased in tenacity, where they give place to the latter; and hence the hundreds of New Castle, Red Lion, and Pencader, possess a soil of a heavier nature than usual. In many instances, however, a stratum of sand in the underlying clays, or a large admixture of gravel relieves it of its extreme tenacity. The red clay formation may be examined advantageously, on the borders of the Christiana, where it forms precipitous hills rising to the height of 60—80 feet above tide-water. We there find it consisting mainly of a clay, varying from a light peach-blossom shade to an intense vermillion, and alternating with thin seams of light lead-colored, or yellow clays, with occasional beds of white and yellow sands. The red variety itself constituting by far the larger part of the whole stratum varies in different localities, for while we find it generally tenacious and plastic, yet again the presence of much arenaceous matter imparts to it a degree of friability. Although inconsiderable veins of a white, and highly plastic clay, are disseminated through the whole region, there is only one locality, where it exists in sufficient quantity to be wrought, on the Delaware shore below New Castle. The material obtained at this place is of a pure white color; remarkably free from ferruginous or siliceous matter. By adding the depth of a boring made at New Castle to the thickness of the stratum south of Wilmington, we may estimate the thickness of the red clay formation to be 250 feet.

§ 14. *Green Sand Formation*.—Towards the southern border of the preceding stratum, a deposit of yellow sand begins to appear in elevated situations, becoming gradually thicker as the red clay sinks below it,

until we approach the canal, where it takes up, and includes in it another member of the series, the Green Sand or Marl. These two in combination occupy the whole of St. George's Hundred, the yellow usually preponderating over the other, sometimes presenting bluffs, 50 feet in height, while the green sand rarely exceeds 30 feet in thickness. There appear to be two principal deposites of green sand, the upper and lower, which rarely unite to form one stratum, and are often separated by 20 or 30 feet of yellow sand. The lower stratum is chiefly confined to the canal, while the upper, although visible at the Deep Cut, first assumes importance several miles to the southward. Both deposites derive their character from a green substance with which they abound, and which, being in the form of small grains, has received the name of green sand, but its granular form being the only property in common with ordinary siliceous sand, the two should not be confounded together; for while the latter contains principally one ingredient, silica or flint, the green sand is composed of five or six, among which are potassa and lime, two substances of the highest value in agriculture. The soil on the neck-lands and dividing ridge of the region in question is rather argillaceous and heavy, but throughout the rest of the hundred, the yellow sand rising to the surface, assumes the character of a loam, that can scarcely be excelled for the well-proportioned admixture of fine sand and clay, and proves itself capable of the highest degree of improvement.

Sec. 15. The lower stratum contains an admixture of carbonate of lime, in a finely divided chalky state, beside that comprised in its abundant shells, with a variable quantity of green sand; the upper is principally composed of the green particles, with a little siliceous or argillaceous matter. The southern border of the formation on the Appoquinimink, consists of a mixture of yellow and green sands, inclosing a compact bed of shells, which have in many instances undergone decomposition. In the same manner, the shelly strata on the western limit of the hundred have suffered the loss of a large proportion of their calcareous matter. Thus the peculiar features of the formation point a convenient classification of the several species, viz: the true green sand and the calcareous deposites—but they may be farther subdivided into eight varieties; such distinctions, however, are not to be considered as scientific, but merely as an arrangement for convenience in describing the different parts of the formation, agreeably to their constitution, their external characters, their situation and fertilising effects.

Species of Green Sands.	Varieties of Green Sands.	Localities of the Varieties.
Calcareous.	Cretaceous or Cretoidal,	St. George's Creek.
	Decomposed & Indurated,	Head waters of the Bohemia.
	Shelly,	Appoquinimink.
Ordinary.	Bluish,	Silver Run & Drawyer's Creek.
	Yellowish,	Drawyer's Creek.
	Black externally,	{ Between Port Penn and Can-
	Pyritiferous,	{ non's Mill-pond.
		{ Heads of Bohemia & Dividing
		{ Ridge.
	Blue micaceous,	Deep cut of the Canal.

CHAPTER III.

TERTIARY FORMATIONS.

§ 16. BETWEEN the lower limit of the green sand, and the lower part of Kent county exists a series of beds of clays and sands, comprising two narrow belts abounding in organic remains, which are different from those of the upper secondary. To these the appellation of Tertiary may be applied from their resemblance to certain formations of Europe, which have been similarly designated, although it may be doubted whether the correspondence between them is sufficiently exact. The land is generally less elevated and more level in this region than in the secondary, and the soil varies to a greater extent, sometimes presenting the extremes of sand and clay.

§ 17. In the northern part of Kent county, on Old Duck creek, and in Wales' mill-dam, may be observed a stony crust, topping a blue clay, containing abundant casts and impressions of shells. On the head waters of Murderkill, in the lower part of the same county, a heavier deposit with similar organic remains presents itself in the steep banks of the creek. The intermediate country offers no similar indications of its age, but consisting of yellowish clays surmounted by sands and gravel of a like character with those connected with the two tertiary belts, it may be included in the tertiary formation. The same remarks apply to the clays of Appoquinimink hundred. The greatest ascertained thickness of the several deposits taken in the aggregate amounts to 125 feet.

§ 18. *Northern Tertiary*.—The northern belt of tertiary offers difficulties of investigation from its presenting itself only in two localities, which are, however, well marked at Wales' Mill, sec. 17; and farther up Old Duck Creek at Cloak's Mill, where it has been examined at the depth of 12 feet, and found to be uniform in its general features. It is a lead-blue

arenaceous clay, containing impressions of shells, the upper portion of which at Wales' Mill has become indurated through the agency of oxide of iron, and the lime which it formerly contained has been wholly removed. In the same bearing, and in a southwest course from this locality we find the same blue clay at Smith's mill on the Choptank but without traces of organic remains. By adding the twelve feet of blue clay to the thickness of the superimposed yellow clay and gravel, the three deposits being always found together in the above localities, we may estimate the thickness of the formation as far as observation permits, to be 30 feet.

§ 19. *Southern Tertiary*.—The lowest stratum visible on the headwaters of Murderkill is a lead-blue clay, closely resembling that of the northern belt, sec. 18, but lying more open to successful investigation. It abounds in impressions of shells in a soft clayey state, and is separated from an overlying, white, sandy bed by a hard ferruginous crust, containing similar organic remains. The white arenaceous stratum is a semi-indurated mixture of sand and clay, and appears to consist almost wholly of shell-casts, but in no one of the places where it is exposed, has a trace of lime been detected, except in a solitary instance, when a shell was found unaltered. By adding the greatest observed thickness of the blue clay at Jester's mill, sec. 85, to that of the overlying sands, &c., examined at Spring-mills, we obtain 25 feet for the greatest ascertained thickness of the Southern Tertiary.

§ 20. *Yellow clays of Appoquinimink Hundred*.—A careful examination of the lower limit of the green sand formation proves it to descend below a yellowish clay or loam, from which it is separated by a stratum of ferruginous sandstone, sometimes six feet in thickness. At these points the clay is not more than 10 to 15 feet thick, but farther south as near Blackbird, it constitutes hills some 30 feet in height, and occasionally alternates with deposits of a yellowish sand. It is a very soft and plastic clay, when wet, and contains a variable quantity of siliceous sand, generally too much to permit its being classed among valuable argillaceous deposits; and although its predominating color is a pale ochrey yellow, yet we sometimes find it lead-colored, and nearly black. Rising in many localities nearly or quite to the surface, it imparts to the soil of a large portion of the region, a considerable degree of tenacity, and consequent difficulty of working. The neck-lands, however, as well as the western part, offer a soil of superior quality: indeed the latter, known as the Levels, has been long celebrated for its fertility.

§ 21. *Intermediate Yellow Clays and Sands*.—Wherever the strata subjacent to the soil can be examined over the large tract intervening between the two tertiary belts, secs. 18, 19, we find the lowest to consist of yellow, nearly white, and reddish clays, the yellow preponderating over the others, and the upper to be composed of gravel and sands, which graduate into the soil. They apparently overlies the tertiary on Old Duck Creek, and seem to be continuous with the yellow clay of Appoquinimink hundred, sec. 20, although the latter point may be doubted from the tendency of all the strata below the primary, to dip towards the southeast. For the same, and other reasons, sec. 88, it would appear to

pass below the southern tertiary belt, and hence must be ranked with the tertiary formations, until it be shown that it is of more recent origin. If we include the sands and gravel in the same formation with the clays on which they rest, we may assign 40 feet as its greatest ascertained thickness.

CHAPTER IV.

RECENT FORMATIONS.

§ 22. To the southward of the lower tertiary, and as far as the southern limit of the State, are deposits of clay, and sands with a preponderance of the former. Organic remains are rarely found in them, and as they contain none of those which characterise the tertiary, and resemble the shells which still exist in our waters, we may not go far astray in assigning to the whole formation a later origin, and terming it Recent. If this be true, the deposits on the neck-lands and on the dividing ridge are referrible to the same class. The surface of the country lying above the recent deposits of the lower part of Kent, and the whole of Sussex counties, is much more level than the preceding regions of secondary or tertiary date, and is less frequently scooped out into ravines. The soil is more variable than in any other portion of the State, offering the two extremes of stiff clays and blowing sands; but in several instances, as in Northwest Fork Hundred, and on the neck-lands, it is of medium texture, and endowed with superior fertility. The greatest ascertained thickness of the clays is 40 feet, § 90.

§ 23. The lowest stratum is a yellowish clay, at times of a light lead color, alternating with thin seams of sand, and super-imposed by yellowish and nearly white sands of very variable thickness, amounting at times to twenty feet. The Lower clays, Upper sands, and the more Modern deposits of the river constitute the recent formations of the State. The clay frequently rising to the surface forms a very heavy soil, while in a majority of instances the upper stratum forms a very light sandy soil, which has improperly imparted its character to the whole county. Organic remains are rarely discovered, among which may be instanced the deposit near Dagsborough, and others in Baltimore hundred, embedded in a blue clay, and those on the Nanticoke, contained in a yellow loam, which rests on a similar blue clay. On the head waters of some of the streams are deposits of iron ore, which have been wrought for years, and may still yield largely, unless the country be subjected to drainage.

§ 24. *Addenda.* Taking a general view of the State, by proceeding from the N. towards the S., we observe that the rolling country of the primary becomes less broken and more level—that the deposits of gra-

vel diminish in extent and coarseness, graduating into fine sand—and that the amount of ferruginous matter decreases in the same ratio. To the latter assertion, the objection might be urged, that the deposits of iron ore in the south prove the contrary. It becomes evident, however, from an examination of the strata, that the iron in them does diminish in quantity, but that while it is carried away by streams from a more broken and hilly region, it is usually deposited at the place where chalybeates issue on the more level lands of Kent and Sussex. A glance at the map of Delaware shows the general bearing of the southern outline of the primary region to be nearly N. 50 deg. E., and by a comparison of the respective limits of the other formations with similar strata in adjoining States, we find their general bearing to correspond with the same line, and all exhibit a parallelism to the great outline of the sea-coast. The irregularity of the primary will scarcely admit of determining its thickness, but the aggregate thickness of the upper secondary, tertiary, and recent formations will probably not fall short of 500 feet.

PART II.

SPECIAL GEOLOGY.

CHAPTER I.

PRIMARY ROCKS.

SECTION 1.

Gneiss.

§ 25. AMONG the numberless places where this rock was examined, a few may be selected that may serve to establish its character as it has been described secs. 4-5, and at the same time show the variations to which it is subject. On the Lancaster turnpike, about one mile from Wilmington, the gneiss may be seen decomposed in its original bed, presenting light colored laminae of quartz and kaolin (decomposed felspar,) alternating with dark lines of black mica. It is very soft, easily cut with the knife, and yet so regularly disposed as to give the ordinary bearing and dip of the rock, sec. 5. Proceeding farther on the same road, it may be seen under similar circumstances in many exposures, but gradually gives way to a more solid rock. On the turnpike passing through Newport, and all the roads that cross the southern outline of the Primary region, this disintegration may be frequently observed, and is usually characterised by a deep red color from the large proportion of oxide of iron it contains. But the frequency of this occurrence is not more remarkable than its depth. 20 and 30 feet in thickness of disintegrated gneiss has been observed, and how much more may be found we cannot determine, although the probability is that the solid stone lies at no great distance below the depth just mentioned. From these facts, we are at liberty to draw conclusions relative to the great destructibility of the rock when exposed to the powerful decomposing agents of nature during lengthened periods of time; a conclusion, however, that is far from militating against its employment in the arts of construction, where it would be less influenced by those agents, and during a period of comparatively short duration. Its liability to change is farther shown by the total ab-

sence of angular fragments, and the rarity of rounded boulders, which have been found chiefly on the Lancaster pike between one and three miles from Wilmington, and near the point where the Brandywine enters the State. Even this last locality might furnish one proof of the point we aim to establish, from the unusual quantity of mica strewed over the soil, were it not that the dissemination of this substance through the soil of the whole region is abundant evidence in itself.

§ 26. Notwithstanding the variable quantities of the three principal ingredients of gneiss, sec. 4, it is rarely found very free from any one of them. One instance of this occurs near Phillips's mill in the vicinity of Brandywine Springs, where a Trappean rock passes through gneiss composed in one part almost altogether of mica, and in another of felspar and quartz. The former of these varieties, if found in sufficient quantity, would answer a good purpose, as a hearth-stone for some furnaces, the latter as a building material, sec. 157. Since the absence of any one of the three minerals is of rare occurrence, when speaking of the rock, they must be supposed to be present nearly in the proportions stated, sec. 4.

§ 27. Beside the three constituents of gneiss, one other simple mineral is extensively diffused through it, the common red garnet, which communicates to it a peculiar tortuous appearance, and sometimes renders it a matter of no small difficulty to take accurate bearings. Thus about five and a half miles from Wilmington on the Concord turnpike is an irregularly stratified gneiss, chiefly composed of white felspar and quartz, with a few lines of black mica, and garnets disseminated through some portions, with veins of a pure white felspar; the same continues to the Pennsylvania line, where it assumes more regularity, and the garnets disappear. Passing from Smith's tavern (on an extension of the Concord Pike), to Smith's bridge on the Brandywine, the same rock is observable, abounding in garnets to such an extent as to constitute a prominent constituent, and yet in some instances so regular as to admit of measurement of its direction, sec. 30. On the Kennet pike, about four and a half miles from Wilmington, the gneiss is regular and abounds in black mica, but a little farther onward, about five miles, it becomes more tortuous from the presence of garnets, and continues the same features for several miles. These few instances may serve to show the extensive diffusion of this simple mineral through the primary region.

§ 28. The quartz and felspar being generally white, the gray color of gneiss is chiefly due to its content of black mica, which is often in such abundance as to give its own hue to the rock, as in the locality mentioned in sec. 27—on the Kennet pike, four and a half miles from Wilmington, and other places on the same road—on Red Clay Creek, N. of the Lancaster pike—on Pike Creek near the lime quarries, &c. But these micaceous scales are not unfrequently replaced by hornblende, (sec. 4,) to distinguish between which often requires minute inspection. Thus, 100 yards on either side of Tucker's spar-quarries, they occur together, the hornblende communicating greater gravity, hardness, and toughness. At this place also, frequent natural joints (sec. 5,) intersecting the planes of stratification at similar angles, split the rocks into blocks so uniform as to resemble crystalline forms, a circumstance most frequently observed

when hornblende is present. When hornblende occurs even in some quantity in the gneiss, it does not necessarily indicate the vicinity of a trappean rock, for there is no evidence of such an injection in the locality mentioned, nor in several others which were examined.

§ 29. Veins of quartz and felspar, are often seen traversing gneiss, forming waving lines, and yet in general following the planes of stratification, or its bearing; such are the localities on the Concord pike five and a half miles from Wilmington, noticed in sec. 27, and on the Kennet pike, a little beyond the fifth and sixth mile-stones, where the quartz has the appearance of having been injected in a fused or liquid state into the rock. In the neighborhood of Centreville are also to be seen true granitic veins of small extent in connection with the quartzose, from which, in all probability, the magnetic oxide of iron occasionally found there has been derived. From the instances adduced in this and the preceding paragraphs, a false inference should not be drawn relative to the irregularity of the gneiss or the deviation from its ordinary features over the whole primary range, for these are merely exceptions to the general characters given in secs. 4—5.

§ 30. In a large majority of cases where the gneiss is exposed, we may apply the compass and levelling quadrant, to measure the bearing and dip with accuracy. Thus on an extension of the Concord turnpike near the State line, sec. 27, it bears N. 60 deg. E., and dips at an angle of 80 deg. to the S. E. contrary to its usual dip, which we may attribute to the vicinity of the serpentine, sec. 43, and its projection beyond a vertical position to the causes which upheaved it; for southwest of this place on the road from Smith's tavern to Smith's bridge it bears N. 60 deg. E. with a dip of 60 deg. to N. 30 deg. W. and still farther to the S. W. at Blair's lime-quarry b. N. 55 deg. E. dip to N. W. On the Kennet turnpike, four and a half miles from Wilmington, b. N. 40 deg. E. d. steep to N. W.;—five miles from Wilmington, b. N. 40 deg. E. d. 80 deg. to N. W.; six and a quarter miles from Wilmington b. N. 35 deg. E. nearly vertical; and on a road running W. from this turnpike at six miles from Wilmington b. N. 30 deg. E. nearly vertical. These last bearings are probably affected by the granitic vein in the serpentine, lying to the southward, for around this injection the bearings vary from the ordinary direction, as on a small stream, emptying into Red Clay Creek, about one and a half miles S. by W. of the Spar Quarries the gneiss b. N. 20 deg. E. and is nearly vertical, while on the Red Clay Creek it bears N. 50 deg. E. To illustrate still farther this variation towards the east, may be adduced the bearing of interstratified gneiss and hornblende, E. of Jeanes' lime quarries, where they b. N. 5 deg. to 10 deg. E., dipping both east and west. If we take those localities where there have been fewer causes of disturbance, we find that the average bearing of the formation is N. 47 deg. E., with a highly inclined dip to the N. W., and that its lower limit bears about N. 40 deg. E., in which number it agrees with the trappean rocks, on its S. E. border.

SECTION II.

Felspathic Rocks.

§ 31. Beside the principal locality of this formation, mentioned in sec. 6, it is recognised by its boulders in various parts of the primary region, and in several instances *in situ*, as near Jeanes' lime quarries, and on Red Clay Creek, sec. 30. The boulders may be seen on the Concord, Kennet, and Lancaster turnpikes, within several miles of Wilmington, and on the Philadelphia turnpike as far as the State-line. Its usual composition, as stated sec. 6, is correct, but the deviations from this are so great, that it often appears to be a different rock. The formation has sometimes been termed the blue rock of the Delaware quarries; an appropriate term for one of its varieties, in which the quartz, in addition to its smoky hue, reflects a shade of blue. The felspar contained in it is highly crystalline, and has likewise a smoky grey color. Being composed of these two minerals, the rock might be supposed to be always dark, but the latter mineral is at times less crystalline, and possesses a light color in common with the quartz, as on the banks of the Brandywine near Gilpin's mills, and where Hornblende abounds, it is black.

§ 32. By examining the several quarries which have been opened, a better idea may be formed of the varied nature of the rock. At Churchman's quarry on the Christianna, the fine-grained variety is most abundant, and hence the fine blue color of the rock. Its predominant ingredient is quartz, veins of which, free from felspar, traverse the quarry; and it is of that kind denominated greasy quartz, with a color nearly white passing on the edges of the vein into green, from the contact of hornblende. The veins sometimes contain a bronze-colored mineral which was supposed to be hypersthene or bronzite, but the small quantities which were obtained do not permit of an accurate determination, whether they are bronzite or fractured plates of felspar. There is a decided tendency to stratification or lamination in this quarry, and the direction might have been measured had a weathered surface presented itself. Several irregular veins, however, traverse it which have not this tendency, and they are distinguished by their content of hornblende and consequent dark color, hardness, weight and toughness. Passing from these decidedly granular veins to that portion of the rock exhibiting lines, the hornblende decreases in quantity, and appears to be often replaced by black mica, until the gradation ceases in a true gneiss. Peculiar to the rock are also great joints intersecting each other at various angles, and as far as observed, without any degree of regularity; hence, in blasting, the fractures follow these lines rather than the planes of lamination.

§ 33. A rock in most respects similar to the preceding is comprised in Clyde's quarry, on the Brandywine, excepting that being much more extensively worked, it displays the formation to greater advantage, in regard to variety, to veins, joints, and structure. As in the preceding, so in this quarry, it is a fine-grained, blue rock, with a superior quantity of quartz,

proportionably less felspar, but rather more black mica. Some few parts exhibit the coarse-grained variety, with more felspar, and generally in this, we find granular hornblendic veins, often containing large plates of hornblende and black mica. In one of these veins were well-defined crystals of sulphuret of iron. We have here a better opportunity of examining the great joints, only one series of which appears to conform in some measure to regularity, the remainder being so irregular as to prevent the possibility of forming a general law relative to their direction. The tendency to stratification is more clearly perceived, yet so obscure on the freshly fractured surfaces as to resist attempts at measurement. Although fragments might be mistaken for gneiss, yet there is no conclusive evidence in this quarry of a transition to that rock. A short distance N. E. of the Brandywine quarries, are Gordon's, presenting similar characters with less of the coarse-grained variety, and showing a more distinct lamination.

