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Dr. M. M. Smith
LETTERS

OF

PROFESSOR R. T. BRUMBY,

EXAMINER IN BOTANY

ON THE IMPORTANCE OF A

GEOLOGICAL SURVEY

OF

ALABAMA.

PUBLISHED IN THE "STATE JOURNAL & FLAG," IN NOVEMBER AND
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PREFATORY REMARKS.

By request of Mr. WM. H. FOWLER, the publisher, the Author of these letters revised them, and made such slight alterations, as were thought necessary to adapt them to publication in pamphlet form.

As they were originally published in a political newspaper, they were necessarily so condensed, that some parts of the subject were simply stated, without elucidation, while others were wholly omitted. Hence, though desirable, it was impossible to give them a more popular character. An elegant writer remarks justly, "where can be no geology for beginners;" because the science presupposes some knowledge of the abstract principles of most of the physical sciences; and it is certainly true that no branch of geology can, without numerous detailed explanations, be made intelligible to uneducated persons. The author's design was, therefore, to present a concise view of the subject to intelligent, educated individuals, especially to the members of the General Assembly, hoping, through them, to convince the people, that the prosperity of the State would be materially promoted, by a thorough scientific survey of her territory.

Should these letters be the means of eliciting inquiry on the subject, the author's object would be accomplished.

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THE
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LETTERS.

No. 1.

To the Editor of the State Journal and Flag.—

SIR—Permit me, through your columns, to invite public attention to the importance of an immediate geological survey of the State.

And, to remove all suspicion of personal interest, let me avow my determination, neither to seek nor to accept any appointment, in the contemplated survey, should it receive legislative sanction.

The principal appointments should be given to older, more learned, and more experienced geologists, who have labored several years in the service of other states, and in learning the minutest details of such investigations. The services of such men can now be procured; for most of the state surveys have been completed.

It is said the present is an unpropitious period; that the late Presidential census diverted all minds of politicians especially, from questions of State policy, to the discussion of the respective claims of the rival candidates, and in the invention of means of strengthening party machinery; and that the indebtedness of the State renders an economical disbursement of a revenue, raised by direct taxation, so obviously proper, as to preclude the hope of procuring, at this time, even a small appropriation for any object, except the payment of the necessary expenses of government, and of the state debt.

These excuses should neither depress the hope, nor check the efforts of the advocates of the measure. It is wholly unconnected with party politics. It would not cost each voter more than five cents per annum. It is so intimately connected with the prosperity and character of the State, that public opinion will, ere long, force the legislature to examine its numerous economical and scientific relations.

It is not my purpose to give an elaborate exposition of all the arguments, by which its expediency can be demonstrated. I propose only to present such an outline of them, as will evince the truth of the proposition, that a thorough geological survey of the State, would elevate her character, and confer signal benefits on all classes of her citizens.

To do this, I will examine:—

1. The nature of geological surveys;
2. How far other governments have undertaken or completed them;
3. The opinions of wise and distinguished men with regard to their utility;
4. The benefits that have resulted from them;
5. The bearing of such a survey on the future prosperity of Alabama;
6. And its probable expense to the State.

First, then, of the nature of a geological survey. Very erroneous opinions are entertained by intelligent men on this subject. The y

suppose that it consists in a purely scientific examination and description of the rocks, minerals, fossils, and soils of a State; that it is more theoretical than practical; and that, though it may gratify the curiosity of devotees of science, it contributes not in developing the resources of nature; nor contribute anything to the means of subsistence; nor benefit, in any degree, the pursuits of life, especially those of the poor.

A geological survey should be the reverse of this. The officers engaged in it should be practical men, thoroughly acquainted with sciences, it is true, but qualified, in all respects, to render their knowledge useful to others. Ignorance of science, makes a man speculate or theorize. Did Davy speculate, when he analyzed the ashes of Knapfield, and published the results in his lessons on "Agricultural Chemistry?" Franklin, when he discovered the temperature of the Gulf Stream; Buffon and DuRoi, when they ascertained the vastness of coal in Virginia and Maryland; and proved its value in imparting permanent fertility to soil and exhausted soils; Rogers, when he analyzed the limestone, iron ores, coal, and mineral springs of Virginia; H. Leacock, when he discovered beds of copper, and other valuable mineral substances, in Massachusetts; Hildreth, when he proved the existence, in Ohio, of an immense millstone rock, equal in quality to the best French Burlington?

The assertion is made, without any fear of contradiction, because it is justified by a mass of positive evidence, that our class of men, equal only in numbers, contributed so much, in the past year, to remove prejudice, to diffuse useful knowledge, to improve agriculture, manufactures, and the arts, and to excite respect for the American name in foreign lands, as the little band of laborious proselites, who were employed, at the expense of most of the states, to prosecute geological examinations of their territories.

A geological surveyer should examine, minutely and thoroughly, every part of the State. It would be his business to ascertain the various kinds, and qualities of its rocks, especially those which may be used as marble, building stones, fire stones, or for other purposes of architecture and decoration; to find out and describe its useful minerals, such as metallic ores, plumbago, porcelain clays, and precious stones; to investigate and publish the extent of its water power and other facilities for the successful investment of capital; to designate the kinds of marl, limestone, and other mineral substances that may be advantageously used as manures, and the means of applying them; to analyze all ores, soils, and mineral waters; to point out the probable causes of the sterility of peculiar soils, and to suggest means of remedying those that are waste, and of draining those that are wet; to collect, arrange, and describe a cabinet of its rocks, minerals, fossils, and shells, and to deposit it at the seat of government, for public use; to prepare full catalogs of its animals and plants; to write and submit, annually, to the legislature, a detailed report of his proceedings; and to prepare and publish a map, representing, in addition to those things which are ordinarily found in maps, the extent of its rock formations and the exact position of its ores, coal, mineral waters, and other important geological characters.

It might be required, as was done in North Carolina, to embrace, in his annual reports, a brief account of the state of agriculture in the

different counties, including descriptions of useful instruments, expeditious modes of applying manure, cheap means of raising stock, and other details of farming and husbandry. He might be required to examine the fitness of the constructions to navigation in rivers, and to fix, by careful observations and measurements, the relative levels, heights, distances, and bearings, of such a number of places, as would furnish important data interesting in all future time, the practicality and valuable cost of internal improvements.

Should the contemplated survey be ordered, I would most respectfully advise the authorities to require the surveyor and his principal assistants to deliver, during their excursions through the State, to make observations preparatory to the commencement of regular operations, brief lectures on the science of geology, explaining, in a plain, familiar way, its objects and economical advantages, and illustrating, on the spot, the importance of aiding them in their researches, and of conducting them to places supposed to possess peculiar scientific interests. By this means, a considerable amount of accurate information would be diffused through all classes of society; a general interest in the subject, excited; and a disposition to scrutinize closely all mineral productions, produced.

But the great business of the surveyors would be, to apply to the productions of the mineral kingdom, all the principles of modern science, geological and chemical, with a view of the early use of them, in the various employments of life.