§ 34. Passing on still farther to the N. E., the rocks at Quarryville, on the W. of the turnpike, present us with the best examples of the coarse-grained variety. It is mainly composed of masses of crystalline felspar, of a smoky color, forming a solid bed with a very small proportion of quartz, and occasional plates of black mica and hornblende. The felspar is very lustrous, cleaving into a regular form, and although closely resembling that found in Norway which often exhibits a beautiful play of colors, such specimens have hitherto eluded a search for them. No tendency whatever to stratification is perceptible, and the great joints or fissures are less frequent, and appear to follow no determinate law. Hence, in blasting, enormous masses of rock are frequently heaved from their solid bed, and are capable of being split by wedges in any required direction. The fine-grained and distinctly laminated rock adjoins the coarse-grained, and seems to bear the same relation to it that gneiss does to granite. The felspathic rock is more subject to disintegration than the fine-grained or quartzose, not from the abundance of its felspar, nor from local differences in the nature of this mineral, for we find it liable to change only in a few instances, where natural fissures admit of the percolation of water, and the felspar seems to be uniform in its character, but it would seem to arise from some cause which has escaped observation. At first sight, the presence of pyrites would point out the cause, but the sulphuret of iron proves, upon a closer inspection, to resolve itself into small scales of quartz and felspar, with a golden lustre. The decomposition having only been observed on pieces taken near the surface of the ground, we might rather attribute it to an incipient decomposition which took place before the rock was removed from its bed, in which case it becomes a matter of little moment. Where this felspar has suffered a partial change it is softer, of a lighter color, and resembles ordinary white felspar. On the east side of the road, we again meet with the fine-grained variety, with a well-marked lamination, and containing more black mica and hornblende than are usually found. As usual, it is distinguished by a greater degree of hardness and toughness, rendering it less manageable under the stone-chisel, but at the same time more durable.

§ 35. In the northeastern corner of the State are the quarries on Naa-

man's creek, which present excellent specimens of the fine-grained rock with an intermixture of the coarser kind, the former abounding in quartz, the latter in felspar. The same appearances are observable as has already been described under the preceding sections, with the exception of an increased quantity of hornblende, which being still in smaller proportion than the remainder, does not materially affect its character for better or worse, in a practical point of view.

§ 36. The above are the most important quarries of the *blue rock* of Delaware, situated on, or near navigable waters. Far, however, from comprising all the localities whence a valuable material for purposes of construction might be derived, there are numerous other points which might be wrought to advantage along the Delaware shore, and farther in the interior, capable of yielding a stone of equally excellent properties, and more varied in appearance. To the N. E. of Wilmington on Shellpot hill, the exposures of blue rock on the turnpike and other roads leading from it, and the openings made for stone around the neighborhood lead to the conclusion that the hill is wholly composed of this formation, but that its surface varies more than the outline of the hill, is evident from the fact of its protruding through the soil in one place, and not far from this the diluvial deposit may be found of the depth of 60 feet. On the Concord turnpike, about two miles from Wilmington, the blue rock is traceable by numerous boulders, and in a few instances may be seen in place. It is distinctly stratified, as may be observed on all the weathered surfaces, even though the fracture exhibit no such appearance; but the latter sometimes shows a lamination composed of lines of light-colored quartz and felspar, alternating with those of smoky quartz, felspar and hornblende. It bears N. 40 deg. E., and dips to the N. W. The same appearances are observable at intervals nearly to the fourth mile, where white felspar and quartz form regular laminæ, and a little beyond, the rock has precisely the same bearing and dip. Near the top of the hill skirting the west side of the Brandywine, at Gilpin's mills, the felspathic rock which is quarried out, is of so light a color as not to merit the name of blue, and closely resembles ordinary gneiss. Composed of a light-colored granular quartz, a light gray, nearly opaque felspar, and light-colored mica lying in planes, it would be pronounced to be common gneiss, did it not gradually pass towards the bottom of the hill into the ordinary blue-rock. It is more distinctly stratified than the same rock of any other observed locality, b. N. 30 deg. E., dipping at an angle of 60 deg. to N. W.; indeed, this feature is so well impressed upon it, that it is quarried by splitting large blocks in the planes of stratification. Nearly the same bearing and dip are to be seen along the Brandywine as far as three miles from Wilmington. At the last place, the rock has a beautiful blue color, and contains veins with a reddish quartz, and apparently much pyrites. A more rigid examination, however, proves the latter to be fissured plates of quartz and felspar, refracting a golden lustre, similar to those met with at the quarries of Christianna, Brandywine, and Quarryville, sec. 34.

§ 37. From the instances noticed in the foregoing paragraphs, as well as from numerous observations which have not been detailed, we are safe

in drawing the conclusion that the greater part of the trappean formation, possesses a clearly stratified structure, that the hornblendic and coarse felspathic veins do not, and that there appears to be a gradual transition from the former into an undoubted gneiss. An instance of the latter rock containing hornblende has been alluded to, sec. 28, but again we have examples of a hornblendic vein with the same structure, as a little to the eastward of Jeanes' lime quarries, sec. 30, and about one and a half miles N. by E. of the Buck tavern on the Kennet road. For a short distance beyond this tavern on the Kennet pike, the rock appears to be a medium between trap and gneiss, differing in few particulars from the latter, excepting in the replacement of mica by scales of hornblende. About one mile N. by W. of Springer's tavern, (on the Lancaster turnpike,) numerous boulders of stratified, and a few unstratified trap, and true gneiss strew the hills and valleys. The instance alluded to (near Jeanes') shows a remarkable deviation from the ordinary direction of the formation. Leaving this anomaly out of the question, we obtain as the average bearing, N. 37 deg. E., with a dip towards the N. W. The gradual passage of gneiss into felspathic rocks, rendering it impossible to define their relative limits with accuracy, the line drawn on the map throws the great mass of the latter on its eastern side, while it embraces at the same time, a few observed localities of gneiss.

SECTION III.

Limestone,

§ 39. The general features of the formation have been given, sec. 7. At Jeanes', it is composed of coarse, crystalline grains cemented together, which, having been subjected to the influence of atmospheric agents, in the upper portions of the quarry, have separated, and formed a calcareous sand and gravel, or are so little coherent as to crumble with a slight blow. Some of the veins have resisted disintegration, and still offer a hard and excellent stone, which is used for burning to quicklime. Descending from the surface to the lower portions of the quarry, the hard seams become larger, until in the lowest visible stratum, it forms one continuous mass of solid crystalline limestone, requiring the blast to dislodge it from its bed. Springs of water do not affect the upper portion, but when it becomes necessary to work the lower and more solid portions, drains and even machinery will probably be required to remove the water. Adjoining the granitic vein, sec. 9, in some other parts of the quarry, we find a mineral in considerable quantity, which, though resembling limestone in appearance, differs from it in hardness, crystalline structure, and composition; it is tremolite, both fibrous and foliated, the former white, and the latter with a bluish shade. The bearing and dip of the limestone, sec. 9, nearly correspond with those of the gneiss. The strata being much shattered, and but few exposures of the rock offering themselves, it is impossible to de-

termine with accuracy, its thickness; it cannot, however, fall short of 60 feet. Of far higher interest to us is the composition of this rock, which varies in its different layers. An experienced eye would say, judging in accordance with generally acknowledged characters, that it is a pure carbonate of lime, but analysis proves it otherwise, and although pieces might be selected, giving no evidence of magnesia, yet a careful analysis of an average specimen from Jeanes' quarry, conducted by Mr. James Blaney, of Newcastle, showed its composition to be—

Carbonate of lime,	-	-	-	53.3
“ of magnesia,	-	-	-	46.6
Alumina and a trace of oxide of iron,				0.6
Talcose residue,	-	-	-	0.3
				<hr/>
				100.8

An examination of a dark colored seam by Mr. Wm. Baxter, gave as its constituents:—

Carbonate of lime,	-	-	78.5
“ of magnesia,	-	-	9.0
Alumina and oxide of iron,	-	-	A trace.
Mica, sand, talc, &c.,	-	-	12.1
			<hr/>
			96.6

§ 40. About two miles S. 80 deg. W. from Centreville, Klair's quarry exhibits a limestone similar to the preceding in its general characters being coarsely granular and highly crystalline, and although wrought to a limited extent, it is sufficiently developed to afford an instance of the interstratification of gneiss and limestone, layers of the former intervening between the latter. The layers of the lime rock are several feet in thickness, one of them probably much thicker than the rest, but whether it can be wrought extensively, want of exposures of the rock and the absence of collateral evidence prevents our drawing a conclusion. That there is more than sufficient to supply the demand of the neighborhood, will scarcely admit of a doubt, and that its quality is equal to that of Jeanes', is shown by the following analysis performed by C. Morfit, of Washington:—

Carbonate of lime,	-	-	-	54.4
Carbonate of magnesia,	-	-	-	45.2
Oxide of iron and alumina,	-	-	-	1.0
Talcose residue,	-	-	-	0.2
				<hr/>
				100.8

Not far from where the Brandywine enters the State, and probably a short distance across the line, an excellent quality of limestone has been found, similar to both of the foregoing formations in the character of the

stone, but differing in its connection with serpentine. Indeed, some hand specimens exhibit gneiss on one side, and limestone and serpentine on the other. Like the other quarries, this shows a stone disintegrated near the surface, displaying a coarse, calcareous sand, composed of rhombs; of its thickness we have still fewer means of judging. Each of the quarries described in this paragraph, are troubled with springs of water, which may be removed by long drains, through valleys with a gentle descent. The bearing of the former (Klair's,) is N. 51 deg. E., d. to N. W.; that of the latter (Bullock's,) could not be measured, but it probably corresponds with gneiss in the immediate neighborhood, N. 60 deg. E., with a dip of 60 deg. to N. W., sec. 30.

§ 41. The two preceding paragraphs contain all that is of importance relative to the limestone formations of Delaware, as far as they have been investigated, but our inquiries should not cease here, for the great value of the stone, leads naturally to researches after other localities of the same. By a close examination of those already known, we find them to agree in the peculiar conformation of the valleys, their great depth, their abrupt flanks, in the calcareous sands of their upper parts of the formation, and in the calcareous waters issuing from them. Similarly situated valleys have been eagerly sought after, various waters have been tested, sands examined in the beds of brooks, and the bearings of existing quarries have been traced, but the search has thus far been fruitless. Nevertheless, the necessary brevity of such examinations, cannot throw reasonable doubts over the existence of other beds of limestone of equal value, and possibly of greater extent.

SECTION IV.

Serpentine.

§ 42. The largest body of serpentine in the State is that mentioned in sec. 8, which is irregularly traversed by a granitic vein, so rich in pure felspar, as to originate the "Spar quarries," in order to its employment in the manufacture of porcelain. The formation to the eastward of Tucker's spar-quarry consists of serpentine of different shades of green, with talc, asbestos, and other minerals, which are its ordinary accompaniments; the light green is softer, and abounds more in fibrous and foliated talc; the darker varieties are much more tough, harder and more massive. A few yards west of Tucker's, another opening displays the serpentine with an abundant content of talc. West of the road passing by Dixon's quarry, several openings have been made in the serpentine, in which it presents the ordinary characters, except in the abundance of asbestos it contains, disseminated in numerous veins. As it crosses the road towards Dixon's, its talcose veins are more numerous, a feature which it possesses at these quarries, and which appears to increase in the most N. Easterly part of the serpentine ridge. At this last-mentioned place, (about one-

third or half a mile N. E. of Dixon's,) the green rock rises abruptly from a meadow, and mainly consists of a fibrous mineral, with less of the unctuous feel, which is characteristic of talcose or magnesian minerals. It is traversed by veins of white talc and carbonate of magnesia. Serpentine often appears to be stratified, and its course can even be measured, but its exposures in this range being few in number, and chiefly in contact with the granite, it is impossible to make admeasurements of its bearing or dip that can be relied on. The greatest length of the ridge is about one mile, its extreme breadth one-third to half a mile. Serpentine rock containing a variety of minerals, cannot be expected to have an uniform composition, but a specimen of the precious serpentine, yielded Mosander and Lychnell, 44.3 silica — 42.7 magnesia — 13. water = 100; but it generally contains in addition to the above principal ingredients, protoxide of iron, alumina, lime and bituminous matter; hence, in connection with it, we find a variety of minerals containing silica and magnesia, such as asbestos, anthophyllite, marmolite, and hydrate, and carbonate of magnesia. Chromic iron, a mineral of some value, has not hitherto been detected in quantity in this range, in Delaware, although it was carefully sought after.

§ 43. There is another locality of serpentine near the State line, between Smith's tavern, and where the Brandywine enters the State, generally of a light green color, and containing hematitic iron ore of good quality. South of the principal exposure, it is associated with limestone, in Bullock's quarry, sec. 40, and bears a resemblance to the verd antique. Subject to a certain amount of disintegration, we find it converted into a talcose clay, in the brook flowing near the quarry, and from a granitic vein probably connected with it, as in that of Tucker and Dixon, arises a deposition of kaolin, with a little talcose matter. It is more irregular than the preceding formation and its dimensions within the State much smaller.

SECTION V.

Granite.

§ 44. The main body of one granitic vein seems to pass through the centre of the serpentine, sec. 42, but its ramifications extend through every part of that rock. It is mainly composed of a pure white felspar, which gave rise to the spar-quarries, and veins of quartz traversing it with a certain degree of regularity constitutes graphic granite, so called from the resemblance of its surface to written characters. Detached and imperfectly crystallised specimens of felspar are frequent at Tucker's; at Dixon's, it occurs at times more massive with large veins of quartz. That there is a difference between the felspars from different parts of the formation, is clearly shown by the partial decomposition of some portions of it in both quarries, while other portions, equally exposed to atmospheric agents are probably as firm as when first generated. The

chief difference lies in the nature of the alkali, which is one of the characteristic constituents of felspar; for the ordinary mineral contains potassa, which, in the decomposable species is replaced by soda. The difference of their constitution is sufficient to establish another species, known to mineralogists as albite or soda-felspar, which is abundant in Tucker's quarry. The only other large vein which has been examined, passes through Jeanes' lime-quarry, and the limestone having been excavated on either side, it stands like a solid wall, with a bearing nearly E. and W. Although it does not appear to have affected the course of the limestone, yet it is possible we may look to it for the S. E. dip of the latter rock, in the same manner as gneiss has suffered in the vicinity of limestone and serpentine, with granitic injections, sec. 30, Pt. 1. Like the preceding, it is mainly composed of felspar, but the presence of ferruginous matter, indicated by its yellowish color, deteriorates the quality of the mineral, rendering it almost useless in the manufacture of porcelain. Knowing the composition of felspar and limestone, we are at no loss to account for the masses of tremolite, sec. 39, on the sides of the granitic vein, for it contains nearly all the ingredients of the two minerals, and has evidently arisen from the injection of fused granite through the stratified limerock.

§ 45. There are numerous other veins of granite in the primary region, abounding in pure felspar, which might undoubtedly be wrought to advantage, but the demand for the material is at present too limited to permit an examination of their extent and value. When felspar undergoes decomposition, it forms a species of clay known under the name of kaolin, which possesses great value in the manufacture of china ware and porcelain, especially where it is free from oxide of iron. A few localities of this substance have been found, but being deposited by small brooks, they are too limited to demand attention. A larger deposit situated a short distance across the Pennsylvania line from Mill Creek hundred yielded an excellent quality of kaolin, to the proprietors of the porcelain factory at Philadelphia, and were a minute search instituted by the farmer, many such localities might be discovered. When found in a moistened state, it resembles white clay, but is less plastic, crumbles when dry to a coarse or fine powder, is very white, may contain a few micaceous scales, between the teeth always shows the presence of siliceous particles, and hardens but slightly in an intense fire. Overlying, and in the vicinity of the granite in the serpentine, occur large blocks of a white granular quartz, apparently pure, which were used successfully in the fabrication of porcelain; no trace of its original bed was discovered, but the probability is that a vein of it traverses the granite.

§ 46. *Deposites over the Primary Rocks.*—Overlying the primary, is a diluvial deposit of clays, sands and gravel of various depths, arising from the uneven surface of the rocks, and amounting at times to at least 60 feet. On the southeastern edge of the region, it consists of a dark red clay, embodying in places a large proportion of gravel, as may be seen in cuttings on nearly all the roads, more strikingly in the neighborhood of Wilmington. The moment we descend from the primary to the succeeding formation, the gravel ceases to exist in quantity, and the red clay

to increase without any visible interruption; whence it would appear that the diluvial deposit overlying the primary is one and the same with the red clay formation to be described. The great amount of clay in this deposit has necessarily its influence in rendering the soil of the upper hundreds tenacious and heavy, the more so as the gravelly beds sometimes, though rarely, approach the surface of the ground. On the Lancaster turnpike, about one mile from Wilmington, the trap is superimposed by a bluish clay, which is surmounted by the red gravel, the latter exhibiting itself at intervals for several miles on the same road. About three and a half miles in the same direction is a bed of white unctuous clay, resembling kaolin, in the bed of a small upland stream. Beyond this point, the argillaceous matter decreasing in quantity, the formation becomes a red gravel of diminished tenacity. Passing westerly, towards Mill Creek, the gravel deposit gradually gives place to a yellowish loam on the upland, and a white clay in the valleys, the former being general, and the latter, local deposits. Proceeding in whatever direction towards the W. and N. W., from the S. E. border of the primary region, we find nearly the same order of deposits prevalent, showing the truth of the conclusions offered above relative to the continuity of the red clay formation over the lower part of the primary.

CHAPTER II.

UPPER SECONDARY DEPOSITES.

SECTION I.

Red Clay Formation.

§ 47. In the vicinity of New Castle, the soil is usually tenacious, loosened only in a few instances by the admixture of the yellow sands sec. 13, but where the basis of this region, the red clay crops out, it becomes rather too heavy to admit of superior culture unless the nature of the soil be altered by the free use of lime or the admixture of sands. About two miles N. by E. of the town, the mingled red and white clays rise to the height of some six feet above tide-water, and can be seen in only a few instances in the direction of Wilmington, in consequence of the superimposed heavy beds of sand and gravel, which may be best observed in the cuttings of the road. On the roads running S. W. and W. from the town, these last beds are so heavy, as to preclude the possibility of making any observations on the red clay, excepting a small exposure of it within the first mile, on the rail-road. That it underlies the town itself, is proved by the borings made for water some years since, when it was struck near the rail-road wharf, at a short depth below the surface, and penetrated upwards of 70 feet, and another boring made on the green,

extended to about 180 feet. It is to be regretted that an accurate account of these borings, together with specimens of the various deposits passed through were not retained, for all that we can ascertain is, that they perforated alternating beds of red, yellow and white clays, and white sands, to the termination of the boring, and that the light colored clays were the most abundant; from which we may draw an important inference relative to their extent, and diffusion.

§ 48. Proceeding from this place to the N. we find the formation on the hills sloping towards Wilmington rising some 30—40 feet above tide-water, and composed of mingled red and white clays, the former predominating, as is frequent in the hills skirting the Christianna farther to the W. Here, too, on a farm belonging to T. Stockton, the superincumbent sand assumes a degree of fineness which gives it value as an ingredient of mortar. No other localities have been seen in which the sand offered similar advantages, but there can be no reasonable doubt of their existence and discovery, and in order to induce a search for the same it may not be amiss to present its characters. It is very slightly coherent even in a moistened state, and when dry crumbles down to a uniformly fine-grained loose sand of a white color with a shade of yellow. Passing on towards the S. W. along this line of hills, the red clay is abundantly found with its overlying gravel and sand, which in many instances assume the characters of that overlying the lower portion of the primary, sec. 46, and sometimes, as in the vicinity of Newport, rise to the height of 40 feet. The neighborhood of Christianna offers the best opportunity of studying the red-clay formation, which presents excellent sections on the banks of the creek, and on the road-cuttings, the uppermost portion frequently lying 60—80 feet above tide-water. The great preponderance of red clay communicates a peculiarly brilliant vermilion hue to the denuded acclivities of the banks bounding the creek on the N. A closer inspection, however, detects numerous subordinate beds of white, lead-colored and yellow clays alternating with thin seams of sand, and shows the variable nature of the red variety; for although the last is usually very tenacious and plastic, throughout the whole region of which it constitutes the principal member, yet here we find some portions sandy and friable in a dry state, from the admixture of both sand and gravel;—other portions become so indurated as to pass into a clay-slate, both in reference to hardness and structure;—and its color varies in intensity and shade from a blood-red, to a delicate peach-blossom hue. In this, and many other respects, we find a strong analogy between it and the clay formation near South Amboy in New Jersey. Whether the light-colored varieties exist along the Christianna in sufficient quantity and purity, to be wrought extensively for the manufacture of pottery might be questioned from the great abundance of the red, the want of uniformity in the deposits, and the not unfrequent occurrence of arenaceous matter, and yet observation having shown the existence of many small beds of superior quality, the hopes of the citizens of this section of the country should not be damped nor their exertions to find such deposits intermitted.