This enumeration of the objects of a geological survey, is sufficient to evince the folly of expecting unaided scientific men, how zealous never they may be in the prosecution of a favorite pursuit, to accomplish a work of such magnitude. Besides, should such men undertake it, they would naturally aim to gain personal reputation, by extending the bounds of science, rather than to add improvement to the progress of art, or to increase the resources of the State.

In my next letter, I will show how far other governments, European and American, have undertaken and completed such investigations; and also, the opinions of wise men with respect to their utility.

No. 2.

To the Editor of the State Journal and Flag:—

Sir:—In my first letter, published in your last paper, I aimed to explain, by enumerating some of its objects, the nature of a geological survey of a state; and to prove that, far from being a purely speculative or scientific, it is an eminently practical measure, calculated to benefit, in some way, almost every laborious class of citizens. It was also, my intention to show, that a thorough exploration of a large State, like Alabama, is a work of immense magnitude, requiring, for its accomplishment, by unaided individuals, so much time, as to deprive the present generation of most of its benefits.

I am not apprised in the illiberal spirit of the age, which requires the advocates of scientific researches, at the public expense, to show,

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that they have an immediate practical bearing on the pursuits of life. It is always wisest to treat man as he is, not as he should be. A large majority of men, even now, are disposed to neglect, perhaps to resent at all investigations, which do not promise to afford knowledge, available to those who labor to earn bread, to accumulate wealth, or to gain reputation. Such men are especially inclined to oppose every new measure. Hence, it is important to show, by giving a brief history of geological surveys, that they have been vigorously commenced, or successfully completed, in most of the States of the Union, and in many of the nations of Europe.

In his "Paper on the Gulf Stream, &c.," Lieut. Maury said truly:—"As a people, we are disposed to do but little for science out of mere zeal for the cause." "Of this the science of Geology affords a striking example. Chemistry and Astronomy, in the Old World, struggled for centuries, in sickly infancy; but on this side of the water, modern Geology, like the Goddess of old, leaped at a bound, full grown and purified into being. *Immediately practical in its character and beneficial in its results, the people were eager in the pursuit of its principles.* And, for the honor of popular institutions he said, the States of Republican America have done more for the science, than all the governments of the world besides. They fostered it with a care, and pursued it with an energy, that to other department of science ever before received of the hands of a nation. But it was not for the mere love of science, that geological investigations were thus encouraged among us. It was because its ends were adapted to our utilitarian ideas, and in themselves promptly answered the great question of utility now to be met." This is the testimony of an officer in the U. S. Navy, whose eminence as a scholar and literary writer is well known.

So, in the first Anniversary Address to the Association of American Geologists, in 1841, Prof. Hitchcock, Geologist to the State of Mass., said, in giving a brief account of the origin of the body which he addressed: "A number of geologists had, for years, been employed in geological surveys, in many widely separated States in the United States, as they were bringing their labors to a close, they felt a strong desire to compare notes. The gentlemen of the New York Survey, at length, issued a circular, inviting those engaged in similar surveys in other States, to a meeting in Philadelphia, which occurred there in 1840. Hence, even at that early period, geological surveys had assumed a character so important, as to call for the formation of a great national Association of Geologists,—an association which now equals, in dignity, learning, and useful influence, any scientific society in the world.

It is proper to mention here two facts, which are honorable to the intelligence, public spirit, and practical good sense of the American people. The first is, that the honor of instituting these enterprises, by civil authority, and at the public expense, is due to the wise and philosophic character of our system of government, no instance of the kind having occurred in Europe or elsewhere, until their practicability and importance had been demonstrated in this country. In this respect, at least, Americans projected a great scheme of national wealth and renown, in which Europeans soon imitated them. The second fact is, that the first commission, accompanied with an annual salary, given to a state geologist, was conferred on Prof. Olmsted by North Carolina, in 1824.

Since that time, twenty states and two territories have ordered geological surveys of their lands, embracing more than 700,000 square miles. What a vast region of mineral wealth has thus been subjected, for nearly twenty years, to the scrutiny of sixty or seventy scientific men! Who can estimate the beneficial effects of the persevering researches of such men, in so many States, actively engaged in agriculture, commerce, and manufactures? Who can calculate the ultimate effects, on the arts and sciences,—on all the pursuits of life—of the final publication of their reports!

Massachusetts ascertains, annually, the income of every kind of labor, in which her people are engaged. She is proverbially a wise State; and her wisdom counsels mainly, in attaching due importance to means of acquiring knowledge, which must improve the processes of art, and give direction and stability to her future legislation. In 1830, Gov. Lincoln recommended a survey of her territory, which, with the approbation of her Legislature, was commenced immediately by Prof. Hitchcock. In 1833, he made a full report on the whole subject, in a volume of 702 pages, with an atlas of plates, a geological map, and zoological and botanic lists. In 1841, the Legislature directed a second edition of this report to be printed. About this time, most of the Eastern, Middle, and Western States, perceiving the advantages that Massachusetts had derived, and would continue to derive from it, commented the work, on a magnificent scale; and in 1836, New York, the wealthiest and most populous state in the Union, committed its execution to four geologists, one chemist, one zoologist, one botanist, and one paleontologist.

Nor can it be said, these measures were the offspring of speculation or of party machination, like the rotten system of banking in Kentucky and Alabama, which perished with the impulse that gave them being. For, in 1837, four years after the close of the first general survey, (time amply sufficient to make known its effects,) Gov. Everett recommended a re-survey of Massachusetts, which was committed to the same able geologist, aided by seven scientific gentlemen. And, amidst all the political changes that have since occurred, in New York and other States, the exploration of their territories has gone steadily on, in most of them to completion.

These scientific undertakings of the wisest and richest States of the Union, were legitimate offspring of the enlightened policy, which, during successive administrations of the Federal Government, directed at the expense of the nation, the exploring expeditions of Lewis and Clark, and Pike and Long; the Geological surveys made in several territories by Featherstonhaugh the coast surveys executed by Hasselner, and the voyages, under the command of Capt. Wilkes, &c. &c. said Mr. Beaman, "to explore unknown seas, to discover new sources of commercial enterprise, and to point out the dangers that beset the path of the navigator."

But, some may ask, were not these surveys excrescences of a diseased state of the public mind in America, with which European policy was not infected. Since they were commenced in this country, France ordered the construction of a geological map of the whole kingdom, which has been ably executed by Bestunton and Duprétoy.

In 1835, an order was issued by the British authorities to combine a geological examination of the English counties, with a geographical

survey, which had previously been commenced. Nova Scotia and New Brunswick were surveyed, several years ago, by Gossans; and upon Kinnelon, an English province, in the Himalaya Mountains, has been surveyed by Dr. McCheson, an officer of the British Government. Indeed, it is the established national policy of England, to order such surveys of her most distant possessions, in India, or America, in Guiana, in N. America, or at the Cape of Good Hope, that accurate estimates of their resources may be made, inasmuch that, whether it be a recent or an old conquest, a thorough topographical and geological examination of it has been completed or commenced.