§ 49. The great curve formed in the river, between New Castle and Delaware City, has been much enlarged by the increased force of cur-

rents during storm or spring-tides, in which the violent lashing of the waves undermines the banks and removes the detritus, while the effect of the ordinary currents of the river is to cover the clay-beach with a deposit of sand. This place affords us an opportunity of observing the red-clay formation under more interesting circumstances, for it may be seen in numberless places from New Castle for the distance of several miles to the southward. We have seen above that the red-clay predominates over every other kind, and that the white exists in many small irregular beds disseminated through it. At this place, however, the latter assumes importance, from its abundance and purity, and indeed it has been wrought for manufacturing purposes for some forty years. The two principal openings for white clay are on the farms of K. Johns and the Messrs. Nevins, in both of which the same general features are observable. The low banks exhibit a heavy argillaceous soil at the top, subjacent to which the red clay of an impure and arenaceous character lies in horizontal strata, and is irregularly traversed by veins of white and yellow clays, and ferruginous crusts. Between the bottom of the banks and beyond low water, the white clay is more abundant, being contained in beds of many feet in extent, and sometimes wholly free from foreign admixture; other kinds are also found, as yellow and lead-colored clays of little or no value, and a ferruginous incrustation coating the exterior of the white beds. The irregularity of the formation precludes the possibility of giving any directions relative to the discovery and detection of beds of the white variety, the plan adopted by the workmen consisting in tracing and excavating a good deposit, when it is found, until exhausted, or as long as convenience permits. As the greater portion of it is obtained below high-water mark, it is found necessary to employ a small coffer-dam or large circular vat open at both ends, which is sunk in any convenient spot, the water removed from the interior, and the clay excavated by digging. When in its fresh and moistened state, it is of a light gray color, cuts with unusual smoothness, is very unctuous to the touch, soft and highly plastic, and capable of being moulded with accuracy into any required form; when dry, it is of a pure white color, of considerable hardness, may be polished on its surface by a hard and smooth substance, is remarkably free from ferruginous matter, and from grit or particles of sand, two most important conditions in determining its value. It is impossible to arrive at any definite conclusions relative to the extent of the deposit; several thousand tons have been extracted, and no reasonable doubt can be entertained that a sufficient quantity of superior quality can be obtained to supply a greatly increased demand. Possibly a greater demand inducing more rigid examinations of this locality will yet detect beds of comparatively unlimited extent.

§ 50. Beside the localities enumerated, the red clay may be observed in numerous places through New Castle, Pencader and Red Lion hundreds. Along Red Lion creek and its tributaries, it crops out on the sides of the hills and generally constitutes the bed of the streams, and exhibits all its characteristics on the roads in the vicinity of Red Lion Post office; but there is nothing worthy of note in these exposures, excepting near the last mentioned place, where it forms the substratum of the yellow sands

and gravel of unusual thickness. In these last, and but a short distance above the clay, is a sandy stratum of a greenish color, which might readily be mistaken for the green sand, until a closer examination shows the coloring matter to be a few particles of greens' and disseminated through common siliceous sand. It has been found in excavations for wells in this neighborhood, on the farms of R. Rhodes, and A. Penington, and may be seen in the cuttings of the roads leading from the Red Lion to St. Georges and the Buck. Small masses of iron pyrites are abundantly contained in it which enables us from its very decomposable nature to account for the frequent occurrence of iron-stone, and ferruginous bands in this district. The transmutation of the pyrites (sulphuret of iron) into copperas (sulphate of iron) by exposure to the air points out at once the impropriety of employing this sand for fertilising the soil, for the quantity of green sand present is far too minute to overbalance the injurious effects of the former. It is evident that these deposits of sand and gravel are portions of the green sand formation overlapping the red clay.

§ 51. From Newark to the Buck on the dividing ridge, the soil is generally argillaceous from the presence of white and yellow clays, but where these are denuded, the gravel and sand below them, which rest on the red clay, improves the quality of the soil, forming a clayey loam with an interspersion of gravel. From the Newcastle and Frenchtown rail-road to the Buck, we find little else than gravel, and a soil assimilated to it. Certain portions of this district being at some distance from tide-water, and other places where mineral manures may be obtained, attention should be drawn to the black vegetable mould on the sources of the streams, which under proper management will be highly useful in improving the soil. Pt. III, § 151-156.

§ 52. There are several outlying spurs of considerable height in the vicinity of the head-waters of White Clay creek, of which Iron-hill is the most important. This elevation, rising abruptly from, and towering far above the plain, consists of clays, sand and gravel, and derives its name from the abundance of boulders of iron-stone and ferruginous quartz scattered over its flanks, the latter of which was probably at one time of good quality, but through exposure to atmospheric agents has been rendered valueless. An excavation has been made on the summit for the extraction of iron ore to the depth of 40 to 50 feet, which enables us to estimate the character of this singular hill. The mass of earth is a highly argillaceous loam, interspersed with large and frequent masses of yellow ochrey clay, some of which are remarkable for fineness of texture, not unlike lithomarge, and consist of white, yellow, red and dark blue clays in detached spots communicating a peculiarly mottled appearance. This variegated clay is very free from grit, soft and plastic when moist, but on drying becomes very hard, and receives a polish from smooth steel. Nodules of iron-ore are abundantly distributed through the whole formation; it is of a chesnut-brown color, (sometimes bluish black from the presence of manganese,) hard and tough; may be considered a moderately hard ore, being both siliceous and argillaceous; the nodules frequently enclose an ochrey clay, more rarely a black earth containing manganese. Large quantities of the ore have already been exported.

SECTION II.

Green Sand Formation.

§ 53. *Cretaceous or cretoidal green sand*, § 15. occurs chiefly along the ravines of the St. Georges creek, and is characterised by various shades of gray, in some cases passing into black, the lightness of color imperfectly indicating the proportion of carbonate of lime contained in it. The upper portion of the bed is usually of a lighter hue than the lower, but even the dark-colored on drying becomes gray. The carbonate of lime present is not contained in the shells alone with which the deposit abounds, but is in the form of white powder or a white pulverulent mass slightly cohering, and for this reason the beds are termed cretaceous or more properly cretoidal, the same features being characteristic of chalk. The formation is composed of carbonate of lime, green sand, and white siliceous sand, the proportions between the ingredients varying to such an extent, as to admit of no general deductions, excepting that when the amount of lime diminishes, it does not follow that the quantity of green sand increases—for the latter is sometimes partially replaced by a greenish micaceous sand, as will be shown to occur at the Deep-cut. The thickness of the stratum averages 20 feet, that of the upper yellow sand 40 feet; the substratum of the cretaceous green sand offers no data on which to ground any positive assertions relative to its thickness or its features.

§ 54. On the ravines opening into the canal west of the junction of the Dragon and St. Georges are several marl-pits, opened by Messrs. A. Biddle, J. Higgins and P. Reybold, presenting the same general features as those described in the preceding sec. 53. In the two former it is lighter in color than the latter, which passes into a black in the lower part of the pit when freshly excavated, but they all bear a strong resemblance to each other in the quantities of carbonate of lime, and green sand, as well as in the peculiar nature of the latter. It consists of very minute dark green grains, resembling the finest powder, and is rarely interspersed with a few micaceous particles. A specimen obtained from J. Higgins in 1838, previous to the opening of the pit, yielded upon analysis

Carbonate of lime	-	-	-	18.6
Green sand	-	-	-	33
Siliceous sand	-	-	-	35
Clay	-	-	-	14
				<hr/>
				100.6

The specimen being obtained by boring, was somewhat contaminated by the superincumbent earth, and the marl is consequently several per cent richer in lime than is shown by analysis, for an examination of P. Reybold's of the same kind, furnished at an early period of the survey,

have a greater content of lime. Thus a sample from the upper part of the bed, of a light gray color gave

Carbonate of lime	-	-	-	24.7
Green sand	-	-	-	35
Siliceous sand	-	-	-	31
Clay	-	-	-	9
				<hr/>
				99.7

and one from below the same of a darker gray yielded

Carbonate of lime	-	-	-	20.13
Green sand	-	-	-	38
Siliceous sand	-	-	-	32
Clay	-	-	-	10
				<hr/>
				100.13

of the carbonate. A. Biddle's marl is of the same quality, and offers convenient access for its extraction. The average quantity of lime in the state of a carbonate may be estimated at 22 per cent. The marl forms a gray pulverulent mass, cohering when dry, although still somewhat friable. In a majority of cases, these beds are unusually destitute of shells, the carbonate of lime being in the form of a fine powder, not unlike friable chalk, sec. 53, a circumstance imparting additional value to it as a manure. The most abundant shells are *Exogyra costata* of large size, and *Gryphæa convexa*. The quantity of lime diminishing in the lower part of the bed, and yielding in the same measure, to an increase of fine green sand, these portions are not inferior in quality to the upper, and the whole must be viewed as a marl of great value. In the immediate vicinity of the pits, there are few opportunities of observing the beds resting on the marls, but artificial sections made on the canal at a short distance from them exhibit 30—40 feet deposite of yellow sand, the upper part passing into diluvial clay and gravel, which sometimes forms the soil; the greater part of the soil of this section, being formed of the yellow sand, is a good loam.—Nearer to St. Georges, and within sight of the town, the same kind of marl is wrought by Mr. Sutton, and that obtained in the lock of the canal at the same place presents no distinctive features from those above described, excepting in the greater abundance of shells, among which are *Ostrea falcata*, and abundant castes of *Turritella*. At the last-named position, as well as on the hills to the N. of St. Georges, the yellow sand swells to the height of some 40 feet. The marl of all these pits being compact, springs issuing from near the upper level of the stratum render it necessary to employ pumps for removing the water, notwithstanding the elevation of the top of the marl to the height of several feet above the canal level, but the expense attending this operation may be diminished by extracting the marl as rapidly as possible after opening one pit, and proceeding with another in the same manner, leaving a partition or wall of marl between them.

§ 55. On the same side of the canal, about two miles W. of St. Georges, Messrs. Price and Reybold have opened a large pit in a ravine, exposing the heavy deposit of marl similar in its general features to the foregoing, for the quantity of carbonate of lime varying in different parts of the same, averages the same per centage; the green and silicious sands are nearly in the same proportion, but the former is in coarser grains. Shells are also much more abundant, and among them we find *Gryphæa convexa* and *vomer*, *Exogyra costata*, *Ostræa falcata*, *Turritella*, and other voluted univalves, a few belemnites. Some time since, Mr. Hurlick obtained a few saurian bones in a perfect state, the greater part having been unfortunately broken by the workmen under the impression that they were stones. Shark's teeth are also among the organic remains of this opening. The breadth of the ravine, and the gradual slope of its sides, together with the considerable elevation of the stratum above the level of the canal, afford great advantages for obtaining the marl, for it will not be requisite for a long time to remove a large amount of superincumbent earth, and facilities are afforded for drainage. The yellow sand at this place attains a much greater thickness than usual, rising in some cases 50 feet or more, and as in other situations approaching the Ridge, is covered on the summits of the hills by gravel and clay. When we therefore observe the height of the land, the deep gorges and ravines exposing the different strata, and their commingling by frequent denuding action, we might be prepared to find a variety of soil in this vicinity; but it is less observable than might be imagined from the uniform mixture of the strata over the undulating surface. In general, the summits of the hills and the valleys are more argillaceous, while their flanks constitute a good loam. The openings into the marl, enumerated in secs. 54 and 55, are those most extensively developed on the north side of the canal; but there can be no doubt that it might be conveniently extracted from many other localities in the same range, and it only remains for those interested in the land to examine closely for it in the low bottoms bordering on the canal. But some precautions on this head may be given. The meadow-lands of the creek being detritus from the surrounding upland frequently attaining great depth, it should not be looked for there, but it is advisable to commence the search in ravines and washes where the bottom of the hill meets lowland.

§ 56. On the south side of the canal, W. of St. Georges, L. McWhorter, J. Wilson, J. Hudson, and E. Lore have opened pits in the cretaceous marl, which presents characters similar to those described in secs. 53-55, the carbonate of lime, green and silicious sands being nearly in the same proportions, the green being rather more coarse-grained. Shells are rather more abundant in this locality, as they also are in Price and Reybold's, on the opposite side of the canal. L. McWhorter's marl-pits lie about one and a half miles W. of St. Georges, at the foot of a broad ravine. The marl is of a light gray color, and is remarkable for the abundance of a delicate, very brittle shell, the *Anomia tellinoides*; but beside this there are many casts of *Turritella vertebroides*, and a few of the genera *Trigonia* and *Ostræa*, the species of which could not be recognised. About half a mile farther W., are the pits of J. Wilson, the

first that were opened on the canal while in the progress of its construction. The marl has been penetrated fourteen feet, with but little variation in its features from the upper to the lower surface of the pit, and being a compact mass, the springs issue from the upper level; but since it is elevated many feet above the canal, it offers facilities for drainage. The most abundant shells besides those usually accompanying the stratum, secs. 54 and 55, are *Belemnites Americana*, *Ostrea falcata*, *Turritella vertebroides*, *Pecten quinqucostatus*, (a few,) a species of *Ammonites*, either the *placenta* or the *Delawarensis*. The overlying yellow sand is some 39 to 40 feet thick, and immediately above the marl is cemented into a hard ferruginous crust; its uppermost portion is overlaid by an argillaceous deposit with disseminated gravel, and hence the soil varies in character. J. Hudson's pits, which are about two and a quarter miles W. of St. George's, although presenting the general characters of the cretaceous green sand, are distinguished by an unusual amount of organic remains, among which are *Gryphaea convexa* and *vomer*, *Ostrea falcata* and *panda*, *Pecten quinqucostatus*, *Cucullæa vulgaris*, *Turritella*, *Rostellaria* and *Natica*. E. Lore's pits are in a deep ravine, and do not differ materially from those described, if we except the lower level of the upper portion of the marl. The small shell *Ostrea falcata* is frequently found with both valves perfect; besides this and ordinary shells, there are a few casts of *Trigonia*, *Cucullæa*, *Pectunculus*, *Rostellaria*, and *Natica*. The yellow sand rises at this place some 50-60 feet, being capped by clay and gravel, and exhibits its planes of deposition, dipping at an angle of 10 deg. to 30 deg. to the S. and S. E.

The preceding secs. 53-56, includes the main part of the observations made on the cretaceous green sand, lying on and near the canal. Many new localities have been discovered since the commencement of the survey, among which are seven of those enumerated in the foregoing pages, and it is certain that many more will be developed, as soon as the true value of the marl is recognised.

§ 57. *Decomposed and indurated Green Sand*, sec. 15.—Passing in a S. W. course from this northern line of the marl stratum to the W. line of the State, we find a calcareous marl, differing in many respects from the cretaceous variety. In a majority of cases it abounds in shells and their casts, but the greater part have suffered decomposition, and seem to have injured the green sand itself, notwithstanding its moderate resistance to atmospheric agents. The marl-pits of W. Polk, about three miles W. of Middletown, on one of the sources of the Bohemia river, present us with the characters of the marl in its integral state or rather perhaps in its incipient stage of decomposition. At the first view, it would seem to be wholly composed of shells cemented into a hard mass requiring the aid of a pick to remove it from its solid bed; a more rigid examination, however, detects a mixture of shells, green sand, siliceous sand and calcareous matter cementing the whole into a stony mass, thus forming an instructive example of the origin of rock formations. It is essentially different from the cretaceous deposits on the canal, secs. 53-56, the pulverulent chalky carbonate of lime being wholly wanting, and the pure white siliceous sand forming coarse grains often one quarter of an inch

in diameter. The carbonate of lime of the shells being frequently wanting around the abundant casts, instead of being carried away, has merely been transferred to other portions of the bed on which it has acted by cementation. These remarks apply rather to the upper portion, for towards the lower part of the excavation, the solidifying action decreases, and the beds become sandy. In a practical point of view, excepting the difficulties of excavating the more solid portions, the whole may be shown to possess great value, for it crumbles to powder soon after its exposure to the atmosphere, and its effects on vegetation may be seen at the present time after an application of 20 years. The yellow sand rises on the abrupt hill-sides to the height of 50-60 feet, and contains several bands of a highly ferruginous conglomerate. The soil of the upland is in general a sandy loam, and has been exhausted by excessive tillage. On the same branch are two other openings into green sand, which being nearly destitute of shells, and varying in several other important particulars, will be described sec. 72, under another division of the subject. The large number of shells and their casts, constituting nearly the whole of the bed, serve as marks of distinction from all others, and were it desired to enrich a cabinet of fossils, no locality in the green sand region affords equal advantages, whether for beauty, variety, or solidity of the specimens. Single pieces of *Ammonites placenta* and *Baculites ovatus* were found; *turritella*, and a variety of other single-celled univalves are abundant, and equally so are the bivalves, among which were found *Gryphæa convexa* and *vomer*, *Ostræa falcata* and *vesicularis*, *Cucullæa vulgaris*, *Crassatella vadosa*, *Anomia tellinoides*, *Plicatula urtica*, and a species of *Plagiostoma*. The upper and lower strata together, are not less than 20 feet in thickness, but not having been penetrated farther than this, we cannot rely upon a higher estimate. The difficulty of excavating to the bottom, arises from the water of the stream which flows over and near the beds. The pits of J. Driver, situated on another of the head streams of the Bohemia, although containing shells, will be more particularly described under the dark colored green sand of the dividing ridge.

§ 58. In the vicinity of Murphy's mill-pond at the head of tide-water on the Bohemia, the green-sand formation assumes a novel and unwonted character. That it appertains to the calcareous variety, is abundantly proved by the organic remains distributed through the whole bed, but analysis showing the absence or deficiency of lime, contradicts the assumption of its presence from the appearance of organic remains, and from the whiteness of the strata. It comprises several substrata, those composed of casts of shells with variable quantities of green grains, and those containing a mixture of white siliceous and dark colored green sands. The greater part being elevated above tide-water, and uncumbered with springs, has undergone a material change from the percolation of water through it at some former period of time, by which the lime has been removed, a part of the green sand decomposed, the oxide of iron taken up and redeposited in various parts of the strata. The reddish brown color of the whole deposit may be attributed to the last-mentioned circumstance. The disseminated milk-white clay and sand, probably owe their origin to decomposed green particles, as they are essen-

tially different from the small rounded grains of siliceous sand which are found both here and elsewhere in the marl district. At J. Smith's, the deposit may be observed in the ravines and washes. Below the soil of the upland, occurs the yellow sand and gravel, varying in thickness according to the height of the land, and beneath it we find a partially compact bed of dark-colored sand from one to three feet in thickness, containing green particles profusely disseminated in a light-colored clay; this is separated by a two to three inch crust of iron ore from an indurated bed of shells. Wherever the beds lie above the water and springs have ceased to percolate through it, induration has taken place, and it is much more the case where shell-casts are abundant. In some instances a trace of lime is found, but in no instance has an undecomposed shell been detected; for its place is usually occupied by a crust of oxide of iron. The mass or cast of the shell, not inaptly compared to old mortar, is composed of a white, earthy, and friable substance, (siliceous and argillaceous,) enclosing granules of the green and very coarse siliceous sand. Some of these casts and the mass around them have become so hard as to require fracture by the hammer, and since both lime and oxide of iron are frequently wanting, the inference is that silica assists in the cementation of the heterogeneous compound. The shells being altogether in the state of casts, and these being imperfect, it is difficult to name them; a good cast of *cucullea* and *cardium* were found, but all that remains of the belemnites are casts of the interior cone in the lower part of this curious remnant of organic life.

§ 59. In the immediate vicinity of the mill, and on the S. E. banks of the stream, the steep banks exhibit the same beds, see. 58, but the dark sand at the top having a darker shade of color appear upon a close inspection to be grains of decomposed green sand, their green protoxide being converted into brownish black peroxide of iron. In the subjacent shell-beds, oxide of iron plays a prominent part by communicating to the whole mass a brownish tinge. A few hundred yards S. of this point the high bluffs offer a section of the formation to the height of 30 to 40 feet, the quantity of ferruginous matter being greatly increased by a total decomposition of shells, casts, and green sand, and consequently it is in a state of induration approaching that of a loose red sandstone. It appears then from an attentive examination of secs. 57, 8, 9, which present the principal exposures of this marl, that it has undergone, and is still suffering, decomposition; that in every place where it is laid dry and unaffected by springs, it is altered by the removal of lime, potassa, and oxide of iron, and that the latter is deposited in other portions of the beds, acting by cementation; that where it is in its incipient state of disintegration, the small quantity of lime abstracted from the shells has been deposited again in the same bed which it cements into a hard and stony mass; and lastly, that no deposition of carbonate of lime occurring in a pulverulent form, this decomposed and indurated green sand is sufficiently distinct from the cretaceous variety on the canal.