What a novel and interesting feature in the history of the world, those acts of the wisest governments of the age present! While scientific expeditions traverse the world, corps of learned geologists, officers of State, search the land for the humane purpose of augmenting the means of human enjoyment! To extend the physical sciences, and, thereby, to augment man's control over the productions of the earth, has become one great object of modern governments. Hence, a wise statesman now regards measures for the accomplishment of this object, as the surest means of advancing the future prosperity of his country. And hence, as we have seen, in most of the states, the devices of the recess, but noble science geology, have been called from their studies, and commissioned to go forth, not at the head of armies, but of scientific corps; not to desolate states, but to ascertain their resources; not to waste the products of agriculture, but to relieve its wants; not to designate commanding military positions, but to open rich mines of mineral wealth.

How different is this policy from that of European nations of the past military era, which, originating in the days of feudal violence, based wars to be constructed, at great public expense, so minutely accurate, that encampments of armies may be chosen; battle fields selected; and all the details of posing sentries, accomplished; in the tent of the distant commander.

Alabama has done nothing to advance science, to encourage art, to improve agriculture. She has perseveringly refused to cope with her sister States, in the enterprises which have been described. She has, for years, treated every proposition to engage in a geological survey of her territory with indifference. In December, 1833, the board of Trustees of the University, by a unanimous vote, appointed a committee of three to memorialize the Legislature on the subject. A few days afterwards, joint resolutions, proposing the necessary appropriations, passed the Senate, but were rejected by the House. In 1839, Gov. Dugby recommended it in his annual message. Joint resolutions of similar import were again introduced, in both branches of the legislature, at an early period of the session. They again passed in the Senate, but were again rejected in the House, by a small majority. — In December, 1841, the State Agricultural Society made an individual attempt to induce the legislature to sanction the measure. Since that time, its advocates have abandoned it, believing, I presume, it was useless to propose it to rulers, whose mistaken notions of economy, induced them to attempt to extract the State from debt, by advising her to withdraw her hand, like a turtle, into a horny shell of retrenchment.

Having given, very succinctly, the history of geological surveys in America and Europe, I propose to show the opinions of distinguish-

ed men with regard to their utility. In all cases of evidence, the testimony of those only is sought, whose superior opportunities of acquiring information, give their opinions peculiar authority. Hence, when a committee of Parliament were required to ascertain the probability of a canal in Great Britain, eminent geologists, Beckland, Seelych, Lyell, and others, were examined. Hence, when a proposition was made to divide the Bank of England, Parliament required the opinions of such men as Rosehill. Hence, also, in courts of justice, though judges preside, and appellate points of law, questions in medicine are referred to physicians, in commerce, to merchants; in art, to artists.

To decide correctly, whether a geological survey of the State would necessarily be productive of numerous great and permanent benefits, we ought to take the testimony, not of ignorant persons; not of learned men, who are ignorant of the history of physical sciences; not even of scientific men, who have neglected geology; but of eminent geologists, who have peculiarly directed their attention to the practical and scientific results of such investigations. Now, suppose the geological societies of England, France, and America, could be summoned, as witnesses, before the bar of our Legislature, would they not unanimously pronounce the contemplated survey an object of great importance, and recommend the immediate adoption of measures for its accomplishment? Would they not say, such a survey could not fail to do much to enlighten the public mind; much to gratify curiosity;— much to extend the boundaries of our empire; much to call the character of the State; much to give wisdom and stability to her legislation; much to enhance and fix the value of lands; much to cause an influx of English much to improve agriculture and the arts? And would it be wise to disregard the opinions of such witnesses?

But, in this case, we are not left to conjecture:—they have recommended; it through their Presidents and anniversary orators, who exhort the people, "that surveys will soon be ordered in the comparatively few States that yet remain to be examined." Indeed, they go much further, and recommend the permanent appointment, in each State, of a new water officer, that of agricultural and analytical chemist, to examine and analyze all soils, rocks, minerals, &c., presented to him for the purpose.

But, in this case, we are not driven to the necessity of relying on the testimony of geologists. Others have voluntarily testified to the utility of such investigations. An order for a thorough geological examination of the District of Columbia, was one of the first acts of the National Institution, established in Washington in 1846. This act excited the criticisms of the Secretaries, Judges, Generals, Statesmen, Divines, and Lawyers, who were then members of that body.

It would be easy to cite, at great length, the opinions of distinguished individuals; but, as they all have expressed the same sentiment, in nearly the same language, I will close this letter with the following words of Mr. Poissent, one of the most eminent scholars and distinguished statesmen America ever produced:

"Natural history, agriculture, commerce, and the useful arts go hand in hand; whenever the first is encouraged, the other branches, which depend upon it for support, will flourish; but whenever it is neglected or lightly regarded, the other branches languish and lose their

value. How many substances of rare materials grow or may be found throughout this vast region, which are unknown in the United States, but which might become articles of extended commerce, if every State in the Union would seriously set to work to explore its resources in the three great kingdoms; of nature, animal, vegetable, and mineral.¹⁰

No. 3.

To the Editor of the State Journal and Flag:—

Sir:—In my second letter, I gave a summary of the extent to which geological investigations, stimulated and sustained by governmental patronage, have been carried in the United States and Europe. I showed also, the importance attached to them, as economical and efficient means of advancing national prosperity, by all men of sense, statesmen, scholars, divines, judges, generals, and naval officers.—Hence, it seems, they owe their progress to a utilitarian spirit of the age, rather than to the visions of speculators, or to the schemes of philosophers. Men now appreciate the useful character of physical science. They see, feel, know, that "the true end of science is to enrich human life with useful arts and inventions."¹¹

Indeed, science is now applied to such a multiplicity of useful purposes, that philosophy may well dread the approach of a period, when its study will be discontinued, except when prosecuted with a sordid view to the improvement of art, rather than with the noble purpose of embodying new parts of the sublime system of truth. Of this, most recent works on science afford apt illustrations.—Take, as an instance, four splendid lectures, delivered last year, before a scientific society in London, by Dr. Pereira, on polarized light. The lecturer, in his exordium, labors to show, though he deprecates the necessity for it, that the brilliant phenomena, which he was about to exhibit, are useful items of knowledge to the druggist, the fireman, the sailor, the distiller, the sugar refiner, the police officer, &c., &c.

In addition to what has been said on this part of the subject, I must invite attention to the report of the late Secretary of the Treasury, Mr. Spencer, made last winter, in obedience to a call of the House of Representatives, on the expediency of connecting geological with the linear surveys of the public lands. In his report, Mr. Spencer said, "the connection is practicable, easy, and highly desirable, in every point of view."¹²

Last April, Dr. Houghton read a paper on the subject to the Association of American Geologists. He depicted ably the vast system of surveys, carried on at great expense, solely "to subdivide lands to be offered for sale," "without seeking to obtain, simultaneously, at a trifling increase of expenditure, such geological, and other scientific information, as is necessary to enable both government and people to understand the character and value of the regions surveyed."¹³ He said, also, he had desired to his aid some of the United States surveyors, and had derived great advantage from their labors, in perfecting his geological survey of Michigan.