§ 60. *Shelly Green Sand*, § 15.—From the high land under Cantwell's Bridge on the north side of the Appoquinimink, and along the southern border of the same stream to the fork at the head of the Noxentown mill-

pond, we find another and well characterised variety of the green sand formation, constituting its extreme southern limit. At the fork of the mill-pond, are the openings of J. Townsend, which fairly expose the deposits to view. It consists of two substrata, rising about fifteen feet above the pond, the lower abounding in small unaltered shells, the upper consisting of yellow sand, in which green particles are sparsely distributed. The lower stratum rises on an average, six feet above the level of the pond, to which height it consists of small friable shells, firmly imbedded in horizontal, somewhat tortuous layers in a mixture of yellow and green sands, the former of which predominates. Above this unaltered marl, the shells are much thinner, and are coated on their inner and outer surfaces by oxide of iron, and still higher we find the main body of brownish sand abounding in ferruginous impressions and casts of the same species of shells which constitute the lower stratum. The upper line dividing the unaltered from the decomposed strata, presents a very jagged outline, rising in some cases four, and at other times 10 feet above the water-level, but sufficient quantities for spreading on the soil may be obtained with facility. Among the shells composing the marl, may be recognised abundant specimens of the *Gryphæa vomer*, *Gryphæa mutabilis* and *convexa*, which T. Conrad views as the same, *Terebratula fragilis*, a triangular *Serpula*, resembling a species found in Alabama, spines of echini, and a single specimen of the claw of a crab; but all of them are friable, and the abundance of minute fragments, together with a few per cent. of green sand, give the marl some claim to our attention as a source of fertility. Interesting in a theoretic point is the gradual replacement of shells by oxide of iron, and the interstratification of the yellow sand with the calcareous beds. The same formation may be seen to advantage at the excavation made by S. Naudain on the N. side of the same pond, and not far from the locality just described. The unaltered shell deposit rises some twelve feet above the water, and presents the same jagged outline formed by currents, but differs in being filled up with a detritus of gravel and clay, or a clayey loam. The central stratum has a greenish hue from its abundant content of green sand particles. The shells, of which *Gryphæa vomer*, *mutabilis* and *convexa* appear to constitute nearly the whole mass, are much shattered, but they are not unfrequently cemented firmly together by calcareous matter. Below the water-level, the shells decrease in quantity and even cease, but give place to a deposit containing a large proportion of green granules. J. Whitby's marl lies on the S. side of the Appoquinimink about a mile S. or S. by W. of Cantwell's Bridge, and has been found on a small branch of the creek in many places. Presenting no distinctive features from the openings of J. Townsend, the remarks made on the latter are applicable to those of J. Whitby, with the exception of the diminished thickness of the stratum, as far as it has been investigated. Its upper level rising but a few feet above high-water mark, is at least 20 feet lower than the highest point on the Noxentown mill-pond, thus showing a rise of the strata to-

wards the W. According to an analysis of an average specimen from the latter locality crushed to a coarse powder, it contains

Carbonate of lime,	-	-	-	-	58.6
Green sand,	-	-	-	-	6.
Common siliceous sand and	}	-	-		35.4
undecomposed shells,					
					<hr/> 100.0

Which may be viewed as the average composition of the undecomposed shell-beds.

§ 61. The same formation underlies the town of Cantwell's Bridge, and forms the high bluffs bordering the creek. It may be described as a brownish yellow sand, traversed by irregular and thin veins of iron stone, having in general a horizontal direction. Some portions have a decidedly greenish tinge from the presence of green sand, others again are whitened by the removal of oxide of iron, while the uppermost layer below the soil is cemented by ferruginous matter, into a sandstone of varying friability. Beds containing casts of the same shells, sec. 60, wholly replaced by oxide of iron, are found both in the upper and lower parts of the bluffs, and as it is continuous with the yellow sand overlying the marl at a short distance N. of the Bridge, we may safely rely upon their identity, and on its membership in the green sand series. Rising the hill from the causeway towards Blackbird, the same formation is seen, differing only in the absence of organic remains. The formation of a sandstone and conglomerate in the upper layers of this deposit is deserving some attention, for we find it in place on nearly every abrupt descent to the creek on its southern side, and in a few instances on its northern banks. Not far from the marl of J. Whitby, it attains the thickness of four to five feet, and boulders of the same are sometimes found weighing more than a ton. Being often extremely hard and tough, and capable of resisting atmospheric agents, it ought to derive importance as a buildingstone, where it can be discovered in sufficient quantity. Taking a general survey of the shelly variety of green sand, as described, it will be perceived that the several deposits lying in the same geological line of N. E. and S. W., are one continuous stratum, that this stratum is essentially distinct from the two preceding varieties in its position, its mineral and its organic contents, that by far the larger portion of it has undergone a decomposition which diminishes its value as a marl, but that the lower part of it is well adapted to agricultural purposes. Further, when we observe its southern position relative to the remainder of the green sand region, its peculiar organic contents, and the amount of lime which it contains, we may view it as a continuation of the yellow limestone noticed in the survey of New Jersey, with which it lies in the same geological bearing.

§ 62. *Bluish Green Sand*.—What precedes comprises the extent of observations made in the several calcareous deposits secs. 53-61 situated on the Northern, Western, and Southern limits of St. Georges hundred. We now pass to the more numerous excavations made into the second di-

vision of the green sand formation, embraced within the above limits, and underlying nearly the whole of the hundred, which has been divided, sec. 15, into several classes for convenience in description. The first of these, the bluish variety, occurs on Drawyer's creek and Silver run, chiefly to the eastward of the main State road, and is so named from the color which it assumes in the few localities where it has been found. It is more perfectly developed at S. Townsend's on Silver run, where it has been excavated to the depth of 16 feet from the top of the stratum, and bored 7 feet deeper through the same material, but a portion of the bed being below the level of Silver run, the entrance of water obstructs the operations of the workmen. The greatest observed thickness therefore is 23 feet. It is a bluish green sand, very uniform throughout the whole bed, excepting two or three feet near the surface, of the size of grains of gunpowder, containing too small a proportion of argillaceous matter to cause it to adhere even when wet, and but a small quantity of arenaceous matter. It is therefore a very pure material, which in addition to its large percentage of potassa stamps its character as among the best marls of the region. The particles are soft, readily crushed by the nail, and as their powder exhibits the same color as the exterior, they have evidently not suffered from decomposition. According to the first analysis, the quantity of potassa appearing too large, it was submitted to a second and third examination with the following average results, as obtained by Dr. H. Seybert, J. S. McCulloh and J. C. B.

Silica	-	-	-	55.775
Potassa	-	-	-	9.00
Lime and magnesia			-	2.30
Protoxide of iron	-	-	-	21.70
Alumina	-	-	-	3.12
Water	-	-	-	8.50
				<hr/>
				100.395

It is accompanied by no traces of shells, the only articles of curiosity being a few sharks' teeth. Adjoining S. Townsend, and nearer to the State road, J. Vandegrift has discovered marl of nearly equal quality, and when more extensive examinations are made, it will probably prove of equal quality in every respect. Still nearer the same road, Z. Glazier's pits show a change in the quality of the material, the upper part being more argillaceous and of a more decided greenish shade, and the lower more sandy and containing casts in which the shell is replaced by oxide of iron. The upper stratum, which is 3 to 4 feet in thickness, has been chiefly employed, but is subject to the disadvantage of becoming compact, by drying. The lower stratum is nevertheless inferior to it in quality, from its having undergone partial decomposition, abounding in siliceous sand and presenting some difficulties of drainage. It would not be unadvisable to search for the bluish green sand on the same premises.

§ 63. The beds of G. Karsner on Silver run about three quarters of a mile E. of the Trap, derive additional interest from the fact that they

were the first excavations made into the true green sand in the State, on the supposition that it was marl. It belongs to the bluish green variety throughout, the greater part of the pits having been found uniform to the depth of 25 feet. The uppermost layers are rather argillaceous, and one of them in particular resembles a green clay in all its external characters, so that upon *washing over*, nothing is left but a white siliceous sand with a few green particles; notwithstanding which it presents to chemical analysis the same composition as ordinary green sand, and must therefore be considered as a pulverulent and not granulated variety of that material. Now the same substance is usually removed by washing over in the ordinary processes of analysis, and hence it follows that an estimate of the amount of potassa in the marl deduced from an analysis of the selected green grains falls short of that which is actually contained in the marl. An analysis of the average sand of the bed, taken at the depth of 8 to 10 feet from the surface, yielded:

Silica	-	-	-	56.70
Potassa	-	-	-	8.50
Protoxide of iron	-	-	-	22.21
Alumina	-	-	-	5.00
Lime	-	-	-	a trace
Water	-	-	-	9.30

101.71

Sharks' teeth are frequently met with in the marl, and occasionally fragments of bone, but the latter are too far disintegrated to determine their character. The upper surface being at no great elevation above the run and being moreover argillaceous, acts as a water-shed for springs and requires, as at Townsend's, rapid excavation, and the use of a pump to keep it free from water. Proceeding down Vance's Neck to the eastward of Townsend's, we might anticipate the existence of the same marl nearer to the bay, but up to the date of the close of the survey, it had eluded observation. There is every reason to believe, however, that researches for it will be crowned with success, notwithstanding the eroding action of the bay, and the replacement of the more ancient strata by the argillaceous and gravelly deposits of the Delaware. To the latter circumstance is to be attributed the heavy nature of the soil on the neck-lands on either side of Silver run. The same variety of marl is found on Drawyer's creek near the State road in the pits of Mrs. L. Sims, and J. Rogers. In the former, the upper part is dark colored and somewhat argillaceous, below which the main body is sandy, and has the characteristic bluish shade. The upper surface being elevated some 15 feet above the creek, it is not improbable that the bottom of the deposit may be reached in this pit, and being nearly dry, will afford facilities for extracting it to the whole depth. In J. Rogers' excavation on the W. side of the State road, the lower part adjoining the road contains the bluish green sand and appears to be the western termination of this valuable variety. Farther examinations are required to discover it in many of the ravines

bordering Drawyer's creek from the bridge to its mouth. It would appear then from the preceding enumeration of localities, secs. 62 and 63, that the bluish green sand is not an extensive deposit, being most largely developed at Townsend's and Karsner's, and attaining the thickness of 25 feet; that it is unusually free from foreign matter, incloses few traces of organic life, and that it contains a very large per centage of potassa, with traces of calcareous matter.

§ 64. *Yellowish Green Sand.*—The principal part of the green sand formation on Drawyer's creek, has a yellowish or grayish tinge in its dry state, arising from the intermixture of much white sand, and a little clay. More or less extensive openings have been made into it to the W. of the State road by McLane, Rogers, Croft, Polk, Uhler and Pennington. The pit of J. Rogers offers a complete section of the formation. Its color is generally bright green and sandy, traversed by a few argillaceous veins, and passing into the bluish green, sec. 63. The uppermost layers have suffered partial decomposition by the removal of silicate of potassa, and the diffusion of peroxide of iron, which communicates a brownish tinge to the marl, and cements it at times to a brown sand-stone. A peculiar white pulverulent substance which constitutes the substratum, is a sandy clay containing variable quantities of carbonate of lime, rarely so much as to effervesce with acids. The lower surface rising several feet above the level of the creek, and the upper some 30 feet, the thickness of the bed may be estimated at 20 to 25 feet. Notwithstanding its general sandy nature, it is so compact as to require the use of the pick to displace it, and yet it is sufficiently porous to permit the percolation of water, which generally issues in springs below the marl. Its freedom from argillaceous matter may be inferred from the last mentioned fact, and is further proved by its readily crumbling upon exposure to the atmosphere. A few sharks' teeth and fragments of bone have been found, but the latter were too friable to admit of transportation.

An average sample of the bright green sandy marl proved upon analysis to consist of:

Silica	-	-	-	-	-	56.35
Potassa	-	-	-	-	-	8.418
Protoxide of iron	-	-	-	-	-	22.25
Alumina	-	-	-	-	-	6.00
Water	-	-	-	-	-	7.11

100.128

Rising from Drawyer's bridge to the N. on the State road, the green sand has been observed for fifty years, and has given rise to a variety of conjectures as to its nature and origin, to mention which would be irrelevant to the subject. It undoubtedly extends westward on the lands of L. McLane, and in all probability does not diminish in quality, even if it decrease in thickness; for the absence of sufficient excavations admits of positive assertions relative only to its nature, which is that of the yellowish green sand. Thorough search after it will be amply compensated by the discovery of marl of good quality, and easy of access.

§ 65. E. Croft and W. Polk, have opened pits in the same formation in a ravine which commences near the N. W. end of Cantwell's Bridge, and runs to Drawyer's creek. It is still more elevated than that of Rogers and appears to be of the same thickness. It has a light green color in the pits, passing in a dry state into a grayish or yellowish green, in consequence of particles of siliceous sand which are transparent when wet, and yellowish when dry. The dryness of the bed is remarkable, since it is so compact, although free from clay, that the necessary use of a pick increases the expense of its extraction. The same marks of decomposition in the upper and lower portions of the bed are observable as were noticed in Rogers, but cannot be considered as characteristic of these beds, since the extent of alteration varies materially in the same locality. That of Croft is lighter colored, and more compact than any of the marls now being described, but it is not on that account inferior, for it crumbles soon after exposure to the air. The yellow sand constituting the uppermost stratum, rises from 5 to 15 feet above the marl, and produces a fine loamy soil. A few hundred yards W. of this point are the marl banks of W. Polk and Dr. Uhler adjoining each other immediately on the abrupt banks of the creek. The lower part of Uhler's pit is about 10 feet above the meadow. The marl is about 12 feet thick, has 15 feet of earth on the top, and a two feet white clayey stratum at the bottom, sec. 64, is partially decomposed near their upper surface, and only differs in the absence of some of the siliceous sand, and consequently darker shade of color. A carefully conducted analysis of Uhler's by J. F. Frazer gave the following results:

Silica,	-	-	-	52.60
Potassa,	-	-	-	5.37
Protoxide of iron,	-	-	-	27.02
Alumina,	-	-	-	7.70
Water,	-	-	-	7.40
				<hr/>
				100.09

The quantity of potassa being smaller than is usually given in the preceding and following analysis should not give rise to the belief that this marl is of inferior quality. A pit excavated by W. Polk in a ravine near this locality offers one point of interest to the geologist, at the same time proving that the marl is not inexhaustible. The substratum, of the green sand is exposed to view, and proves to be a coarse yellow sand, wholly destitute of the green particles, and reposing on an argillaceous bed, as may be inferred from the springs issuing from it. Still farther west on the same stream, Mr. Pennington has commenced operations for extracting marl, and although the stratum was not laid sufficiently open for a more accurate description, yet enough was observed to justify the conclusion that it is the same kind of marl, and probably of the same extent, differing only in its liability to become charged with water. But even this may be obviated by opening a pit on the flank of a hill, instead of in the bottom of a ravine. During the first eighteen months of the survey,

green sand had not been found on the N. side of Drawyer's creek, but impressed with the belief that it did not fine out, although circumstances seemed to strengthen the assumption, the banks of the creek and its ravines were closely investigated several times without success. Since that period it has been accidentally discovered in the race-way of Tatman's mill, on the southern branch of Drawyer's, closely resembling the marl found lower down the same stream, but it has not been farther investigated. The detection of the marl in this place, points out the advantages of instituting farther researches for it on the N. branch of Drawyer's as far as Cannon's mill-pond, since it is also found on the head-waters of this branch. One difficulty attends the extraction of marl on the lower part of the two branches of Drawyer's, in the unusual thickness of the superincumbent yellow sand, a difficulty only to be obviated by finding it in ravines, and near small water courses.

§ 66. A few miles W. by S. of Cantwell's Bridge, the Appoquinimink is formed by the union of two branches, the one of which abounds in shelly green sand on the Noxentown mill-pond, sec. 60, and on the other we find the same as is described in the preceding paragraphs. It may be seen in the banks of the stream from the fork of the two branches as far as Murphy's mill, where the formation may be better studied. The upper portion is partially disintegrated, and colored brown by the oxide of iron, below which the main body of the sand is dark green when wet, grayish green when dry, and is free from argillaceous matter. While digging for settling the foundation of the saw-mill, the marl was penetrated 14 feet, to which if we add five feet for the height of it above the road, we have above 20 feet for its greatest observed thickness. Near the lowest point of the digging, the workmen struck a bed of shells, not a specimen of which could be obtained; and it is to be regretted since they might have determined the question more satisfactorily, whether the green overlies or is subjacent to the shelly sand on the Noxentown branch, sec. 60, or passes into that deposite. The stratum rises 12-15 feet above tide-water, and is overlaid by 10 to 20 feet of yellow sand, the upper part of which is converted into a sand-stone, sec. 61. The lower part of the green sand submitted to analysis gave,

Silica,	-	-	-	-	-	58.10
Potassa,	-	-	-	-	-	7.54
Protoxide of iron,	-	-	-	-	-	22.13
Alumina,	-	-	-	-	-	5.14
Lime,	-	-	-	-	-	a trace
Water,	-	-	-	-	-	8.22

101.13

Many fruitless attempts have been made to discover the same stratum on the N. side of this branch both above and below the mill, and the probability is that it does exist, but so covered with detritus as to elude superficial research.

§ 67. Reviewing the preceding secs. 64-5-6, it may be gathered that

the yellowish green sand is characterised by its elevation above tide-water, so that the lower surface may be reached in some instances, that it attains the thickness of 20–25 feet, that it is remarkably dry and compact, that it is rarely argillaceous, and abounds rather in siliceous sand, whence its yellowish and grayish green color; that it contains on an average more than 7 per cent. potassa, and is, therefore, an excellent material for fertilising the soil; that its uppermost layer is usually decomposed, the protoxide being converted into peroxide of iron; and lastly, that it is surmounted by 5 to 20 feet of yellow sand, capped by a mingled clay and gravel, on which reposes a fine yellow loam. The elevation, dryness, and sandy nature of the marl, offer facilities for its extraction and employment on the soil not ordinarily met with in St. Georges hundred. The planes of deposition, so obvious in many localities where the yellow sand is freshly excavated may be observed to advantage near Taiman's mill on the southern branch of Drawyer's.

§ 68. *Black colored Green Sand.*—Between Silver run and the canal to the E. of the State road, we find the largest number of excavations into the marl, embraced in a district three miles in length by one-half in breadth, and disclosing a distinctly granular sand, usually of a very dark shade passing into black, and remarkable for its hardness. It is not presumed that the marl exists in greater abundance in this district than in other parts of the hundred, but the land gradually sloping to the bay, exposes in numberless places the outcropping of the green sand, and renders it generally more easy of access. The undulating surface on the land of S. Higgins, exhibits the marl on the flanks of the hills communicating a greenish color to the soil, and by the argillaceous character of its upper layers renders these spots heavy in moist, and hard in dry weather. It is to be regretted that notwithstanding the readiness of access to the marl, it has been wrought to a very limited extent, not sufficient to determine its character with accuracy. It has a dark green color, contains an admixture of siliceous sand, its upper surface is elevated many feet above tide-water, the bed is generally dry in summer, and it may be obtained in many places without difficulty. In addition to these circumstances, its good quality should entitle it to credit as a fertilizer. Specimens of amber have been found in the deposits on the canal, but the green sand of S. H. is the only non-calcareous variety, in which a well characterised piece of that curious remnant of ancient forests has been hitherto detected. At J. Jefferson's, adjoining the former, it lies in a similar position, being often ploughed up in the fields, but not being extensively wrought, the features of its better qualities cannot be given, excepting so far as to state its resemblance in every respect to that of H. S. In a ravine between J. Jefferson and J. Dale, the latter after persevering research has succeeded in discovering green sand of the same character, but the formation being uncovered to some depth, offers a better means of examining its features. It has a dark shade of green, is evenly granulated, nearly uniform to the bottom of the opening, slightly decomposed and mingled with foreign matter near its upper surface, and contains a little arenaceous and still less argillaceous matter. The larger part of it lying above the water and not materially affected by springs, offers no

impediment to its being extensively worked, as far as its thickness has been ascertained, which in all probability does not fall short of 20 feet. The above openings lie on the S. side of the road leading to Augustine landing; and to the N. of the same road are several others bordering on the streams which flow into Augustine creek. J. Walraven's marl has no distinctive features, the upper layers being light green and argillaceous, the lower darker and more sandy; when examined, it had not been deeply penetrated. J. McConaughy's pit has a stratum of bright, bluish green clay at the top, under the yellow sand, and beneath it the marl consists chiefly of black grains, intermixed with green. It is partially decomposed where exposed to view, but when it shall have been more fully developed, it will prove to be of good quality, and springing water will throw fewer obstacles in the way of its extraction. Viewing all the above openings into the green sand on either side of the road, we observe that the marl where sufficiently wrought, is of good quality, and promises the same in all cases; that it is sandy in its nature, and therefore convenient for spreading on the soil; that it is elevated above tide-water, and not incommoded by springs, and therefore in its employment offers great facilities. From the proximity of the Delaware, we might anticipate the fact of the prevalent argillaceous character of the soil, which, however, may be demonstrated to admit of profitable culture.