The Association appointed a committee of seven distinguished geologists to memorialize the Federal Government on the subject. Their memorial, presenting, as it doubtless will do, a clear and forcible view of the benefits that must necessarily result from the connection, will, it is hoped, induce such improvements in the existing system; as to make it subservient, in future, to all the purposes of topographical and geological, as well as geographical surveys.

Here, I must remark, that the accurate linear survey of Alabama, already made, constitutes an admirable groundwork for a geological one. The whole state has been divided, by marked lines, into ranges, townships, and sections. This is an advantage which the Eastern States did not possess, and which will diminish greatly the expense of a scientific examination of her surface. Who does not now regret, that ignorance or parsimony prevented the Federal Government from associating skillful geologists with the land surveyors, commissioned to ascertain and describe the character of each township in the State? Had this been done, a mass of facts would have been published, or deposited among the public archives, useful to the government, in fixing the prices of lands, and to the people in selecting their homes. Thousands of men have been deterred, by the contradictory accounts of travellers, from emigrating to Alabama, who would have come, had the government supplied them with authentic knowledge, such as a geological survey would have afforded.

In the Carolinas, iron ore is raised with difficulty, at a distance from water power; limestone for fluxing it, is hauled in waggons, twenty, thirty, or forty miles; timber for fuel is comparatively scarce; mineral coal is wholly wanting; and labor is performed almost entirely by slaves; and yet, even there, manufactories of iron exist, sufficient to supply the country, within a hundred miles of them, with nails, at five cents; bar iron, at four or five; and castings at three or three and a half. At these low prices, the business, wisely conducted, is more profitable than the cultivation of cotton, or the raising of stock. The only difficulty the provinces encounter is a glutted market. This South, therefore, is adapted to the manufacture of iron in all its forms.

It may be said, if Alabama possesses superior advantages for the manufacture of iron, why have not her people engaged in the business? To a very small extent they have, very recently, however, and the reason is obvious. Most of the emigrants to the State were either agriculturists, mechanics, artists, or professional men, who had neither the kind of capital, nor the degree of skill, necessary to success in any branch of manufactures.

Had the great abundance and wide distribution of iron ore, limestone, sandstone, freestone, and water power, in central Alabama, been made known by competent scientific officers of the Federal Government, when the linear surveys of the state were completed, who can fail to see, that there would, long ere this, have been such an influx of capital and skill, as would have reduced the price of iron two cents below the present rate? Iron forms a large item of expense in any community. Two cents a pound saved, so what is usually consumed in Alabama, would more than pay the expense of a geological survey. Hence, the injury and loss already sustained, should teach our rulers the importance of developing our resources, and the folly of longer

postponement. What a pity it is, that our legislatures annually waste their sessions in discussing national politics, in discussing for office and in log-rolling for the accomplishment of county purposes, while a prompt and zealous attention to the great questions of State policy, would enable them in a shorter time to give more than enough, in one session, to send the benign and vivifying influence of science into every township. Have we not reason to believe, that Al. is and long has been, the policy of the dominant party in Congress, controlled by the representatives of the manufacturing States, to discourage any transference to the West of manufacturing capital and skill? Are not national States more selfish than individuals? Are candor, fairness, liberality, generosity and justice, over national utility? Read a late article in the North American Review, on the "Manners, Morals, and Laws of England." Read a still more appropriate article, on Ireland, in which it is demonstrated, that England loses, by a legalized system of rapine and plunder, suppressed various manufactures in that tired country. Ask the proprietors of the Tasselous Cotton Manufactory, and those of the furnaces and forges in Bibb, Taliaferro, &c., and they will tell you, that we possess such advantages as would enable us, with the requisite skill and experience, to undersell the Northern manufacturers. Who can doubt it? Yet, how necessarily have our Northern brethren labored to convince us that, though our rich valleys are admirably adapted to the growth of cotton, our mountainous mountains and hills are valueless.

In most respects, we use, advantageously, the practical knowledge of England, and other civilized nations. Why should we fail to derive a beneficial lesson from their experience, on the subject of geological researches? Do they act upon the presumption, either that enough is already known of their resources, or that individual exertions, prompted by self-interest, will spontaneously apply known principles of science, as well to the discovery of valuable substances, as to the conservation of them in useful purposes? They certainly do not. Let us examine a little more minutely the policy of England. Her geological investigator, as has been, for the last sixty years, most thoroughly established, that of any part of the earth. Chiefly by private enterprise, every square foot of the British Isles has been examined; and, to the knowledge thus acquired, must be ascribed a large part of her vast preponderance, in mining and manufacturing substance. Indeed, so well has the value of this kind of knowledge been long understood, that, in the agricultural districts, every variety of soil has been often analyzed, and, in the mining districts, models in wood of the whole of each subterranean estate, on a reduced scale, have been constructed, from which the character, thickness, and mineral contents, of every geological stratum, may be seen at a glance, with the parts that have been exhausted, those that are undergoing excavation, and those which remain to be explored. To each mine and colliery is attached an officer, designated the mineral surveyor, who is an accomplished geologist, chemist, and mining engineer; and under whose direction the whole work proceeds; yet, England is not satisfied. For the last ten years, geological investigations have been vigorously prosecuted, at the public expense, by some of her most learned men. For she knows that science is rapidly advancing, that many things are still unknown,

and that each discovery increases her resources, diversifies the employments of her people, and affords new means of sustenance.

Have these investigations been fruitless? By no means. Take a single illustration. Science has proved that phosphates, (salts containing phosphoric acid, which exists in bones or other animal substances,) contribute most essentially to the capability of a soil to produce nutritious food, the various kinds of grain, &c. Liebig says—A field, in which phosphate of lime, or the alkaline phosphates form a part of the soil, is totally incapable of producing grain, peas, or beans. It is exhausted. The nutriment in vegetables, &c. is in direct ratio to their amount of phosphates." Hence, the enormous importation of guano and bones into England. As early as 1827, Hackman estimated the cost of bones imported annually, at £200,000. The English have, therefore, sought earnestly for mineral phosphates, and the researches of their chemists and geologists have been crowned with success. They have found rocks consisting chiefly of fossil grains, (reptiles of extinct animals,) and limestone containing 18 per cent of phosphate of lime, the earth which renders bones so valuable as manure. "What a curious subject for contemplation! In the remains of an extinct animal world, England is to find the means of increasing her wealth, magnificent produce,"—Liebig's Lectures, p. 175-6.—One cause of the efficacy, as a manure, of the shell man of Virginia and Maryland, is the great amount of phosphates which it contains. This, too, is doubtless the secret of the marvellous fertility of our prairies. Should not sands and limestones, containing these substances, be sought in other poorer parts of Alabama? Her people depend almost wholly, on the culture of cotton. Admonished by a steady decline in the price of cotton, ought she to rely longer exclusively on it? Will she make no effort to diversify the employments of her people? Can she rely solely on individuals to make the necessary investigations for their own expense? Older states and nations, which are foremost in the career of public services, might do so with some prospect of ultimate success; for, in them, the number of scientific men is great, in proportion to the extent of surface to be examined. In this State, however, the number of men, of competent skill, is too small, to permit us to expect any valuable results from their occasional labors.