§ 69. All that land lying between Silver run and Augustine creek near the bay, shows a deposition of a light colored clay, imbedding gravel, to such a depth as to preclude the discovery of green sand without close investigation: it is probably an ancient deposit of the bay, when the land was relatively at a lower level than at present, and has replaced a portion of the marl which has been removed. That the latter has not been wholly removed, is proved by the deposit opened by J. Dale, and still more conclusively in those nearer Port Penn, which immediately underlie the clay without the intervention of the regular deposit of yellow sand. There are several places from which marl is obtained on that neck of land lying between Augustine and St. Georges' creek, at the extremity of which Port Penn is situated, and this appears to be its nearest point of approach to the bay. A light green, argillaceous marl from the upper part of the bed opened by W. Kennedy was analysed by C. Morfit and found to consist of—

Silica,	-	-	-	55.9
Potassa,	-	-	-	8.0
Protoxide of iron,	-	-	-	18.1
Alumina,	-	-	-	4.9
Water,	-	-	-	12.1
				<hr/>
				99.0

The same kind of green sand was found at J. Carpenter's a short distance below the surface, and was probably the upper layer of the formation. It was not excavated below the clay, and cannot therefore be described with more minuteness. W. Cleaver has discovered the same

variety within view of Port Penn, which was examined chemically, and found to contain agreeably to two analyses performed by R. McCulloh, and J. V. Blaney:—

Silica,	-	-	-	58.42
Potassa,	-	-	-	7.51
Protoxide of iron,	-	-	-	17.45
Alumina,	-	-	-	7.13
Water,	-	-	-	8.57
				<hr/>
				99.08

The upper part of the stratum has likewise been discovered on J. Dilworth's land not more than a foot below the surface, presenting the same argillaceous features and lightness of color, which characterise the preceding. The land being higher at J. Cleaver's, the same formation crops out on the flanks of the hills, and having been excavated several feet in depth, affords us the means of describing its character. The upper part is bluish green, argillaceous, and contains small disseminated masses of iron-stone. Below this the main body of the marl is black when moist, and dark gray when dry, contains a trace of argillaceous matter, a little siliceous sand, and the green granules which vary in size are remarkably hard. The latter property in connection with their color, indicating a change in their composition, the marl was subjected to analysis, and proved to be of good quality, as may be practically shown by crushing the grains in a white surface, when their characteristic green color is developed. The black color is, therefore, nothing more than a decomposition on the surface of the granules not detracting from their value. The following are the results of analysis, as obtained by C. Lea:—

Silica,	-	-	-	49.93
Potassa,	-	-	-	7.80
Protoxide of iron,	-	-	-	23.41
Alumina,	-	-	-	6.90
Water,	-	-	-	10.95
				<hr/>
				98.99

The land in the vicinity of Port Penn rises from 5 to 20 feet above high water, and the marl being usually elevated, affords great facilities for its extraction, notwithstanding the probable inconvenience of water. In this district, the main part of the marl is black and sandy, and is overlaid by a light green argillaceous stratum rather inferior to the former: above the latter, we generally find a thin seam of iron ore, and the whole is capped by a mingled white and yellow clay, with imbedded gravel, an undoubted deposit of the bay. That ferruginous springs have been in action is shown by the stratum of iron ore, which is best observed at J. Carpenter's, where it rests on marsh mud. The springs still exist, but their chalybeate nature has ceased.

§ 70. The marl exhibits its outcrop on the road from Port Penn to the State road, and is found on the lands on either side of the road. On the S. side it has been excavated by T. Stockton and L. Vandegriff, particularly on the lands of the former, where its constant outcropping on the flanks of the low hills proves it to underlie the whole farm. T. S., having searched for it in many places, and excavated it to some extent, has shown that it is variable in its character near the surface, being at times argillaceous, and of a light green color, at others, sandy, yellowish, and gray. After the upper and adulterated portions have been removed, the principal body of the marl appears of a very dark brown or black color, in grains of variable size, generally very coarse and hard, mingled with a little white siliceous sand, and rarely with a little clay. In nearly all the exposures, its sandy nature is evinced by the dryness of the bed, the water-bearing stratum lying below it; but as the ordinary consequence of this dryness, we find the upper portions of the sandy marl partially decomposed and the bed traversed by veins of the same nature. It is unnecessary to allude to the manner of its decomposition, which has been frequently alluded to in the preceding pages. This green sand was one of the first subjected to analysis, and at that time the ordinary method adopted of selecting the green granules from the rough marl, and submitting them to chemical examination; according to the analysis, the green particles alone contained:—

Silica, - - - - -	47.84
Potassa, - - - - -	10.30
Protoxide of iron, - - - - -	24.29
Alumina, - - - - -	7.38
Water, - - - - -	10.19
	<hr/>
	100.00

By a comparison of these results with a similar marl from J. Mansfield, sec. 74, and observing the amounts in the unselected marl of the latter, we have the means of ascertaining the per centage of potassa in the rough marl of T. Stockton. But that portion submitted to analysis was obtained from the surface, and the main part of the marl has undoubtedly the same composition as that of J. Cleaver, sec. 69, to which it bears the closest resemblance. On the opposite side of Augustine creek, the deep ravines with steep flanks show the marl at a higher elevation under the same general features, and L. Vandegriff has not been inattentive to these developments, having made several openings with the view of testing its qualities. It is nearly black in color, loosely granulated, and is characterised by the abundance of a white earthy material, which often forms thick layers in the marl in a horizontal position. This peculiar substance found under J. Rogers' marl pit, § 64, and in small quantities in several other places, consists of white clay, green and siliceous sands, partially cemented by silicate of potassa (!) into small irregular nodules from half an ounce to several pounds in weight, sometimes forming casts of shells, and containing (but rarely) a sufficient quantity of carbonate of lime to

effervesce with acids. These layers also embrace pieces of bone in a very friable state. The quantity of lime being small, the beds containing the nodules cannot equal the pure green sand in value. On the N. side of the road, C. Vandegrift has obtained the black colored marl, described in the preceding, in several places in the vicinity of his house, and will undoubtedly find it in many other situations on the farm, where it is easy of access and not incommoded by water. It appears to have undergone more change than any of the preceding, and is probably not of the same thickness; for on the farm of W. Bennet, a short distance to the N. of C. V., the stratum may be seen in the washes of hill-sides only a few feet in thickness, much decomposed and mingled with the over and underlying yellow sand. At W. Bennet's, a large proportion of the green sand is converted into iron-stone, and has suffered such an alteration throughout, that it is questionable whether it can be profitably employed on the soil. Passing a little farther to the N., the green sand disappears and fines out in the yellow sand, for the hills bordering Scott's run are composed of the latter with green grains sparsely distributed through it, to the height of 40 to 60 feet. At the extreme northern point where it is observed, (Bennet's,) it lies at a considerable elevation above tide-water, and could certainly be found on Scott's run if it existed there, but an examination made on that stream failed to detect the least trace of it to the E. of the main State-road. At the mill, a short distance W. of the road, it is said that shell-marl was found in digging for the foundations of the dam or race-way, and it is probable that it was the cretaceous green sand of the canal. The difference of elevation between this deposite and the above black colored green sand, point to two different strata of this formation included between the yellow sands.

§ 71. Reviewing the preceding details relative to the darker variety of green sand, secs. 68-9-70, we observe that at its southern limit, it attains the thickness of 20-25 feet, is dark green, and uniform throughout, that to the westward of Port Penn, it is 15-20 feet thick, externally black from a partial disintegration, and is overlaid by a light green argillaceous sand—that still farther to the N. it is three to five feet thick, much decomposed, a large proportion being black internally, and that eventually it fines out, passing into the yellow sand, which is the heaviest deposite in the green sand series. We farther observe that its upper surface near the bay lies but a few feet above tide-water, and rises towards the W. and S. W., so that the bottom of the stratum may be reached above the level of tide—that the land rises in the same direction more rapidly; and that, therefore, the denuding action of the bay in former periods of time has merely removed the yellow sand, and been resisted by the superior tenacity of the green-sand stratum. As a consequence of the last conclusion, we find an argillaceous and gravelly deposite near the bay shore, producing a heavy soil, and as it gives way to the yellow sand on the more elevated country forming a good loam, characteristic of the middle portion of St. Georges hundred.

§ 72. *Pyritiferous Green Sand of the Dividing Ridge, and the Head Waters of Bohemia*, sec. 15.—Passing across the State to the S. W. corner of the Hundred, and resting on one of the head streams of the

Bohemia, we find a dark green, nearly black marl in the vicinity of the calcareous beds, sec. 57, and although resembling the bluish green sand, secs. 62, 63, in its general composition, yet materially differing from all others in its content of phosphoric acid, it deserves a separate notice. It has been sought for and extracted by W. Polk with praiseworthy enterprise. It is very uniform in color, and granulation, and contains few traces of organic life and few impurities. Situated at the base of the steep flanks of the hills skirting this branch of the Bohemia, and its upper surface being slightly argillaceous and semi-indurated by the deposition of peroxide of iron, it becomes a water bearing stratum, which incommodes its ready excavation, and prevents us from ascertaining its thickness; it exceeds 25 feet, and if we may judge from the adjacent decomposed beds, sec. 59, its thickness is over 30 feet. That of the yellow sand above it is upwards of 40 feet. While workmen were employed in the excavation, they observed it sparkle in the sun's light with the brilliancy of polished silver, which they attributed of course to the presence of that metal in the form of small spangles. A closer inspection proved them to be small crystals, with a brilliant, nearly adamantine lustre, perfectly limpid when first obtained, but rapidly changing to blue by exposure to the air; and chemical analysis showed their constitution to the phosphoric acid, protoxide of iron, and water. They are the same as those found some years since at Mullica Hill in N. Jersey, and termed Mullicite by Dr. Thomson of Glasgow, who analysed them. This marl is farther characterised by a white efflorescence which coats the grains on drying, and often forms no inconsiderable proportion of the mass. The efflorescence submitted to examination was found to contain sulphate of lime, rarely a little copperas, and although not detected, it undoubtedly contains phosphate of lime. The formation of the copperas, which would be detrimental to vegetation, is obviated in a great measure by the presence of carbonate of lime, which explains the efflorescence of sulphate of lime (plaster.) A specimen of that obtained prior to the opening of the pits, effervesced slightly with acid (from the carbonate of lime,) but contained lime in addition to that in the carbonate. The following is the result of the analysis of a portion destitute of phosphate of iron:

Silica,	-	-	-	48.30
Potassa,	-	-	-	8.63
Lime,	-	-	-	1.50
Protoxide of iron,	-	-	-	26.46
Alumina,	-	-	-	4.80
Water,	-	-	-	10.79
				<hr/>
				100.48

C. Polk has opened pits in a similar marl a few hundred yards lower down the same stream. It differs from the former in containing exogyras and a few other shells in its upper part, in the presence of a little more siliceous sand and the absence of a quantity of the phosphate of iron. Its thickness, not yet accurately ascertained, is over 20 feet. In a south-

westerly direction from these openings is a third across the State line, deviating in no important particulars, and as it lies without the limit of the survey will not be described. Above the marl, an unusually heavy deposit of yellow sand rises to the land level, and constitutes a soil of superior quality, which, however, having been exhausted by excessive tillage, requires the employment of this excellent marl, to restore it to fertility.

§ 73. A short distance to N. E. of the preceding localities and N. of the road leading from Middletown to the Bohemia River, lie the marl pits of J. Driver, on one of the branches of that river. It is a dark colored sand, very uniform in texture, containing a little argillaceous, and arenaceous matter, and frequent shells or their casts; among which we notice, *Exogyra costata*, *Gryphaea convexa*, *Ostrea falcata*, and *Belemnites americana*, many casts of *Turritella* and other univalves, and small pieces of *Baculites* and *Ammonites*. Being sufficiently sandy to permit the percolation of water and sufficiently elevated above the bed of the stream comparatively few difficulties will be experienced from the entrance of water into the excavations. Its thickness, not yet ascertained, will probably exceed 20 feet, and as it may be found in many places on the branch much more may be obtained than is sufficient to meet the demand. It is said not to have been found on the N. W. side of the stream, although but a few yards distant; the presumption is, however, that it does exist there, and remains to crown the labors of some enterprising individual. About two miles N. by E. from J. Driver's, we again meet the marl on another of the sources of the Bohemia, where it has been opened by J. Clayton. It is remarkable for its elevation above tide-water, its upper surface approaching within some 20 feet of the top of the dividing ridge. It is a very fine-grained black sand, containing much siliceous matter in its upper layers, which diminishes in descending, and gives the first evidence of sulphuret of iron, so abundant in the deep-cut of the canal. Small nodules of the sulphuret may be found, and after the marl has been exposed a short time to the atmosphere, its surface becomes covered by an efflorescence of sulphate of lime (plaster,) and sulphate of iron (copperas,) the quantity of lime being too small to decompose the whole of the latter salt. Organic remains are not abundant, the principal species observed being the *Belemnite*, casts of *Turritella*, and a few small bi-valves. The thickness has not been ascertained, nor is it necessary to do so, since it may be conveniently opened at many points. Hitherto the excavations have been made adjoining or in the branch, but since the sandy character of the marl tends so authority to its being a water-bearing stratum, it may be presumed that it will be detected in some equally convenient spot, and less incommoded by water.

§ 74. Reference was made to the probable continuity of the yellowish green sand, sec. 65, on the main stream of Drawyer's, with that on the head waters of its Northern branch, the nearest points of approach being Tatman's mill, and J. Mansfield. This branch, on which Cannon's mill is situated, is formed by the confluence of two streams, on each of which marl is found at some distance from their junction. On the more southerly of these brooks it has been found on H. Templeman's land of the

we find the same kind of marl near the surface of the ground, constituting the bed of the brook. Several pits were there opened by Mr. Haughey, and the heaps of marl thus exposed to the air were more thickly coated by the white efflorescence of a strong, styptic taste, and even small pieces of sulphuret of iron were detected. It is, therefore, of inferior quality to the preceding, although still a valuable marl, and its astringent quality may be wholly obviated by the conjoint application of a little lime. While the presence of more or less sulphuret of iron may be considered as characteristic of the ridge marl, from this point to the deep cut, observation nevertheless shows that it is more abundant in the upper layers of all the pits just described. Lower down the same branch H. Templeman's principal marl opening is made in the steep banks of the run, where it rises about 8 feet above the water-level, is very dry, compact and argillaceous, of a bright green color, and seems to have lost all traces of sulphuret of iron. Its character, and convenient position offer strong inducements for its employment on the adjoining land. Nothing certain can be asserted relative to its thickness, but from its rise above the water, and its being found in the stream, it undoubtedly exceeds 10 feet. One hundred yards below T's a singular bed has been struck, and slightly opened by G. Houston on the edge of the branch. It abounds in shells, such as *Exogyra costata*, *Gryphæa convexa*, *Belemnites Americana* and others, of large size, and closely resembles the cretaceous green sand of the canal excepting in the absence of much cretaceous matter and green sand, which are replaced by siliceous sand. The bed has not been thoroughly explored, but should these characters continue the same, it will not prove a superior marl. Of a better quality will that be, when sufficiently excavated, which crops out in the adjoining field north of the branch, where it is constantly turned up by the plough, and produces sterility from its excess. It is probably a pure green sand destitute of organic remains.

§ 76. Reviewing the localities just described, secs. 74, 75, it appears to be a uniform black sand (internally green) containing a little siliceous sand, traces of sulphuret of iron and lime, and overlaid by a clayey green sand—that it constitutes the bed on which the streams flow from the ridge nearly to their confluence, therefore, that the formation rises towards their sources on the ridge. The latter point may be farther shown by a comparison of the heights of the formation on the main stream of Drawyer's, as at Polk's, Rogers', &c., with that at Houston's lying nearly on the same level. Where the yellow sand overlies the marl, as it does at some distance from the ridge, we find a good medium soil capable of high cultivation by the use of marl and other fertilisers, but the nearer we approach the summit-level, the heavier, and less productive does the soil appear, and the more necessitous of improvement. Still the presence of the marl in exhaustless quantities should encourage the proprietors of that land to employ it, and redeem the soil from comparative sterility. By a comparison of the height and nature of this marl, with that of J. Clayton on the western slope of the ridge, and with the upper stratum in the deep cut about to be described, we might anticipate the existence of the same bed under the whole ridge, at no great depth below the surface, but with

the exception of one opening on Scott's run, it still remains to be discovered. The opening alluded to was made by Mr. Jamieson on the upper part of Scott's run, and contained a marl similar to the foregoing, but appeared to have undergone partial decomposition. Its thickness and other circumstances cannot be stated with precision, having been newly and not extensively cultivated; but sufficient is known both of its quality and quantity, to recommend its employment. Fruitless examinations have been made to discover it lower down the same stream, and the promises held out by it are too fair not to advise continued and persevering search until it be detected. At the mill near the State road on the same stream, the cretaceous marl is said to have been found, sec. 70, and we know that at a short distance S. E. of it, the green sand fines out at a considerable elevation above tide water, sec. 70. It would appear therefore, that there are two principal beds of green sand, to the upper of which that described in the present section belongs, and if so, there is every probability for supposing that the stratum of Mr. Jamieson also fines out lower down Scott's run.

§ 77. *Blue Micaceous and Tenacious Sand*, § 15.—The deep-cut of the canal presents a view of the various strata constituting the green-sand formation as they repose in their native beds, such as could not possibly be attained without a similar artificial section in any other portion of the region. Passing directly through the dividing ridge in an easterly and westerly direction, and descending to a depth not far above tide-water, it exhibits below the soil several distinct layers of green sand with undulating upper and lower surfaces, of varying thicknesses, sometimes approximating and uniting into one, again separating to the distance of 20 feet, and interposed by the yellow sand. The following sections are extracted from Dr. S. G. Morton's synopsis of organic remains, to whom they were given by Mr. A. A. Dexter, one of the engineers on the canal. The first section was made at or near the summit-bridge, to the depth of 82½ feet, the second about one-quarter of a mile west of it, to the depth of 62½ feet, and both beginning at the top or soil. "1. A series of white, yellow, and brown sands and gravel, traversed by iron crusts, and containing large masses of primitive rocks, 35½ feet thick. 2. Argillo-micaceous sand of a dark blue color; organic remains few and indeterminate, 28½ feet thick. 3. Argillo-ferruginous sand of a greenish color, abounding in ammonites, baculites, Pholadomyæ, lignite, succinite, &c., four feet in depth. 4. Coarse gray sand with similar organic products as No. 3. Depth, seven feet. This stratum forms the bottom of the canal, but the excavation was made six feet deeper for experimental purposes. 5. Argillaceous sand of a dull green color, which it imparts to water; organic remains same as in the last beds. Depth three feet. 6. Coarse gray sand, which was penetrated about three feet, but no fossils were observed." The second section contained:—"1. Ferruginous gravel and sand. Diluvial. Depth nine feet. 2. Black tenacious clay. Depth seven feet. 3. Ferruginous brown sand and clay containing a profusion of ammonites and baculites, with scaphites, lignite, succinite, and casts of various simple univalve and bivalve shells. Depth 23 feet. 4. Blue micaceous sand and clay with similar fossils to No. 3. 5. Ferruginous sand and clay, of

a dull green color, abounding in multilocular and other shells. Depth six and a half feet. 6. A white siliceous sand, which, about 200 yards farther west, rises 12 or 15 feet above its level at this point and contains lignite in vast quantity; sometimes even the trunks of trees 20–30 feet long, and a foot in diameter. No other organic remains were observed in it.” A comparison of the sections is sufficient to show the varying quality and quantity of the several beds, and that they belong to the green sand series, but they are not given with sufficient precision. The following section made during the survey, was commenced about 200 yards west of the summit bridge on the tow-path, and continued upwards in an oblique direction towards the bridge.—1. Blue micaceous and argillaceous sand, very uniform in its appearance, and of a fine grain, most remarkable for the abundance of small colorless micaceous scales. Height nine feet, above which it gradually intermingles with a yellow sand, and contains less mica, till at length it forms—2. a partially indurated bed of yellow ferruginous sand, embodying a few layers of the blue, containing a few grains of green sand, and a greater number of micaceous particles. Its thickness is eight feet. 3. Another stratum of blue sand, containing a few green granules, one and a half feet thick, and capped by six inches of an iron stone, enclosing white sand. 4. A bright yellow siliceous sand, eight and a half feet thick, the upper foot of which alone contains green sand. 5. A dark green compact stratum, six feet thick, the first three and a half sandy, the upper two and a half feet argillaceous and lighter colored. It is a pure green sand stratum containing a little clay and siliceous sand, and is topped by iron-stone and yellow sand containing pebbles about two feet thick. 6. A bed of yellow sand similar to 4th, $11\frac{1}{2}$ feet thick. 7. A compact bed of white siliceous pebbles, one and a half feet, above which they are distributed in a white and yellow clay of five feet thickness to the surface or soil. The irregularities of the strata within short distances did not require mathematical accuracy in their admeasurement, but great care was exercised in examining the nature of the deposits. An analysis of the fifth stratum (dark green sand) of the preceding section, made by J. V. Blaney, gave the following results:—

Silica	-	-	-	80.73
Potassa	-	-	-	4.46
Protoxide of iron	-	-	-	8.37
Alumina	-	-	-	2.12
Water	-	-	-	4.84
				<hr/>
				100.52

From which it appears to be an ordinary green sand, containing a larger proportion of siliceous sand. The following diagram exhibits the three sections, the first on the right being made at the bridge, the second on the left, about one quarter of a mile W. of it, and the middle taken intermediate between the two during the geological survey.

W. $\frac{1}{2}$ ————— E.	Soil.		Soil.
	White and yellow clay with pebbles and gravel, 5 ft.		
Soil.	White siliceous pebbles, $1\frac{1}{2}$ ft.		
Ferruginous gravel and sand, 9 feet.	Yellow siliceous sand, $11\frac{1}{2}$ ft.		White, yellow and brown sands and gravel with iron-crusts, $35\frac{1}{2}$ ft.
Black tenacious clay, 7 ft.	Sand and pebbles, 2 ft.		
	Argilla, green sand, } Granular green sand, } 6 ft.		
Ferruginous brown sand and clay, abounding in ammonites, and baculites, lignite and amber, 23 ft.	Yellow siliceous sand, a little green sand, in the upper part, $8\frac{1}{2}$ ft.		
	Blue argillaceous sand, $1\frac{1}{2}$ ft.		
	Yellow ferruginous sand, mica, a little green sand, 8 ft.		Dark blue argillaceous and micaceous sand, with few organic remains, $28\frac{1}{2}$ ft.
Blue micaceous sand and clay, with same organic remains as above, 11 ft.	Blue argillaceous and micaceous sand, 9 ft.		
Tow.	path.	Tow.	path.
Ferrug. sand & clay of a dull green color, many shells, $6\frac{1}{2}$ ft.			Argillo-ferrug. sand, greenish color, 4 ft.
White siliceous sand, Lignite abundant, 5 ft.	Bottom of the canal.		Coarse gray sand, abundant organic remains in this and above, 7 ft.
	Coarse gray sand. }		Arg. sand, green, same organic remains, 3 ft.