No. 4.

To the Editor of the Journal and Flag:—

Sir:—The chief tendency to an increase of national wealth in Alabama, is the general necessity of using the productions of early States or nations, which are entirely consumed by use, like soap, glass, and gunpowder. Alabamians are, in almost all respects, situated as were the French, at the commencement of Napoleon's reign, in regard to soda, for the manufacture of soap and glass, and saltpetre, (Nitrate of Potash,) for that of gunpowder. Hence, the discovery, by La Blanc, of a mode of obtaining soda from common salt, saved to France an annual expenditure, for soda, of about \$6,000,000. Hence, also, the

discovery, by geologists, in Peru, about the same time, of a bed, 200 miles square, of nitrate of soda, capable of being substituted for saltpetre, in the manufacture of sulphuric acid and other substances, enabled the same government, not only to prosecute the wars in which she was engaged, but to save many hundred thousand dollars annually, by using, in the manufacture of gunpowder, all the saltpetre that was prepared in a way discovered by chemists employed by her for the purpose, at the public expense. From these facts it is evident, that scientific researches may, and often do, eventuate in saving to nations, of millions; and hence, I propose to examine briefly, in this letter, some of the benefits, direct and practical, that have resulted from the State surveys, of which a concise history was given in my second and third letters.

And, here, I must remind your readers, that science, notwithstanding her numerous signal conquests, has been kept in bondage by a sudden despair of success; by a supposed impossibility of effecting new discoveries; and, especially, by a secret satisfaction and complacency with what had already been achieved. Against these obstacles, she has always had to contend; and her advocates cannot now reasonably claim exemption from their baneful influence.

I must, also, allude to a still more serious obstacle; by which I am opposed, in this attempt, to demonstrate the utility of a geological examination of Alabama. For it is impossible for me, in a few short letters, either to enumerate a hundredth part of the beneficial effects of such surveys, or to direct attention to the many ways in which they must exert, in future, a salutary influence on the various avocations of the industrious and inventive genius of the American people.

To form a just estimate of the direct advantages of the surveys, that have been completed, a person ought to peruse many volumes of reports, replete with scientific discoveries and economical details. It is obvious, therefore, that I labor under a serious disadvantage in treating this part of the subject. I cannot, without making these letters too long, enumerate the errors in maps that were corrected, the dangerous coasts that were delineated, the soils and mineral resources that were analyzed, the ores and minerals that were discovered, the mineral springs that were analyzed, the coal beds that were explored, the defects in chemical composition of rocks, easily remedied, that were detected, the prejudices that were obliterated, the false notions that were rectified, the various searches in improper places for minerals that were prevented, the mineral cabinets that were collected, and the maps that were constructed, by various State geologists. Long as this list may appear, it does not embrace half the subjects to which they successfully directed their attention.

Still, as I am aware that many very intelligent persons are disposed to ask, what practical benefits resulted to the laboring classes in the states that were surveyed, I will designate some, which none can gainsay or deny.

1. Dr. Jackson, who surveyed Rhode Island, analyzed the soils of most of the farms in that state, ascertained accurately the proportions of their constituents, and published the results, in plain language, with the names of their proprietors. He also published tables of the constituents of the best soils in Europe, Egypt, and on the Mississippi

river. Each Rhode Island farmer was thus enabled, by comparing the composition of his soil with that of the best soils in the world, to remedy its deficiencies, and to improve its fertility, in the most certain and economical way. In some cases, lime was wanting; in others, oxide of iron; in others, phosphates; in others, sand or alumina; in others, organic matter.

It has been demonstrated by agricultural chemists, that a soil which wants any one of the substances found by analysis in the ashes of a plant, as wheat, rye, or cotton, is incapable of producing that plant to maturity. Thus, wheat may grow luxuriantly, without yielding any grain, on a soil containing no phosphates. Now the constituents of the ashes of all valuable plants, grains, fruits, &c., have been published in all the recent works on agricultural chemistry. To an Alabama planter, these works are comparatively valueless. Dr. Jackson has, however, enabled every skillful farmer in Rhode Island, to ascertain the capabilities of his soil, by comparing its composition with that of the ashes of any plant that he may desire to cultivate. He, therefore, can derive practical knowledge from the writings of Johnston or Liebig.

But Dr. Jackson did more. Experiments in manuring, &c., as published in agricultural papers, often mislead than instruct those who attempt their repetition, because the composition of the soils on which they were made is not stated. Thus, a farmer sees in his newspaper a description of the successful use of sulphuric acid, in preparing compost manure in England. He applies it in the same way to his soil, with manifest injury to his crop, for his soil is calcareous, while that of England is calcareous. His soil contains nothing on which sulphuric acid can act. That of England contains much carbonate of lime, with which the acid unites, forming gypsum, that stimulates the roots of most plants to increased absorption, and evolving carbonic acid, by which vegetables are nourished. The Rhode Island farmer can now proceed, with the results of his experiments, the composition of the soil on which the experiments were made.

It may occur to your readers, as an objection to the value of such analyses, that the soil of every plantation, in so large a state as Alabama could not be analyzed. Such a course would be unnecessary, if it were practicable. The kinds of soil, either in our prairies, on the low grounds or any of our rivers, or in our pine lands, are not numerous. Each kind is, however, essentially the same, wherever it is found. The surveyor could easily analyze such variety, and a single analysis would soon be made available by his polished reports to thousands of planters.

2. Geological surveys have shown, that many mineral resources, which have long been imported, at great expense, are abundant in our own country. I will illustrate this proposition by a single example, though many others might be adduced. Millstones, used in flour mills especially, have long been imported, chiefly from France, at an expense of from \$250 to \$500 a pair. A vast amount of capital has thus been silently withdrawn from the U. S. A rock, equal in value to the French Buthon's, and similar to it in all essential characters, exists in Ohio. It was traced by Dr. Hildreth, during his survey of that State, through seven counties, forming a long belt twelve or fifteen miles wide. The stones pay out from this rock, are sold annually for more than \$25,000, yet the price of a pair does not exceed \$150 or \$200. As this rock

has been thoroughly studied by a man of scientific attainments, who says it is equal to the best Barbstone, we cannot doubt that it will, ere long, be brought into general use, to the exclusion of the foreign article.

The discovery, in Alabama, of a single substance, equal in value to the Ohio Barbstone, would amply compensate her for the expense of a geological survey. Can any one believe her to be so void of mineral resources, that a thorough scientific search for them should be unprofitable? Very recently, I was supplied with mineral fragments, the examination of which induces me to hope, that a rich bed of copper could be found in St. Clair county. I have also analyzed rich ores of zinc and lead; but those who brought them to me refused to tell whence they came.

Individuals, who search the surface of the State for minerals and metallic ores, are generally ignorant of mineralogy and geology.—They are, therefore, liable to pass unperceived the most valuable substances. When I see such men into my very rich and extensive cabinet, selected from the best localities in all parts of the world, the "frat" no variety of limestones, talc, cobalt, chromite, iron, silver, copper, and manganese, almost every metal, gold not excepted, nor would they perceive, should they discover them in their native rocks, any talc in soap, pitch, lapis lazuli, garnet, emerald, chrysoberyl, or sapphires.—This fact alone would cause a wise legislature to order a survey of any State in the Union.—Gold is never easily discovered than other metals, because it always exists in the earth in a pure metallic state. Other metals, except platinum, occur usually in ores, combined with other substances, which alter materially their visible properties. Not more than one individual man has thousands can distinguish a trace of chromite or manganese from iron ore; nor could he readily perceive any difference between some of the ores of silver, copper, or lead, and other metallic minerals.

6. They have rendered geological science available to all, who search for useful minerals, in any State that has been surveyed, by furnishing a certain guide for prosecuting successful researches for valuable substances. It is not easy to render the utility of the guide intelligible to those who are ignorant of geology. The principle on which it depends, may, however, be succinctly stated.—Each mineral is found in a particular rock formation, associated with certain other substances. Hence, it is useless to seek it in other situations. Thus gold always occurs, either in the alluvial gravel and mud of a stream, or in veins in a peculiar silicious slate rock. Bituminous coal has not wholly limited to one position, in a peculiar series of rocks, consisting of sandstone, shale, conglomerate, and clay, filled with impressions of leaves, &c., of plants. Geologists know they cannot find gold, silver, lead, tin, or coal, in our prairies. Now, geological surveys have traced accurately, and described minutely, each kind of rock found in their respective states; have represented its position, extent and boundaries on a large map; and have enumerated the substances that may be sought in it with a prospect of success. "All that I aimed at," says Dr. Deuel, in his Report on Connecticut, p. 479, "was to trace the indications of valuable minerals, and to connect substances or indications with particular geological positions, so as to furnish a guide for future researches."

Such reports supply each citizen of a surveyed state, with a full description of the character, position, extent, and mineral contents of each kind of rock. Hence, he is taught not merely how to see, but where to look for mineral substances. Thus, after informing the people of Connecticut that they cannot find, in their State, either rock salt or gypsum, Dr. D. tells them where, according to established principles of science, they may, with a prospect of success, search for copper, iron, coal, and other useful minerals. Had the people of Alabama been furnished with such knowledge, many fruitless researches would have been prevented.

4. They have settled disputed points in the geology of the States, deeply affecting important commercial interests. Anthracite coal exists abundantly in Pennsylvania; and hence, the people of New York long cherished the hope of finding it, among the concealed mineral treasures of that State. This hope was revived, from time to time, by interested persons; and ruinously expensive excavations were made, where substances, similar in structure and color to coal, were found.—Geologists had not ascertained the relative age and other characters, of the numerous and complicated rocks of the State of New York; hence, they were disposed to encourage researches for coal. At all events they could not say there was no reason to hope for its discovery. The State geologists have, at length, shown conclusively, by a most able examination of her rocks, that as they lie geologically below those of Pennsylvania, anthracite coal, similar to that of Pennsylvania, will never be found among them. They found, however, immense beds of gypsum, which do not extend into Pennsylvania. This knowledge will, most assuredly, prevent, in future, costly investigations for coal in New York. Moreover, a union of the two states, by a rapid and cheap mode of communication, was immediately seen to be so important, that a committee of the Pennsylvania legislature was sent to that of New York, to propose the joint construction of a canal, to effect a mutually beneficial exchange, of the coal of the one for the gypsum of the other.

5. These surveys have greatly extended the dominion and enlarged the boundaries of science. This is undeniably true, and all will admit that scientific knowledge of any kind is power, and constitutes the basis of national wealth. The stupendous power of England is a monument in honor of science;—rests on principles discovered by men, who were ridiculed by their ignorant contemporaries, as useless visionaries, who wasted time and money in vain pursuits.

6. They have exalted our national character, by convincing foreigners, that our free institutions are favorable to enlarged views of science, to a general diffusion of knowledge, and to a just appreciation of its benefits. By all intelligent European, American geologists, Hitchcock, Jackson, Rogers, Vanuxem, and other authors of geological reports, are better known and more highly esteemed than the foremost of our politicians, except Webster, Clay, and Calhoun.—Really, foreign nations must know very little of Alabama, except that cotton is her chief staple commodity, and that she imports almost everything. In my next letter, I will conclude this part of the subject.

The Editor of the State Journal and Flag—

SIR.—Permit me to thank you for requesting a continuance of these letters. It is my object to benefit the State; and it is, perhaps, a duty imposed on me, by the place I occupy in the State University, to urge, annually, the consideration of a measure, which is commended to public regard, both by the best established principles of a comparatively recent science, and by the experience of almost all civilized States and nations.

I am aware that any one can readily discover surpassing worth, dignity, and utility, in any subject, to which he may identify and personally devote his attention. In this way, trivial objects of individual pursuit, futile parts of scientific research, or useless measures of state policy, are often viewed with undue importance, even by very sensible persons. Still, making proper allowances for any bias, produced in my mind by ten years' study of a science, rich in every thing calculated to captivate the intellect, and to excite the imagination, I am forced to believe, that the question of a geological survey of Alabama, is fraught with more serious consequences to her people, than any measure which now claims the attention of her legislators. It is, in my estimation, the great question of state policy. And to those who doubt the truth of this statement, I must propose a few questions. Have you studied the subject? Have you a clear conception of what it proposes to accomplish? Have you examined its numerous relations to agriculture and the arts? Have you reflected seriously on the important effects, that would necessarily flow from an application of the highest principles of chemistry, mineralogy, and geology, to the substances on the surface and in the rocks of a State, embracing 50,000 square miles? Can you propose any mode, equally efficient and cheap, of making known to the poor and ignorant the mineral contents of their lands? Are you satisfied with the belief, founded on little more than rumor, that the mineral wealth of the State is great, though no one can tell precisely its kind or quantity, where it exists, how it may be found, or by what means it can be made available?

7. This question brings me to the consideration of the seventh direct, practical benefit of geological surveys. They embodied, for each state that was surveyed, all the knowledge that had been obtained, by any means whatever, with regard to their physical resources. In states that have been so surveyed, an enquirer can ascertain accurately, by consulting a few pages of a geological report, the localities, kinds, qualities, and quantities of coal, iron ore, copper ore, marble, limestone, granite, or other substance. Indeed, such reports are great storehouses of all kinds of useful knowledge, so systematically arranged, after appropriate heads, that any one, by consulting an index, may readily turn to the page, from which he can learn what he wishes to know concerning the mines, or the quarries, or the springs, or the water power, or the soils, or the rocks and minerals, or the animals and vegetables of his state. Thus, the geological reports on Massachusetts contain a short but full and exact tabulated 52 pages, on the quadrupeds of that State, on the 34th

page of which is an admirable description of the Fossa or American lion, recently exhibited in this city as a South American animal.—The cowardly animal formerly infested Massachusetts, and it is still found in St. Lawrence county, N. Y., and other parts of the United States. It is a great mistake to suppose, that a geological surveyer's business consists in hunting for and discovering new substances. He is most usefully employed when engaged in collecting, systematizing, arranging, and publishing, what is already known to individuals in all parts of the State. In Alabama, for example, one man knows where gold, iron, zinc, lead, or other metal exists; another, where flint-stone, limestone, coal, iron ore, and adequate water power, are in such proximity to each other, as is necessary for the successful manufactory of that metal. A surveyor would collect all such knowledge and publish it.