By comparing the right and left sections, we find the coarse gray sand below the water level of the canal sinking slightly towards the west, but still further west it rises 12 to 15 feet higher. It therefore rises on the whole, and lends strength to the position, that the red-clay formation dips below the green sand. The blue argillaceous deposit which is $28\frac{1}{2}$ feet thick at the summit bridge, becomes $18\frac{1}{2}$ feet in the middle, including a bed of yellow sand, and diminishes to 11 feet one quarter of a mile W. of the summit.—As it does not dip below the coarse gray sand, it therefore only diminishes in thickness, and probably passes into a greenish sand, sec. 50, which is above the red clay. The yellow and brown sands and gravel of the right-hand section have not been accurately observed, for the six feet bed of green sand noticed in the middle section may be seen of varying thickness on either side of the bridge nearly at the same height above the water, and passes into the black tenacious clay of the western section, which is in fact a dark-colored argillaceous green sand. The whole bed of yellow sand including the green is $35\frac{1}{2}$ feet thick on the right, 35 in the middle, and 39 on the left without diminishing in thickness therefore, it apparently sinks towards the west, but this is only apparent, for it gradually replaces the blue argillaceous clay, and the two together do certainly rise, and repose on the coarse gray sand. To the irregularity of the strata, which are thus revealed by the deep-cut, may be ascribed many otherwise unaccountable phenomena observed in the green-sand region, such as the varying thickness and elevation of beds within limited spaces, as well as their varying qualities.

§ 78. The blue sand stratum being sufficiently tenacious to constitute the water-bearing stratum of the region, numerous springs issue at various heights above the canal, transporting fine clay, sand and mica in great quantity, the former of which communicates a greenish color to the water, and the two last are constantly tending to lessen the depth of the canal. Several of the strata also at various heights holding a small quantity of water, renders the whole mass liable to slips or slides of earth in the present steepness of the sides, several formidable instances of which have occurred, and more may be anticipated unless efficient means are adopted for obviating them. One obvious method would be to remove such a quantity of the earth, as to give a gentle slope to the sides of the canal, and to transport it to such a distance that its weight would not force out the softer subjacent strata. Without resorting to such an expensive process, others might be adopted. Short stakes driven into the heavier beds at various heights, will not be sufficient security against slides, since they include such masses of earth as would carry the stakes with them. Long and heavy piles driven down in rows, and at several points of elevation, would in a great measure obviate the difficulty, and wholly so, if combined with a partial removal of the earth. The silting up of the canal from springs can scarcely be prevented, and although their operation is too slow to offer a formidable obstacle, it will nevertheless in all probability require the frequent employment of a dredging machine to maintain sufficient depth of water. Independently of the matter mechanically suspended in the spring-water, a considerable quantity of sulphate of iron (copperas,) in solution is thrown into the canal, which is so highly charged

with it as to destroy fish and other aquatic animals, such as the barnacles adhering to the bottom of sea-vessels. Nearly all the springs in the deep cut, give evidence of copperas in their taste, and in the ferruginous deposit they form at their point of issue, and we might hence conclude, that the formations abounded in sulphuret of iron (iron-pyrites,) if we had not stronger evidence of it in masses of that mineral abundantly diffused through the sands and clays. We have seen that the green sand of the ridge generally contains pyrites, but it is minute in quantity compared with that found in the deep-cut, where it often constitutes a very material part of the strata. The question arises, whether it could be applied to the manufacture of copperas? Probably not; for it would require much labor and time to discover localities where it be sufficiently abundant to work profitably; and such is the irregularity of the formations, that the extent and continuity of these beds could not be depended on. The same efflorescence of sulphate of iron may be anticipated in nearly all the openings for marl, which will be made in the N. Western part of St. Georges hundred, has proved to be the case, in the excavation of Mr. Ellisson in that section of the green sand region. Existing in small quantity in the uppermost strata, it is probable that no injurious effects will flow from the employment of this green sand on the soil, or if it should do so, means of obviating them will be pointed out in the third part of the memoir.

§ 79. Reviewing all the descriptions of the green sand formation from sec. 53 to sec. 78 inclusive, we find that there are two deposites, the upper and lower, which sometimes unite and again are separated by interposed yellow sand, that the lower appears on the canal and western border of the State, and the upper embraces the remainder of the region. Practically speaking, there are two principal kinds of green sand, that containing lime as an essential ingredient, and that consisting chiefly of green particles. The former contains variable quantities of carbonate of lime, the highest limit yet observed, being 25 per cent. The average composition of the latter in its natural state and selected may be thus expressed:—

	<i>Unselected.</i>		<i>Selected.</i>
Silica, - - -	58	- - -	50
Potassa, - - -	7	- - -	10
Protoxide of iron, -	22	- - -	22½
Alumina, - - -	5	- - -	7
Water, - - -	8	- - -	10½
	<hr/> 100		<hr/> 100

The first is either *cretaceous*, containing finely divided carbonate of lime not formed by comminuted shells, and occurring on the canal, sec. 53 to sec. 56; or *decomposed calcareous*, on the western limit of the State, from which the calcareous matter has been wholly or partially removed, although abounding in casts of shells, sec. 57 to 59;—or *shelly green sand*, on the southern line of St. Georges' hundred, in which there is no fine calcareous matter but that of comminuted shells; sec. 60 to sec. 61.

The second contains mere traces of lime, and consists of green sand particles, with variable quantities of clay and common sand, and is either *bluish green*, and of the finest quality, as found on Drawyer's and Silver run, sec. 62 to sec. 63;—or *yellowish green*, containing white siliceous sand, as on Drawyer's and the Appoquinimink, sec. 64 to sec. 67;—or *black-colored*, decomposed externally, rarely internally, and containing both white sand and argillaceous matter, from Silver run to Scott's run, sec. 68 to sec. 71;—or *dark-colored*, and containing pyrites, as from the S. W. corner of St. Georges' hundred, and along the ridge to the Deep-cut, sec. 72 to sec. 76;—or lastly, the *blue micaceous sand* of the Deep-cut rarely containing particles of green sand, although abounding with casts and impressions of shells characteristic of the green sand formation, sec. 77 to sec. 79. We have seen that the yellow sand is the principal member of the series, both over and underlying the green sand, that it is characterised by its uniformity of grain and color, and rising to the surface constitutes the chief and most valuable soil of the region. We farther observe that the green sand stratum is undulating, and varies in its depth, the average thickness being 21 feet, from which we may form a rough estimate of the amount contained in the whole district. It is seven miles long, and nearly six and a third broad, and therefore embraces about 44 square miles. Deducting from this one quarter for the place where it fines out, and for streams, ravines, &c., we have 33 square miles underlaid by green sand. There are then 102,220,800 square yards, which multiplied by seven yards, the average thickness, gives 715,545,600 cubic yards of green sand in Delaware. Supposing then that the one-hundredth part of it is accessible, we have more than seven million cubic yards which may be made available. In a majority of cases, the flowing of water into the pits presents a source of inconvenience that may be remedied without great difficulty, and with a trifling expense compared with the value of the material; but whatever the disadvantages in particular localities, it is within the reach of every individual in the district, and no reasonable doubt can exist that the fertility of St. Georges and the neighboring hundreds will be limited only by the enterprise, industry, and intelligence of the inhabitants.

CHAPTER III.

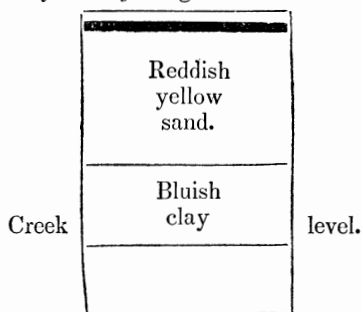
TERTIARY FORMATIONS.

SECTION 1.

Northern Tertiary.

§ 80. ON Old Duck Creek and its branches, about four miles below Smyrna, we find the tertiary formation only recognisable by its characteristic shells in a few localities, the best of which is at Wales' mill-dam, sec. 18. Its features will be clearly seen by the adjoining section. From

below the water-level is a very tenacious bluish clay, containing a little white sand and scales of mica, the greatest observed thickness of which at Cloak's mill was 12 feet. Above it reposes a 6-10 feet bed of reddish yellow sand, passing at times into a similarly colored clay, and its uppermost gravelly layer cemented into a conglomerate by oxide of iron, while the whole is capped by a light-yellow, loamy soil. These strata in



the same order of superposition may be observed at Layton's mill, where Old Duck Creek crosses the State road, at Wales' about one mile W. of it, at Cloak's still farther west, and on several branches of the same stream. At Wales' mill-dam, the blue clay is visible at the water-level, and constitutes the bed of the creek. Its upper surface has been converted into a ferruginous sandstone of moderate coherence, averaging a foot in thickness, and abounding in numerous casts of shells of the same character as those found on Murderkill, and evidently belonging to those characteristic of the tertiary period. Among these we notice a species of *Mastra* probably new, *Balanus*, *Serpula* and *Cardium*, the specific characters of which are difficult of determination; farther *Venus alveata*, *Venus inoceroides*, *Nucula laevis*, and *Myoconcha*, probably the *incurva* lately described by T. Conrad. The *Mastra*, *Venus inoceroides* and *Nucula laevis* are the most abundant. Immediately below the stony crust lies the blue clay, which preserves great uniformity in its mineralogical characters wherever it has been observed. It consists of a bluish clay and white sand in such proportions as to crumble without difficulty, on becoming dry, to a lead gray pulverulent mass; that there is a small amount of pyrites may also be safely inferred from a white efflorescence with a styptic taste, which appears on its surface after exposure to the air, although the clay when freshly obtained gives no traces of copperas. The hardening of the upper layer may be attributed to the decomposition

of pyrites and formation of peroxide of iron which cements the remaining mass. By carefully taking up the blue clay, impressions of the same shells as in the stony crust are observable, and often indeed one half of a large shell-cast is soft and tenacious, while the remainder is converted into stone; from which it is evident that the formation has decomposed *in situ*. Notwithstanding the abundant indications of the former existence of shells in the formation, it now gives no trace of lime, and is therefore worthless as a material for enriching the soil. Passing westward on the same stream, we find few indications of the blue clay until we reach Cloak's mill-dam, below which it is observed under its ordinary features, excepting in the absence of organic remains, but one specimen of a large *Pecten* having been detected. It rises several feet above its level at Wales' mill, and at the head of Cloak's mill-pond on H. Ridgely's land appears to be still higher, whence the conclusion that it rises towards the dividing ridge, like the green sand. A boring to the depth of 10 feet from the top of the stratum at Cloak's mill gave no indication of a change in the nature of the clay at that depth, excepting that it became more arenaceous. As in the lower tertiary on Murderkill we here find chalybeate springs issuing from the blue clay, which, by depositing their oxide of iron, form a ferruginous conglomerate, an instance of which may be seen on W. Nelson's farm about half a mile N. E. of Wales' mill-dam. In the several localities noticed, the overlying formation is a yellowish clay, loam or sand, capped by gravel, and hence the varying nature of the soil in this section of country, according as it is based upon one of these formations. Crossing the dividing ridge in a S. Westerly direction to the head of the Choptank, there is a blue clay found at Smith's mill, rising a few feet above tide-water, differing in no respect from that on Old Duck Creek excepting in the absence of shell-impressions. It is in like manner overlaid by a yellow sand and loam with bands of yellow clay and capped by gravel. The quantity of copperas efflorescing from the blue deposit after exposure to the atmosphere, induced the proprietor to send samples to Baltimore to ascertain whether it could be employed in the manufacture of that salt; the operation would probably not prove advantageous. Now since this blue clay appears to be continuous with that belonging to the tertiary lower down the Choptank, we may suppose it also to be a continuation of that on Old Duck Creek, in which case it would form a belt, falling in with the tertiary shell-marl on Stow Creek in New Jersey, and parallel to the usual N. E. and S. Western bearing of the green sand and other strata.

§ 81. Near that branch of Duck Creek lying immediately south of Smyrna, are found large masses of siliceous rock, which from its extreme hardness and toughness, could scarcely be supposed to have had its birth in this region of soft clays and light sands, had it not been found in place in one locality. So numerous and so large were the blocks on a farm of Messrs. Cloak lying on the State road on the south side of the branch, that it was found necessary to sink them in order to the better cultivation of the land. They consist of coarse sand and gravel cemented by siliceous matter containing frequent casts of shells, and what is still more interesting, the shells themselves are often converted into a pure translucent si-

liceous substance, which may be called flint or more properly chalcedony. Large blocks of the same are to be seen on a farm of Judge Davis, about one mile S. W. of Smyrna, and are so hard and tough that small pieces cannot be broken off without great difficulty. Small fragments are frequently found in the neighborhood, but the rock is not seen in place. Many such hand specimens would remind the geologist of the Buhrstone of Georgia and Florida. About five miles S. W. of Smyrna on the road to Kenton, a small branch crosses the road and empties into Cloak's mill-pond. Rising the hill on the south side of it we again light upon the silicified shells which appear to be in place. Being much more abundant and the mass less coherent, by striking them a little, the greater part of the adhering pebble falls off, leaving a shell wholly composed of silex, excepting its white surface, which may contain a trace of lime, very similar to nodules of flint found in the chalk of Europe. Detached specimens of petrified wood were found in this locality, which closely resemble those already described, sec. 80, and point out the probability of the identity of the two deposits. There is no reason why the large masses above described may not be near their original localities, but the elevation of this bed above tide-water (some 30-40 feet,) countenances the belief that the fragments strewed over the surface of the country for many miles are derived from this or similarly elevated points. It is exceedingly difficult to recognise the siliceous fossils, the most prominent being a *Mastra* similar to that found at Wales' mill, sec. 80, and an *Ostrea*, both of which will probably prove to be new species. The above, secs. 80, 81, are the chief localities of the deposit which have been developed, but there is every probability that others will be discovered, and it will be interesting to know their extent and character, not merely in a scientific but also in a practical point of view, for if they could be found of sufficient extent, they will prove a valuable material for the purposes of construction. Relative to their age it may be remarked that the blue clay appears from its fossil contents to belong to the older pliocene period, and that the siliceous deposit appertains to the same era, resting upon the former. If this last observation prove correct, then the loam, clay and sand in which the silicified shells are imbedded, connects the yellow clay of Appoquinimink hundred, secs. 85, 86, with that occupying a position intermediate between the two belts of Tertiary, and they consequently belong to the same epoch.

§ 82. Examinations made on the other branches of Duck creek and on the head-waters of Chester river led to no useful results relative to the continuation of the tertiary strata, the main deposits being yellowish sands and clays with overlying gravel, similar to those described as resting on the tertiary. It is difficult to say whether they belong to that formation, or are of more recent origin, nor is it matter of sufficient moment to determine. We cannot leave the subject without referring to a local deposit, which gained some reputation for a short time, in consequence of its external resemblance to green sand. It has been found in several of the small branches within a short distance of Layton's mill about three miles S. of Smyrna, and was more particularly examined on the farms of Messrs. Williams and Register. Below the black soil of the branch lies

a 2-4 feet bed of a green, and bluish green sand, very similar in color and size of the grains to some varieties of green marl; but here the resemblance ceases; for by crushing it on a smooth surface, it abrades hard iron, showing its siliceous nature, and by heating it becomes yellowish, and then white, proving the coloring matter to be of vegetable origin. It is therefore nothing more than a white sand colored externally by vegetable matter, for below the influence of the latter, the same sand is colorless, and if applied to land might produce the same effect as earth removed from one field to another.——Although the soils of the northern part of Kent county are very variable, yet we may distinguish three kinds, which are most prevalent, viz: those on the neck-lands of a heavy character, but supposed to be the most fertile in the State; those of the dividing ridge, consisting of very heavy bottoms, not always productive, with occasional light sand hills—and lastly those intermediate between them in position, and occupying a much greater space; they are light loams, easy of culture, and although reduced by excessive tillage, are capable of receiving the highest degree of improvement.

SECTION II.

Southern Tertiary.

§ 83. Crossing the middle section of Kent county, we again find the tertiary formation more fully developed on the confluent streams of Murderkill. There being some confusion relative to the names of the numerous branches of this creek, it may not be amiss to describe them. At the town of Frederica it divides into two parts, the smaller coming from the N. W. on which Bonwill's mill is situated, the main branch again dividing about two miles S. W. of Frederica, at the Fork landing. On the most southerly of the two latter, which comes from the S. W. and is called Brown's branch, is Short's mill; while on the other are located Spring mills, and further W. Jester's mill, its branches being named Fork and Spring branches. The clearest indications of tertiary strata are observable at Spring-mills, where the following occur in a descending order. The uppermost stratum is a loose sand, below which is a ferruginous conglomerate of sands and pebbles, 1-2 feet thick; next a brownish yellow sand, containing a large proportion of oxide of iron, 3 feet, at the bottom of which is a thin layer of gravel; still lower a light gray, somewhat argillaceous sand, partially indurated, and abounding with casts of shells, from which the carbonate of lime has been wholly removed and sometimes replaced by a thin coating of brown oxide of iron, excepting in one instance in which a part of a single shell remained; its thickness from 3 to 6 feet; below it is a stratum of hard iron stone, 1 foot; and the lowest stratum visible is a blue clay similar in every respect to that of the Northern Tertiary, sec. 80, consisting of more or less white sand imbedded in a highly tenacious blue clay, and abounding in impressions of the same shells as

characterise the upper white sand. The hardest shell casts are found in the iron-stone, and among these we recognize a large scolloped shell, probably the *Pecten Madisonius*. A boring made to the depth of 5 feet below tide-water, offered no variation in the nature of the blue stratum. At the upper end of the mill-pond, where Spring branch enters it, the cold spring, a chalybeate of excellent quality, issues from the upper part of the blue clay, in which no traces of shells were found by boring. Above it lies a yellow sand, and the whole is capped by a yellow clay and heavy loam, from which numerous springs pour out large quantities of pure water, and indicate a rise towards the N. of the water-bearing stratum.—At Jester's mill on Fork branch, the blue clay rises a foot or more above the water-level below the dam or 11 feet above tide-water, and as usual, is topped by iron-stone. It contains a few impressions of the shells found at Spring mills. The Northern banks are more sloping, and their deposits more argillaceous than the southern, which at this place attain an elevation of some 30 feet, are steep, and chiefly arenaceous. The following strata in a descending series are observable at Short's mill on Brown's branch: a loose sand, and a thin band of iron-stone subjacent to it; a brownish yellow sand, sufficiently fine and even in grain to make a good moulding sand for bricks, 2–4 feet; a light yellow ochrey clay, from below which issue several springs of pure water. One spring rising still lower is chalybeate, with decided traces of sulphuretted hydrogen, and probably originates in the blue clay, although the latter was not discovered. No traces of the tertiary were detected at Smithers' mill, farther to the S. W. on the same branch, the main deposit at that place being light colored sand, rising steeply to the height of some 30 feet on the southern banks. That branch which empties into the main stream at Frederica, is again divided into two branches a short distance N. W. of the town, one coming in from the N., and the other from the W. by N. An examination on the latter near Bonwill's mill exhibited the following strata in descending from the soil; a yellowish sandy loam, 5–8 feet thick, a light lead colored and yellowish clay, free from sand and compact, but splitting even in its moistened state into small rectangular fragments, 3–4 feet thick; a white and yellow compact argillaceous sand, 5–8 feet. Similar strata are found on this branch for several miles along the steep banks of the southern border, the northern being too sloping to admit of accurate observation.

§ 84. From the data presented in the preceding, we conclude that this belt of Tertiary is about two miles in width; that the lowest accessible stratum is a blue sandy clay which abounds in impressions of shells, and has been decomposed *in situ*; that the stratum above it, a white, slightly argillaceous sand, abounding with the same organic remains, has suffered the same loss of calcareous matter, which renders them both of no value to agriculture; that the upper stratum, a yellow sand and clay resting uniformly on the preceding, and shading into it, belongs to the same formation, and is situated in the same relative position to it, as it is to the northern belt; and that the loose sand with included bands of clay presenting little uniformity relative to the above strata, is probably of more recent origin. The abundance of organic remains and their peculiar cha-

racter prove that these deposits are of the same nature with the shell-marls of N. Jersey and Maryland, but that causes which were not as extensively in operation in those States, have obliterated the calcareous features of the tertiary deposits of Delaware. We farther observe that the numerous chalybeate springs of this region issue from the blue clay, and that the latter deposit, ordinarily impervious to water, must be broken in some localities to admit the passage of water through it, which sometimes flows copiously from below its upper level, as seen at Spring mills, or that the clays and sands about to be described in the fourth section pass under it.—There is a blue clay found at various depths below the surface, between E. and S. E. from Frederica. About $1\frac{1}{2}$ E. by S. from the town, it was observed in digging a well, and by boring at two or three points in the vicinity, the same stratum was struck, its nearest approach to the surface being within 7 feet. It contains an 8 or 10 inch stratum of thin shells, (the ordinary oyster of the creeks,) imbedded in a blue clay distinguishable in none of its external characters from the blue deposit of the tertiary, although it probably does not belong to that period. The same formation has been found about $2\frac{1}{2}$ miles in the same direction from Frederica, about three feet thick, and at the depth of 16 feet from the surface. Offering no superficial indications of its existence, this deposit presents unusual difficulties of investigation, which could not be surmounted in the short space of time allotted to the survey, but those interested in the lands of that vicinity, as well as of the whole tertiary region, should not cease making examinations for shell-marl, wherever opportunities of instituting them without much expense are offered; for although observations have shown the absence of lime in that which certainly was at one time a marl, yet it cannot be safely asserted that the whole of it has undergone a similar decomposition.—From a short distance N. of the tertiary to the lower part of the county we find the soils of the high or ridge land generally light and sandy with occasional clay-bottoms; farther east they are usually light loams, and as we approach the bay become more tenacious, and finally very heavy.