8. They have supplied artists, manufacturers, agriculturists, and scientific men, with accurate analyses of all the important mineral productions of most of the States. Such analyses have been prosecuted on a grand scale, since geological surveys were first instituted, in the United States. The chemical composition of many thousand specimens, from different parts of an area embracing 700,000 square miles, has thus been made known. It is impossible to estimate, in dollars and cents, the benefits that have already flowed silently from these analyses. Some limestones have thus been shown to be capable of yielding the best Roman cement, others, the best hydraulic lime. I showed, in my last letter, how the discovery of 18 per cent. of phosphate of lime, contained in limestones in England, promises to prevent, in future, the importation of bones and guano into that country, at an annual expense of at least £400,000. The city of Baltimore pays to the people of Pennsylvania, annually, more than \$50,000 for the kaolin, which is used in their manufactures of china ware.—Had the State geologists discovered kaolin in Maryland, they would have saved to her people this large amount of capital, which now flows east through a single channel.

Well may Leibniz say that, "were long, a knowledge of chemistry," in clothing, especially, its relations to geology and mineralogy, "will be as necessary to the statesman and practical agriculturist, as to the physician."

9. Geological surveys, in numerous instances, directed public attention to valuable mineral substances, the utility of which had been known to a small number of individuals only. In the eastern parts of Maryland and Virginia, in more than twenty counties, the plasters, cultivated soils, exhausted lands, in the creeks, ravines and valleys of which, were essentially beds of marl, with the nature and use of which they were generally unacquainted. The geologists of those States, Dana and Rogers, examined the beds of marl, ascertained their limits, designated the places in which they could and in which they could not be found, examined their value, and described the mode of using them, which had been so successfully adopted by Singleton and Ruffin. In this way, a knowledge of the best and cheapest mode of fertilizing sandy and arid land was widely diffused. Hundreds of persons were taught on their plantations to distinguish marl from a class of other substances. They became teachers in their turn; and, in a few years, a valuable mineral manure was brought into general use.

I grant that the existence and value of the marl was discovered by private men, Singleton, Ruffin, and others, but no one, who is acquainted with the subject, can deny, that the geologists of these States performed, for the people, a most valuable service, by tracing the geological relations of the marl beds, and by discovering their existence in hundreds of places, which neither Ruffin nor Singleton had visited. This subject is one of vast importance to Alabama. The immense value of marl is now well known to every intelligent man. Farmers, strange to tell, are more ignorant on the subject than other men, because they read less. A very large part of Alabama consists of poor, sandy land, covered with dense forests of pine, precisely similar to the lands on the eastern side of Virginia, described by Ruffin.—Such lands, without improvement, are almost valueless. The few fertile spots, found in them are soon exhausted. Rich and inexhaustible beds of marl lie either a few feet under the surface, or in their immediate vicinity. Nineteen-twentieths of the owners of such lands cannot, however, distinguish marl from a clay or any other earthy strata. A geological survey of the State would certainly have the effect of making known the localities, kinds, properties, and uses of marl. In this way, the value of such lands would be enhanced, the agricultural products of the State increased, and the prosperity of all classes, especially that of the poor, augmented. The writer has often seen large bodies of poor land, in Montgomery, Autauga, Lowndes, Dallas, Perry, Greene, Marengo, Sumner, Pickens, and other counties, lying in the immediate vicinity of thick beds of rich marl. The farmers were generally, however, unconscious of its existence, and ignorant of its value. Still, all know, who have read the recent publications on agriculture and agricultural chemistry, that the use of marl and calcareous manures has, in a comparatively short time, nearly or quite doubled the produce of England and other European nations. Similar effects have been produced by it in this country. Mr. Ruffin, several years the editor of the "Farmer's Register," and author of the "Essay on Calcareous Manures," has given us the results of his observations and experiments, through a period of twenty years. He says, the application of thirty cards of marl, to an acre of totally unproductive land, caused it to yield, in some instances, ten times as much as it had previously done; that he never knew such a marking of seed soil to be followed, in the first crop, by an increase of less than fifty, often a hundred per cent.; that a single man, with a good horse and cart, can marl sixty acres a year; and that without any other marking, the land continues to improve, for twenty years. And, a few days since, an intelligent gentleman of Alabama, Dr. Withers, told me that, having tried the effect of throwing mud on very poor, sandy spots of his plantation, he was able, the first year, to perceive, distinctly, a manifest improvement in the crop, where each load had been thrown. Still, there is some difficulty in the use of this valuable manure. It comes in ascertaining the strength of the marl, and the constitution of the soil to which it is applied. "If," says Mr. Ruffin, "the nature of the soil, its condition and treatment, and the strength of the marl, all were known, it would be easy to direct the amount of a suitable dressing." Now, it is obvious, that these are conditions, which a geological surveyor would readily ascertain by accurate analyses. In his report of 1834, he

the geology of Maryland, Dr. DaCosta says, "the experience of the farmers of the eastern shore, confirms the views of Mr. Ruffin." I have dwelt at some length, on this part of the subject, because the tertiary strata, in which marl usually occurs, are more largely developed in Alabama, than in any State in the Union. Nor are our strata similar to those described by Dr. Mitchell, in his geology of N. C. p. 127, which consists chiefly, as in some parts of Florida, of the *ls* so little decomposed, that, "in many cases, the cohesion of their particles is scarcely impaired." A geologist would promptly pronounce such marls, should they be found in South Alabama, to be comparatively worthless.

10. They have furnished invalids and physicians with accurate knowledge of the medicinal ingredients of most of the mineral waters of the States. Prof. Rogers, for example, has analyzed all the mineral springs of Virginia, since he began the survey of that State.—The analyses of all the springs, in all the States, will, doubtless, ere long, be embodied in a separate volume, accompanied with facts, from which principles of great importance to the science of medicine will be deduced. Already, a physician, who has carefully examined such analyses, can give his patients and friends judicious advice, in regard to the waters which they ought to frequent. Dr. Daubeny has published a work on the mineral waters of Europe; and Prof. Rogers contemplates the publication of a similar volume, on those of America.