SECTION III.

Yellow Clay Formation of Appoquinimink Hundred.

§ 85. The yellow clay formation lying in Appoquinimink hundred, sec. 29, being of a uniform character, and containing but few points of interest, will not require lengthened description. It was observed sec. 61, that the southernmost deposit of the green sand passes under the clay, from which it is separated by a 6 feet bed of sand-stone; and the same holds good of many other exposures of the sand-stone on the southern banks of the creek to the E. and W. of the State road from Cantwell's Bridge. On the road from Middletown to Blackbird and near the head waters of the Noxentown mill-pond, the overlying yellow clay is distinctly

observable, becoming thicker on the southermost branch. It consists of alternating bluish, white and yellow clays, the latter of which is most abundant, and encloses a large amount of coarse gravel. The beautiful tract of land, to the W. and N. W. of this place, appropriately called the *Levels*, is the dividing line of the waters which flow towards the E. and W., and forms a remarkable exception in its fertility to the usually heavy and less productive soil of the ridge. The soil is a fine loam, and capable of retaining more moisture in consequence of the yellow clay at no great depth below the surface. Indeed the proximity of the latter to the soil combined with the level character of the country may prove an annoyance to farmers from ponds of water formed in the fields which often lie long enough to injure the crops; but it is probable that the difficulty can be overcome by wells, which may reach the yellow sand stratum at a moderate depth below the surface, and may then be filled up with stones and brush. The yellow clay formation contains abundant fragments of petrified wood, belonging to an ancient species of *Pinus*, the only specimens of organic remains hitherto detected in it, one of the best localities of which is on the road from Cantwell's Bridge to Blackbird, about a half to three quarters of a mile from the Bridge, where it is profusely distributed in the gravel and ploughed up in the fields in masses sometimes weighing thirty pounds. From the nature of the clay, we may hazard the conjecture that they have been transported in the state of wood to this place when it was below the surface of the water, imbedded in the fine mud, and have there been converted into stone, the vegetable matter being replaced by silica and alumina. Similar petrifications occur at intervals on the ridge lower down the State.

§ 86. Whether the green sand suddenly disappeared or gradually sank below the yellow clay being viewed as a question of geological interest and practical value, examinations were made on several of the small streams in Appoquinimink hundred, the most minute of which was on the Blackbird, where the main road crosses it. A well was dug on the northern bank to the depth of 15 feet, a boring made 7 feet deeper, in which the following strata appeared, beginning at the surface. 1. Vegetable soil half a foot. 2. White siliceous sand containing much black sand, $3\frac{1}{2}$ feet. 3. Coarse yellow sand containing a few particles of green sand, $3\frac{1}{2}$ feet on the upper, and $6\frac{1}{2}$ feet thick on the lower side, declining towards the creek. 4. The same stratum containing pebbles and green particles $1\frac{1}{2}$ on the upper, and 2 feet on the lower side. 5. White and yellow clays, the former predominating 9 feet on the upper, and $5\frac{1}{4}$ on the lower side. 6. Bluish and greenish blue fat clay, 4 feet thick. The following sections represent the formations:

which lies on the lower part of Thoroughfare neck, where the main body of it is a yellowish clay varying from 10 to 20 feet in depth, below which a blue clay contains shells of the common oyster and clam, and from 1 to 3 feet in thickness. They are too deep, and not sufficiently charged with lime to become useful to the farmer, nor is there a probability of their forming large and continuous beds, as they are of recent origin. In some of the upland branches were observed conglomerated masses of gravel cemented by oxide of iron, which, however rich they may have been prior to the drainage of the land, are now valueless.——The soil of Appoquinimink hundred is of good quality in the western and eastern borders, being rather heavier than a medium soil, but fertile; intermediate between which, it is generally a heavy clay of less fertility. In the lower part of the hundred we meet at times with the lighter loam and sands of Kent county.

SECTION IV.

Intermediate Clays and Sands.

§ 87. Between the Northern and Southern belts of Tertiary, a distance of about 20 miles, are a series of beds of clays and sands, the lowest of which is clay observable on nearly all the streams, varying in its color and texture in the same locality, but generally of a yellowish shade and of medium fatness or richness, and the upper consisting of ferruginous sands and gravel. The planes of deposition observable only in the sands are to the S. and S. E. dipping at an angle of from 10 deg. to 30 deg. to the horizon. At Layton's mill on Old Duck Creek, it is either continuous with the tertiary blue clay or rests upon it; it is somewhat difficult to say which is the case, although the presumption is in favor of the latter conclusion; it has a bluish white color, with streaks of yellow, and is topped by 6–8 feet yellow loam, terminating in gravel at its upper surface. The same order of superposition may be seen on the branches of Little Creek. At Dover the sandy nature of the upper beds and the upper level of the clay are indicated by the numerous springs of excellent water, which issue at the foot of nearly every declivity. On Jones' river E. of the State-house, we find the clay rising a little above the water-level of its prevailing yellow color, with a few white seams occasionally varying its appearance; above which is a reddish gravelly loam about 8–10 feet thick, and still higher a yellowish sandy loam 4–6 feet in thickness. The numerous springs between this part of Jones' river, and Tydbury branch would sufficiently prove a depression in the upper surface of the clay, if other evidence were wanting; but the gradual dip of the bed observable towards Dover from the head streams of Little Creek, and its rise again towards Tydbury branch are conclusive. Its western rise may be also shown by an examination on Isaac's branch. We are, therefore, at no loss to account for the large amount of water

thrown off in springs, which, draining an extensive surface of country, give rise to several branches of limpid water, like Puncheon run. Below the entrance of Tydbury branch into Jones' river, at the Forest landing, the clay and overlying loams can at all times be observed, the former rising some 10 feet above tide-water. The greatest observed thickness of the clay is 15 feet, as ascertained by boring at this point, where a stratum of yellow sand was attained; the latter may, however, be merely a subordinate bed in the clay. Where Isaac's branch is crossed by the lower road to Frederica, we find the clay rising several feet above tide-water, and resting on it a heavy bed of gravel rising some 20 feet. To the ferruginous character of the gravels and sandy loams are due numerous crusts of iron-stone, which have sometimes given rise to a fruitless search after iron ore; for although there is a sufficient amount of ferruginous matter in these formations to constitute good beds of ore, yet their elevated position, causing the rapid drainage of water, prevents the deposition of oxide of iron. The effect of a sluggish flowing of springs through such formations may be observed about one mile N. of Rash's cross-roads on one of the head-streams of Jones' river, where such deposits of bog-ore are found at intervals to the extent of nearly a mile along the branch. Yellow sandy loam composes the adjacent formation, through which the water slowly percolating, dissolves a quantity of oxide of iron, which it again deposits in the form of ore, where it oozes out from the ground, and remains on it for a short time. The aluminous earth resting upon the ore to the thickness of a foot is highly charged with peroxide of iron, and contains numerous small pieces of grain ore. The bed of solid ore below it is from 4-10 inches in thickness; it is brown, glistening with a resinous lustre, compact and tough.——The same tendency to form bog-ore is perceptible on many, indeed on nearly all the branches which take their rise on the level land of the ridge, and prove that formations similar to the above are loamy and ferruginous.

§ 88. As we experienced some difficulty in determining whether the clay is continuous with, or rests upon the tertiary blue clay on Old Duck Creek, so do we meet with the same obstructions in investigating its position where it adjoins the southern tertiary. The general dip of the strata south of the primary rocks towards the S. E. would seem to show that it passes under the lower belt, and this might be farther confirmed by the more numerous issue of springs on the N. side of the streams where this tertiary exists. On the other hand there is a gradual rise of the strata from near Dover southerly to the northern branches of Murderkill, and we have clays and sands resting over the tertiary blue clay, secs. 85-86, on other branches of the same stream, similar in every respect to those just described. The most probable conclusion is that the clay of Appoquinimink hundred is continuous with the intermediate clays of Kent, and that the latter pass under the southern tertiary belt. From the similarity of soils throughout a great part of Kent county in the same relative situation, we may readily class them as was done with those of New Castle county. With the exception of the marshes bordering on the bay, all that low land known as the neck-lands is of a heavy argillaceous character and remarkably fertile, a character which some of them still retain, not-

withstanding the excessive tillage to which they have been subjected for nearly a century. As we rise the country to the westward and meet the tertiary deposites, the soil becomes more loamy, corresponding with the subjacent deposites, and as these become covered by loose sand towards the ridge, the surface necessarily partakes of the same character. Proceeding from N. to S. through this middle section, the amount of loose sand increases in depth and breadth, so that much of the land in the lower part of the county has a loose sandy soil. On the ridge we find the same alternations of light sand hills and heavy clay bottoms, which was noticed in New Castle county, but which in Kent are more strongly contrasted; in addition to these however, there is a vegetable soil too remarkable to be passed over by a simple notice, a rich, deep and black vegetable mould situated on the marsh lands of the west, which will be particularly described in Pt. III, sec. 151.

CHAPTER IV.

RECENT FORMATIONS.

SECTION I.

Lower Clays.

§ 89. From the lower limit of the Southern Tertiary, that is from Murderkill and its branches, to the extreme southern border of the State, embracing part of Kent and the whole of Sussex counties, are a series of deposites of clay and sand, to which we can assign no date excepting in a few instances, in consequence of the absence of organic remains, and the impossibility of drawing any conclusions relative to their age from their mineral characters. Thus the lower tertiary blue clay on Murderkill could not be distinguished from a similar clay on the shores of the bay, which is quite recent in its origin, except by comparing the ordinary bay-shells in the latter with tertiary shells in the former. In the few cases where shell-beds have been found there are no indications of tertiary fossils, the shells being referrible only to the same genera and species which now inhabit the waters of the bay. We may therefore view the whole country alluded to as of recent origin (after-tertiary,) until future investigations may show the incorrectness of the position. The lowest formation visible and the deposites along the shores of the Delaware are usually tough clays, the superficial strata light sands or loams. On Mispillion Creek in the vicinity of Milford and to the west of it, the uppermost stratum is a loose sand with an occasional argillaceous bed, below which is a heavy bed of

clay extending below the water level. It is more or less ferruginous in its upper part, lower down white and lead-colored, extending many feet below tide-water. Its texture is that of a very plastic, fat clay, and free from grit, but whether it could be adapted to the manufacture of earthenware, to which its external characters give it some claim, can only be determined by subjecting it to the action of a strong fire. On Mill branch, about a mile S. E. of Milford, and near P. F. Causey's mill, the uppermost stratum is a loose yellowish sand, resting on a clayey loam, which is underlaid by and interstratified with a white clay, and the lower part of the latter has a lead color to the water-line; below this again is a fat yellow loam, reposing on white sand. The whole thickness of the loam and clay is about 15 feet. On Cedar Creek the clay lies at a much lower elevation, while the superimposed sand is of considerable thickness. From the springs which issue copiously near Milford, we might conclude that the formation rises towards the south, a supposition which is confirmed by as many observations as the nature of the unbroken surface of the country admits. There are occasional deposits of gravel above the clays, which appear to belong to the same formations rather than to the superficial sands, for the loam constituting the upper member of the argillaceous deposits graduates into the gravel, while there is a marked line between the latter and the overlying sand. From the abundant superficial loose sand, the soil of the region under notice derives its character; but where this has been partially removed, we have basins with a substratum of clay, which being impervious to water, constitutes ponds that are sometimes a convenience, but oftener an annoyance to the farmer.

§ 90. The clay beds are again visible on Prime-Hook creek, where they have usually a yellowish color, but at Ponder's mill it becomes nearly white, is very plastic and contains but a small amount of arenaceous matter. At Milton, the clay rises to the height of some 40 feet above tide-water, and from its undulating surface often appears through the superficial sand. It is of a light yellowish color, very compact, lies in horizontal undulating strata, interrupted occasionally by beds of sand, and breaks into small angular pieces resembling slates. On the S. side of the stream, there are wells over 40 feet in depth passing through clay nearly to their full depth; others are excavated only to thin seams of sand in which the supply of water is less abundant than in the lower stratum, from which it would appear that the argillaceous deposit is extensive. To the W. and E. of Milton, the same stratum may be traced by exposures on the creek and its feeders, generally offering the same features as at the town, excepting that lower down Broad Creek it becomes more ferruginous; for on a farm belonging to P. S. Parker, a short distance E. of Milton, bricks of good quality are made from the same formation. The surface-coating of sand communicates its own light character to the soil of this section, excepting in a few instances where the clay being uncovered constitutes a heavy bottom. Proceeding in a S. Western course from Milton to Lewistown, we find the same beds of clay presenting themselves on Cool Spring and several small streams, offering the same features as have been already described, the yellowish and light-colored clays every where predominating. Numerous and large springs indicate a rise in the

clay stratum towards the N. and W. One of these on Black Oak Gut has been deservedly held in high estimation from its size, coldness, clearness, and delightful taste, but its medicinal virtues have been probably overrated. The numerous springs issuing out of the banks of Lewes Creek from the upper surface of the clay prove that the formation rises towards the west, but it is not of great thickness, scarcely exceeding six feet, below which is a stratum of sand. There are a few large springs, however, which evidently rising from below this sand, prove the existence of another and deeper layer of clay, and that it also rises towards the west. Thus it appears that what was remarked of the secondary and tertiary formations relative to the rise of strata towards the west, holds good of the recent deposits, and farther that like them the latter are independent of the general rise of the surface of the land.

§ 91. The same clay which is to be seen in many places below Lewes, crops out in the beach about 3 miles S. of Cape Henlopen, where it is uncovered by the gradual encroachment of the ocean on the looser loams and sands resting upon it. The upper portion is yellow, the lower lead-colored, very plastic, and of a superior quality. We farther observe the deposit in question skirting the higher banks of Rehoboth bay, under the same features as before. It is also met with on the streams which flow into Indian river, and is more clearly developed on those, which constitute the head of that stream. It is visible near Dagsborough, and to the S. and S. W. of the town, but in all these localities the yellow clay appears to predominate. About two miles N. of Dagsborough, a deposit of recent shells has been opened, which are contained in a blue clay below a yellowish argillaceous stratum, constituting the soil. The shells are in a shattered condition, and being intimately mingled with the clay, will prove serviceable to poor and sandy soils. An average specimen pulverised, yielded upon analysis:

Carbonate of lime,	-	-	-	23.65
Siliceous sand,	-	-	-	48.00
Clay,	-	-	-	28.00
				<hr/>
				99.65

The upper surface of the bed lies some 15 feet above tide-water, being several feet below the soil, is about 8 feet in thickness, including layers of clay destitute of shells, and is probably several acres in extent. Two other deposits in every respect similar to the foregoing excepting in extent have been partially investigated in Baltimore hundred, on the lands of Johnson and E. Walters, and there can be little doubt that many more will eventually be discovered. The *Ostrea virginiana* constitutes the main part of the organic contents of these beds, beside which we have *Venus mercenaria*, and occasional fragments of the *Fulgar canaliculata*. The argillaceous deposit resting upon the shell-beds appears to be of a different nature from that which we term the Lower clays, and to be the same as that which constitutes the heavy soil of the neck lands through-

out the greater portion of the State, so that it is difficult to determine whether the blue clays and shells belong to the lower clays or are mere nests on their surface, as seems to be the case on the Nanticoke. The beds appear to lie in depressions on or near the sources of streams; and it is more likely that these have followed such natural courses in which they have subsequently worn their present channels, than that they were small streams in which the shells were originally deposited. It is from such deposits and their accompanying circumstances that we deduce conclusions relative to the gradual emergence of our coast from the ocean. Over the greater part of the surface we have passed from below Lewes to the southern border of the State on the S. and nearly to the dividing ridge on the W. the soil is a light sand, excepting where the lower clays are exposed, when we may have the extremes of light and heavy and in the same field; and excepting on the necks, where the river-deposit forms a heavy soil of good quality.

§ 92. Although we do not find many traces of the lower clay on the heads of Cypress swamp, yet there is every probability that it underlies the whole country between Indian river and the Nanticoke, constituting the basis of the swamp, for we observe it well developed in the vicinity of Laurel, closely resembling that on Indian river, and it may be seen on nearly all the branches of the Nanticoke river rising from 5 to 20 feet above tide-water, composed of yellow and lead-colored clays. Under the town of Laurel, it is observable in the steep banks of the creek consisting of yellowish clays of an arenaceous character, alternating with thin seams of sand reaching nearly to the soil, and were it not for the covering of loose sand it might be seen in nearly every ravine. Indeed it is in consequence of the ease with which the sand is transported by the wind, that so few exposures of the strata offer themselves to our examination, and that the investigations cannot always be relied on for perfect accuracy. We are not, however, destitute of sufficient data on which to base satisfactory views of the region, which is peculiar to itself, and different from the remainder of the county. A considerable quantity of iron-ore has been removed from Little Creek about two miles S. of Laurel, where it is still wrought; the hard, and loam ores are chiefly obtained, and together with a medium ore are converted into wrought iron of good quality at Chipman's Forge, situated on Broad Creek, about two miles E. by S. from Laurel.

§ 93. Between one and two miles S. W. of the same town is a series of small beds or rather nests of shells, chiefly the *Ostrea virginiana*, imbedded in a yellow clayey loam, the nests being generally 2-4 feet broad, and 1 to 2 feet deep. In a majority of cases the shells are whole, both valves being present, but are so friable as to crumble readily to a coarse powder after exposure to the air or on being excavated by the spade. The S. Eastern banks of the Nanticoke between Seaford and Concord, exhibit similar shell-deposits more clearly in their position relative to the other formation. From the water-line to the height of 5 to 15 feet is a nearly vertical section of a blue clay, very tough and impervious to water, and containing a small quantity of arenaceous matter; above which are some 5 to 10 feet of yellow loam or clay, graduating into the soil. The

shells lie in clusters or nests, as in the preceding case, between the blue and yellow clays, being evidently contained in the latter, but forming at the same time excavations in the blue; for they are always coated with the yellow loam, and never with the latter. The upper line of the blue is level excepting where the shells occur, and then it is excavated as if for their reception. The dimensions of the nests vary, containing from a peck to many bushels, and they are met with at short intervals for the distance of several hundred yards along the stream. Under the town of Seaford, we have an opportunity of examining the formation overlying the blue clay. It consists of a series of clays with yellow and white colors, containing very different proportions of arenaceous matter and occasional seams of sand, with intervening crusts of iron-stone, the whole rising from 15 to 20 feet to the sandy soil, but no traces of shells were found either at this place or nearer Concord; nor are there indications of them lower down the river, until we reach Cannon's ferry, where they were formerly met with in digging wells, but were again sought for by boring without success. They occur, however, a short distance below the ferry on the land of John Goslin, imbedded in a yellow sandy loam, similar to the beds above Seaford, and still lower down near the State line on the land of the Messrs. Wright. At the last mentioned place the shells are generally whole, the two valves enclosing a yellow, very sandy loam, the same in which the deposits are enveloped. The amount of shells appears to be greater than usual, and if more extensive deposits could be found, their crumbling nature would render them useful for application to the soil. The same formation occurs on the N. W. Fork, and apparently under similar circumstances, but as it lay without the limits of the State, it was not farther investigated. There are few localities in N. W. Fork hundred, where the lower clays are seen, excepting on branches of the Nanticoke, and these presenting no novel features, it is unnecessary to describe them. Of a more interesting nature are the overlying sands to which we shall presently proceed. Reviewing the localities above described, it appears to be a deposit of modern shells imbedded in the same earth in which they lived when it was a soft loamy bottom, (otherwise we should sometimes find the shells detached and fragmentary;—that it is in the lower stratum of the lower clays, and rests upon an older blue clay—that the different deposits at distances of 15 miles apart are of the same geological age, as proved by the constant uniformity of circumstances under which they occur—and that they are not extensive, as shown by the smallness of the nests, wherever found, and their absence in nearly every place where the same clay exists. The age of the underlying blue clay is a problem of difficult solution; but it would appear to be connected with a similar clay on the N. W. Fork river, which probably belongs to the tertiary. The few data, however, which the formation offers in Delaware, cannot be considered a sufficient basis on which to ground positive assertions, nor is it of practical moment to determine the point, until it is found to contain beds of good calcareous marl.

§ 94. There are a few other localities of the lower yellow clays on the various branches of the Nanticoke, in N. W. Fork hundred, but their features are so similar to those which have been given that it would be

mere repetition to describe them. The soil in the S. Western part of the State exhibits the same extremes as in the S. E., according as it is formed by the lower clays or overlying loose sands. In N. W. Fork hundred, there is one section of country remarkable for the good quality of its soil, which may be designated as a medium loam; although it does not form a large district by its continuity, yet since many smaller patches of the same quality of land exist in that hundred, the amount of surface covered by a good loam places it as an agricultural district in the first rank among the lower hundreds of the State.

SECTION II.

Upper Sands.

§ 95. To the traveller, who for the first time passes through Sussex county, the formations would undoubtedly appear to consist almost wholly of loose white and yellow sands, but a more thorough investigation shows the fallacy of such a conclusion, proves that in reference to geological deposits, the argillaceous greatly predominates over the sandy, forming the substratum of the whole county, but that the latter overlying and capping the clays over a large proportion of the surface, communicates the well-known sandy character to the soil. These upper sands probably cover one-half or two-thirds of the county, are of very variable thickness, sometimes yellowish and more tenacious, at others nearly white, and so loose, as to be readily transported by the winds. We have had occasion to notice them casually, while describing the lower clays, from Milford through the eastern and southwestern portions of the county. Along the eastern border they are generally of inconsiderable thickness, from six inches to several feet, and the lower clays may often be thrown up by the plough. Towards the S. E., the sand is unusually white, and may probably be found of sufficient purity for the manufacture of glass. If this formation be examined in the vicinity of the coast, its very undulating surface must strike the observer. A surface we would suppose to be more level from its position, we there find to consist of a series of hillocks apparently following no law relative to form, size, or situation, consisting wholly of light sand sometimes bare, but generally covered with herbage. The sand is so slightly coherent that often, where the sod has been removed in an exposed situation, the action of the wind roots it out to the depth of several feet, distributing it over the surrounding soil or heaping it against a bush, fence or other obstruction. The formation of *dunes* along the coast at Cape Henlopen is due to the same cause. As the fine sand thrown up by the waves of the ocean becomes dried, it is raised by the wind, and deposited on the sides of the present dunes, which were first formed by its lodging on the outer edge of a pine-forest. They stretch along the shore for some distance, enclosing one of the Light-houses, and imburying many of the trees, some of which were about 40 feet in height, and yet their tops only appear on the dunes like small

bushes. These dunes are evidently of very recent origin, and still in the act of forming, as is proved by the moderate age of the trees, and the want of herbage on their surface. The whole forest against which they have lodged appears from the very undulating surface of the ground, to have sprung out of the remains of more ancient dunes. Similar appearances are observable near the coast in Baltimore hundred, and may be traced for several miles inland, until the undulating surface gradually becomes more even, and forms the ordinary superficial stratum of light sand.

§ 96. That the superficial stratum of sand is due to the destruction of sand dunes is more clearly seen in the western portion of the county, where the arenaceous stratum is much heavier, often attaining the thickness of 20-30 feet, and many of the ridges of loose sand are nothing more than dunes which have resisted the destroying influence of the wind, and may be traced from the lower hundreds to the sources of the Nanticoke in the southern part of Kent county. Indeed, in whatever direction we approach the Nanticoke from its source to the point of its crossing the State line, a range of sand hills strike the observer from their frequency—often from their continuity, their steepness, and the lightness of the sand composing them, circumstances which would at once induce him to refer them to the same origin as dunes. The sand is of so loose a nature, that where the sod is removed, it is very liable to removal by the wind, to the great annoyance of agriculturists. While alluding to the forest lands of the upper counties, we have incidentally noticed the existence of sand hills, which increasing in number and extent as we approach Sussex, and gradually passing into the sand dunes, must be attributed to the same origin. But although we meet with the sand in great abundance in the form of detached and connected hills, the greater portion of it constitutes a nearly level covering to the subjacent clays, varying in thickness from 1 to 20 feet, and covering a large amount of surface in the southwestern part of the county. In N. W. Fork hundred, the greater part of it is in the form of hills, and there is a comparatively small amount on the dividing ridge, where the soil is usually more or less argillaceous. This formation of light sand should not be confounded with several ranges of gravel hills in the county, which have a totally distinct character, although they are partially covered with the sand. The most striking of these ranges is one lying to the south of Milton, and between Georgetown and Lewes. It is a ridge of variable breadth, not more than 50 feet in height, extending for several miles apparently in a N. W. and S. E. direction, composed of fine gravel and sand with a sufficient admixture of clay to render it compact. Its isolated situation in a region composed of such different materials has attracted the notice of the inhabitants, and given rise to a variety of conjectures relative to its origin. It is undoubtedly to be referred to the same causes, formerly in action when the land was beneath the water, which are now operating in the bay to form shoals and bars, and which, if the whole bottom of the bay were elevated, would present the similar elevations composed of sand and gravel.

§ 97. Reviewing what has been said relative to the sand in the two preceding secs. 95, 96, we find that it is a stratum covering one-half or

two-thirds of the county of Sussex, and extending partly into Kent, composed of a light colored sand of a fine and even grain, containing scarcely a trace of argillaceous matter, excepting on its surface, and so loosely deposited as to be liable to shifting from the action of the wind, that the greater part is distributed as a loose covering over the surface, from 1 to 30 feet, but probably averaging 5 feet in thickness;—that it is frequently drifted into the form of hills, closely resembling the sand dunes still forming on the coast near Cape Henlopen, and may be referred to the same origin.

§ 98. The ores of iron found in various parts of Sussex in considerable quantity and particularly on the dividing ridge, claim attention as having yielded, and still introducing some revenue into the State. The most remarkable are those situated a few miles N. W. of Georgetown, near the sources of several streams flowing westerly, which being on elevated and level land, spread themselves in broad and shallow basins covered with a stratum of black, argillaceous mould. The ore found below this black soil is of various kinds, hard or solid, gravelly and loam ore. The hard variety which exists in great abundance, forms a solid substratum to the mould from 6 to 18 inches or more in thickness; it is hard, moderately tough, of a rich brown color, and resinous lustre, with an uneven, conchoidal fracture; sometimes compact, oftener cellular in structure, composed essentially of peroxide of iron and water. An analysis of this variety of ore from the Clowes bed, performed by E. Mayer, yielded:

Peroxide of iron,	-	-	80
Water,	-	-	15
Silica,	-	-	5
Alumina,	-	-	a trace
			<hr/>
			100

which may be viewed as the average composition of the same kind found in other localities. The amount of metallic iron in the above is $55\frac{1}{2}$ per cent., but when subjected to roasting, the remaining ore will yield nearly 66 per cent. The gravelly ore consists of irregular masses of a similar ore of the size of a nut and smaller, disseminated in a yellow ferruginous loam, but containing rather more argillaceous matter, is softer and more readily worked. The loam-ore, which is still softer than the preceding, is a yellow ochre or clay highly charged with hydrated peroxide of iron. For working in the furnace the several kinds are mingled together, which not only facilitates the reduction and fluxing, but results in the production of a better quality of iron. Various names have been given to the ores in Sussex, more dependent on differences in their external form and other characters, than on chemical composition; thus the honey-comb ore varies only in its extreme cellular structure. There is probably another point of difference, which is not discerned in the external characters of the ore, and first renders itself perceptible in the metal; it is that matter which forms a cold short metal and in all probability is a compound of phos-

phorus or arsenic, but analysis has not hitherto detected their presence in the ore. The hard or solid variety is very apt to produce such a metal, but by mixing with the softer kinds, the result is a good malleable iron when worked in a forge.

§ 99. Collins' ore bed, the lowest on one of these streams, called the Green-meadow branch of Deep Creek, consists chiefly of a solid loam ore, which is principally wrought at Collins' forge of a hard compact ore, very rich in iron, but said to yield a cold short metal, and of a small quantity of sandy ore. There are many other deposits of ore in various parts of Sussex, such as that on Green branch about 10 miles W. of Millsborough, the best of which is in balls or nodules and yields good metal—that on Burton's branch one mile W. of the same town, making a cold short iron—that on Little Creek near Laurel, sec. 92, and others in which the characters are referrible to those given above. There are numberless localities in which smaller deposits of iron have been made, and are yet being formed from the visible action of springs, such chalybeate waters being every where abundant, some of them of excellent quality, and scarcely a mill-pond can be examined, but gives traces of such a ferruginous water recognisable by its yellowish and reddish yellow deposit. These appearances are however, far from being evidences of beds of ore, as is frequently conjectured, and merely indicate the presence of a considerable quantity of iron in the formations whence the water flows. Under favorable circumstances, they might generate ore beds, but being so situated that the water flows off freely, of course the greater part of the oxide of iron is carried away by the stream. Adjoining the town of Dagsborough on a meadow belonging to W. D. Waples, good evidence is presented to us that these deposits arise from ferruginous springs, for such chalybeates are still in action, and the effects of others are visible in small mounds of ore, through which the springs originally flowed. The process of deposition was more particularly described in the latter part of sec. 87. If we examine the formation adjacent to the ore beds, we shall generally find it to consist of a yellow ferruginous loam, both sandy and clayey, giving visible evidence of a considerable amount of peroxide of iron, but the quantity being apparently insufficient to account for the size of some of the beds, we must suppose that the springs flow from a greater distance, or that the formation has been more heavily charged, and is now partially exhausted. The raising of ore in quantity was commenced about 1814, since which time, nearly 200,000 tons have been raised, about 190,000 of which were exported, introducing not less than 600,000 dollars of capital into the State.

SECTION III.

River Deposites.

§ 100. The Delaware has been for ages engaged in transporting gravel, sand and clay from the Northward, by means of which the sand-banks

and shoals of the bay have been raised, and the heavy soils on the neck-lands deposited. A large number of the shoals are in all probability remnants of the land which once united Delaware and New Jersey prior to the wearing away of its channel by the river, but they have undoubtedly been increased, and many of them entirely formed by the detritus brought down by the river. A boring made on the island on which Fort Delaware is situated, proves it to have been wholly formed by the river deposit; for the formations on either side of the river are red and white clays, and green and yellow sands, whereas in the boring they passed through river-sand with occasional beds of blue mud for the depth of 100 feet and more. Farther confirmation of deposition is given by the increase of some of the banks, as for example, the point separating the mouth of Lewes creek from the main land, which promises to unite it with Broad creek at no distant period of time. Although a portion of these deposits lower down the bay are due to the tributary streams of the Delaware from the above tide-water, yet a large proportion is more immediately derived from the destroying effects of waves during spring tides on the shores of the bay.

§ 101. As interesting as the more minute investigation of the deposition of sand and gravel might be in a geological light, yet the deposition of argillaceous matter, is of greater practical importance. It is generally known by the name of *blue mud* along the Delaware shores, from its peculiar lead-colored hue when in a partially dried state. When land which is ordinarily under water is embanked, and afterwards thrown open to the influx and efflux of the tide, this argillaceous deposit gradually accumulates on the surface of the marsh, forming a solid stratum, when the embankment is renovated, that is remarkable for its fertility. On Bottle neck on the northern side of Duck creek, S. Spearman was engaged in 1837, in reclaiming a portion of meadow land by embanking it, when the deposit of blue mud was observed to be from 6 to 18 inches in thickness, formed in the lapse of 15 to 20 years, previous to which, the same tract had been enclosed. The old top was found under the blue mud in a decomposed state and mingled with earthy matter, below which the same black mould abounding in vegetable matter lay to the depth of several feet, sometimes containing much vegetable fibre or being wholly composed of it, at others being entirely deficient in the same. The whole was based upon a white sand.—The same observations will apply to a majority of the marshes, with the exception of the thicknesses given, for it is probable that the depth of the black mud sometimes attains nearly 50 feet, as at the confluence of the St. Georges and Dragon creeks. In all of them we find the black mud below crowned by the blue, where the latter exists. A close examination of them from the mouths of the creeks inland leads to the conclusion that the blue is wholly produced by the river, and that the black is the result of the combined action of the river and creeks, and a luxuriant vegetation.

§ 102. It has been a frequent subject of remark that the soil of the neck-lands, or those tracts bordering on the Delaware from New Castle to Sussex are always argillaceous, secs. 69, 81, 84, 86, 88. The St. Georges, Augustine, and other marshes reclaimed from the river, belong rather to those described in the preceding, § 101, but also offer an expla-

nation of the origin of the neck-soils, for having been laid dry for a length of time, we may compare the nature of the marsh-soil with that of the adjacent upland. They appear to be identically the same, or if different, the variation is only such as might be anticipated from the action of time with its accompanying and altering effects. On the neck between Silver run and Augustine creek there is a lead-colored and yellow clay with occasional beds of gravel, the yellowish variety constituting the soil, but by proceeding southwardly, the gravel is less frequently observed, and the same argillaceous soil is characteristic of the necks, modified in color by its content of decomposed vegetable matter. The yellow clay was mentioned as occurring on Thoroughfare neck to the depth of 20 feet, sec. 81, and that beds of bay-shells were found in it. It is also of considerable thickness on Little Creek and Jones' necks. The shells found in a blue clay, S. E. of Frederica, sec. 84, seem to place it in the same class, as the argillaceous strata lying above it, which is of the usual nature of neck lands. On the bay-shore in Sussex, the same formation meets our observation, but less frequently in consequence of the abundance of loose Upper sand, and even on the coast in Baltimore hundred, the soil is of a similar nature, excepting that the blue clay is rather more abundant. It appears, therefore, to be a uniform deposit of argillaceous matter lying upon or within a short distance of the river and bay, indiscriminately covering older geological formations, such as the Upper secondary, Tertiary, and the more recent strata of Sussex; and from its similarity to the present deposits of the river under like circumstances to have resulted in like manner from the matter brought down by the river when it had a relatively higher water-level. The fertility of these neck-lands is proverbial, and shows another point of resemblance to the blue-mud now depositing by the Delaware, sec. 101; among them may be mentioned Raymond's neck, supposed by many to contain the best land in the State—Little Creek, studded with excellent farms—Prime Hook and Slaughter necks, remarkable for the superior quality of their soils, although much exhausted by excessive tillage. It is highly probable that the noblest forest in the State exists on Prime Hook neck, consisting of Tulip-poplar, black walnut and black oak, remarkable for their enormous size and flourishing condition. Those enumerated are but a few of the fertile lands fringing the Delaware, which are deservedly held in the highest estimation. In conclusion, it appears that the river has been largely depositing gravel, sands and clays throughout a lengthened period of time, and that its operations are still in activity with the production of useful results.

PART III.

ECONOMICAL GEOLOGY.

CHAPTER I.

AGRICULTURE.

SECTION 1

On Soils.

§ 103. Soils are under all circumstances difficult of classification, in consequence of the variety of mineral and organic substances composing them, as well as of their different states of disintegration, and although many have attempted a scientific arrangement with partial success, yet until such systems attain greater perfection we may content ourselves in the present work with a nomenclature commonly received among the farmers of Delaware, applying the term *sandy* or arenaceous to many of the soils of Sussex and Kent; *clayey* or argillaceous to those in N. Castle county N. of the canal, to those on the ridge and neck lands; *loam* to a medium soil or proper mixture of clay and sand, such as the middle portions of St. Georges hundred, and many in Kent and Sussex; and a *vegetable mould* to such as contain a large proportion of decomposed vegetable matter, like Marshy Hope, Tappahanna and other marsh-lands. The substances constituting soils are silica, alumina, oxide of iron, lime, magnesia, alkaline, earthy or a few metallic salts, and animal and vegetable matter in various stages of decomposition. On the proportion in which these are combined together, and on their fineness depends fertility. Thus a soil consisting in a large proportion of gravel must be sterile, and even 90–95 per cent. of siliceous sand cannot be productive; nor can it be more profitable, on the other hand, where the matter is almost wholly a finely divided clay: there is, therefore, a medium between these extremes which is requisite for fertility. Again, supposing the materials to be in a due state of fineness, their relative proportions are of the highest importance, for plants will not grow thriftily in any one of the above-named substances, and it is found that the most fertile soils contain a majority of

them. Of these silica is the most abundant and may be viewed as the basis of all, and with alumina and oxide of iron, acting with reference to the other substances, as nitrogen to oxygen in the atmosphere, moderating and equalising their action. These then, in a state of fine division, give coherence to the soil, particularly where alumina is present, and the same effect is produced by decomposed organic matter. Gravels are commonly termed *hungry* from the quantity of manure required to render them productive, the reason of which will be evident from a knowledge of the fact that chemical action takes place more readily when substances are in the finest comminuted state, and hence little or no combination taking place on the surface of gravel, the richest portions of the manure are liable to destruction from atmospheric agents, or to be carried away by water previous to the action of plants upon them. The same reasoning will apply to pure sands, although in a diminished ratio. Again, where the quantity of fine matter is very great, the manure will be held a greater length of time, and in this case there is another difficulty, which is chiefly mechanical in its nature, where the alluminous or argillaceous earth is in such quantity as to constitute a fat clay; it is then more difficult to work, bakes hard in the sun, does not absorb a sufficient amount of moisture from the atmosphere, and parts with it with difficulty. To correct the stiffness of clays, such as occur in the Upper hundreds of New Castle, north of the canal and in Appoquinimink, in some portions of Sussex, and on the neck-lands of all three counties, it is only necessary to add sand or better a sandy soil; while the lighter sands of Sussex and portions of Kent will be greatly benefitted by the application of clay or a heavy soil.

§ 104. The advantages of a good medium soil are not only the greater facility of working and increased power of retaining manure, but also the greater power of absorbing moisture from the atmosphere. The utility and absolute necessity of water for prompting the growth of plants is too generally acknowledged to require further notice, but the manner of its operation is not generally understood. It is in fact the medium of chemical action in vegetable organisation; for the food, whether mineral or organic, is not taken up by them in a solid state, but by solution in water; and hence the power of absorbing and retaining moisture in soils is a matter of great moment, essentially connected with their fertility. The more finely divided the constituents of the soil are, the greater its absorbent power, the same substances being present, but it is found that different materials possess it in differing relations; for stiff clays and loose sands absorb far less than a medium soil composed of a mixture of the two, and an ordinary loam less than one containing organic matter. Absorption takes place in the night, and when succeeded by a hot sun, the moisture is readily evaporated from a sandy soil, much less so from loam; but the action of the sun on clay is such as to render its surface compact, so that its porosity being diminished its absorbent power is decreased.

§ 105. It has been often observed that white clay soils are much less productive than the yellow, and the former are termed *cold, unkindly*, an observation that deserves some notice, as it is true and can be satisfactorily accounted for. The theory of the absorption and radiation of heat might be brought to bear upon it, but it is more to our purpose to view the

subject practically. It has been observed that dark colored soils will absorb more heat from the sun than those of a lighter color: and hence one abounding in decomposed vegetable matter possesses this power in a high degree, and a yellow clayey bottom containing oxide of iron excels one composed chiefly of white clay: farther, the presence of ferruginous matter renders a clay less cohesive, more porous, and consequently more capable of receiving and retaining moisture. We may therefore attribute the different productive powers of white and yellow clay soils in a measure to their relative capabilities of receiving both heat and moisture, for there can be no doubt that the heat of the vernal sun tends to accelerate vegetation when the season is usually more moist, while the dry sun of summer evaporates the moisture of very stiff land, and by rendering it more compact diminishes its faculty of re-absorption. We see in these circumstances in part the cause of the fertility of the upper hundreds of New Castle county, of St. Georges hundred, of the neck lands, particularly in Kent and Sussex, and a portion of North West Fork, in all which the soil is decidedly clayey but is relieved by the presence of oxide of iron and organic matter. In parts of Red Lion, in Pencader, and frequently on the ridge throughout the State, we find a white clayey soil, not remarkable for its fertility, but it is fortunate for those holding such cold soils that either sands or loams are to be found in the vicinity, by which their sterility may be ameliorated. Another cause of the greater productive power of yellow clayey soils will be pointed out in sec. 115.

§ 106. The necessity of finely divided matter to fertility was long since discovered, and so striking was the result which the earlier experimenters obtained, that they believed it to be the chief or sole cause of fertility, an error which may readily be excused when we examine the mode of its operation and its vital importance. Now the constituents of plants are organic and mineral matter, the latter of which obtained in the form of ashes consists chiefly of alkaline and earthy salts, and it is remarkable that most plants contain very small quantities of oxide of iron and silica and scarcely a trace of alumina, a circumstance giving strength to our position, sec. 103, that they serve as a basis for the action of other inorganic and for organic compounds. But since chemical effects or the vital action of plants take place only on the surface, and since the more minute the division, the greater the extent of surface, then, when the latter condition is fulfilled in a high degree, the alkaline, earthy and organic matters forming the requisite food of vegetable organisation will be more comminuted and mingled with the soil, and a greater amount of chemical action ensuing, the more luxuriant will be the vegetation. Let not the conclusion be drawn from this that the fattest clays, composed of exceedingly fine matter, comprise all these conditions, for independently of the mechanical difficulties which such soils present, their chemical constitution is a strong hindrance to their fertility. They contain silica, alumina, and a little oxide of iron, not one of which is received in quantity by wood, and the silica only exists in abundance in grasses, grain and other plants—whereas we require potassa, lime, magnesia, manganese, and the phosphoric, sulphuric and muriatic acids, all of which are found in the ashes of plants, and the two first named in considerable quantity. The