11. They have supplied most of the States with large collections in mineralogy, geology, botany, and other branches of Natural History. Such cabinets belong to the state governments, and may be preserved for the inspection and study of artists, engineers, scholars, agriculturists and statesmen; or deposited in colleges and academies for the instruction of future generations. Most of the States own large libraries, deposited at their capitals, for the use of public functionaries. Why are not cabinets in Natural History so necessary to such officers as collections of books? In one respect they are more necessary; they are more rare and more difficult to procure; yet, I propose to show presently that the knowledge, which they impart, is indispensable to statesmen. Some of the cabinets embrace even 8,000 pieces of rocks, ores, minerals, soils, &c. "It is proposed," says Prof. Mather, in his first report on the geology of Ohio, "to make a comprehensive collection of the natural productions of the State, so as to exhibit under one roof complete suites of specimens of the animal, vegetable, and mineral kingdoms." This was done; and in some of the states, such specimens have been arranged in separate cases, containing distinct compartments, for the mineral productions of each county. A very convenient index to the resources of each state has thus, in some degree, been obtained, accessible to the inspection of those interested, and especially to that of the Representatives from the several counties.

12. Geological surveys have supplied information of great value to statesmen. By statesmen I mean those, (and such exist in all our deliberative bodies,) whose enlarged minds enable them to take a comprehensive view of all the diversified interests of their country, and the causes by which those interests are affected.

To show that a knowledge of the geology of a state or nation, is minutely useful to statesmen, let us suppose with Dr. Buckland, three

foreign travellers to arrive in England, and cross the Island; one through Cornwall, Wales, and the Greatmoors of Scotland; one through the midland counties; and the third through Dorset, Yorkshire, and other portions of the eastern shore. "The first" says he, in his *Bridgewater Essay*, "would represent Great Britain as a thinly peopled region of barren mountains, occupied by miners; the second, as a land of rich pastures, crowded with a flourishing population of manufacturers; the third, as a great corn field, occupied by persons almost exclusively engaged in the pursuits of husbandry. Hence, it appears, that the numerical amount of our population, their varied occupations, and the fundamental sources of their industry and wealth, depend, in a great degree, on the geological character of the strata on which they live."

Geology furnishes knowledge, then, of which no wise statesman can be ignorant. In legislating for a state or nation, he should have reference to the numerical amount of the population, the varied occupations, and the fundamental sources of the wealth of different portions of a state, not merely as they now exist, but as they may exist, in future times. The history of other nations may supply him with much of this knowledge; but history itself reflects the influence—the silent operation, through successive generations, of geological causes. Hence, many of the errors in legislation, which stain European and American annals, resulted from ignorance of the necessary effects of geological causes, on the people for whom the laws were passed; and, if this position be true, it is the duty of the legislature of Alabama, for this reason alone, if there were no other, to cause a scientific exploration of her territory to be made, as early as practicable, that her laws may be framed, in future, with reference to her geological character; for, from this cause will result, necessarily, the employment, manners, and morals of the people.

13. They have established the important fact, that nearly every mineral may be obtained, for the various purposes of the arts, in our own country.

14. They have given rise to the discovery of many new minerals, which will doubtless be applied to useful purposes.

15. They have given rise to the construction of geological maps, of most of the states, on which are accurately delineated their geological and mineralogical phenomena. Take, as a specimen, the map of Massachusetts. In addition to towns, rivers, mountains, and other geographical details, it exhibits all the principal depositories of granite, serpentine, limestone, soapstone, and other building stones; plumbago, coal, peat, and other useful minerals; iron, copper, lead, and other metals. A citizen of that state can ascertain as readily from this map, the positions of the mines, quarries, manufactories, &c. which he may wish to visit, as those of towns, cities, mountains, &c. From these state maps, some master spirit will, at an early period, construct a great geological map of the United States, in which geographical, mineralogical, and geological knowledge, will be happily blended. To all classes such a map would be eminently serviceable. To statesmen it would be invaluable.

16. They have directed public attention for years, in nineteen states and two territories, to investigations in the mineral kingdom.—Practical and scientific knowledge of the useful and curious produc-

tions of nature, has thus been spread cheaply, silently, and extensively, through all grades and classes of society. For most of the state geologists delivered public lectures on the science, as they went through their states, promoting their researches.

17. They have refuted the charge brought against us as Americans, by eminent European writers, as M. De Toqueville, who describe ably our civil institutions, and award to us the merit of fertile invention in labor saving machinery; but reproach us with not cultivating the principles, on which these discoveries were based, and with neglecting the most important branches of science.—We can now point triumphantly to the brilliant discoveries, made by Prof. Hitchcock, during his survey of Massachusetts,—discoveries which not only added a new and fascinating branch to the science of geology, but materially modified and enlarged the views of learned European geologists. His name is now as indelibly stamped on the list of original contributors to science, as is that of Cuvier or Mantell.

In one additional short letter, I will state the probable cost of the survey; the plans which were adopted in most of the states, in engaging the services of surveyors; and some of the peculiar considerations, which should induce our legislature to make, this session, at least a small appropriation, sufficient to secure, forthwith, the services of two individuals.

No. 6.

To the Editor of the State Journal and Flag.

Sir.—The annual expense of the proposed survey, can be very accurately estimated. An experienced state geologist can be secured for \$3000 per annum. He will be paid, this amount to Dr. Jackson; and an equal or a larger salary was paid to the principal surveyors of other States.

A part of the year, the state geologist would need at least one assistant; and a young geologist, anxious to prosecute, practically, in the woods, the study of the minutest details of his favorite science, could be engaged, for six months, for \$500.

The other incidental expenses for instruments, travelling, paper, &c., would not exceed \$1000. At all events, the legislature, by a specific appropriation, could limit the amount of expenditure to any sum as \$4000. Even \$3000 would be sufficient for the first year.

The appropriation should be placed under the control of the governor. He should be authorized to make contracts with the surveyor and his assistant, and to draw on the treasurer for their salaries, and for other necessary expenses. To him, therefore, they would be required to present their accounts; and he could, at any time, diminish the incidental expenses of the work.

It is not surprising, that some degree of apathy exists, on this subject, in the rich, level counties, in the southern half of the State. They cultivate, essentially, an agricultural region; and a scientific exploration would be directly beneficial to them, chiefly by directing public attention to means of fertilizing poor, of draining wet, and of reclaiming exhausted soils.

The indifference, yea, the opposition to the measure, existing in the central, northern, and north eastern counties, is a sensible proof of the efficacy of ignorance, and of an established system of employment, in retarding

the prosperity of man, even in highly civilized communities. These portions of the State, already much exhausted, possess mineral productions and manufacturing facilities, in a degree far greater than any southern part of the Union,—in a degree equal to any part,—yet, they still struggle against nature in the cultivation of cotton. North Carolina, South Carolina, and Georgia, are very different, in this respect, from Alabama.

They possess very little mineral wealth, and their people are, by the character of their soil, water power, and other circumstances, forced to depend chiefly on a few certain crops.

It is too obvious, however, to require proof, that Alabama is now engaged, more exclusively than any other state, in the ancient system of cultivating a single vegetable, the produce of which is wholly exported.

Most not the same fate await her, which befel the once prolific soils of Virginia, North Carolina, South Carolina, and Georgia. In the tobacco, wheat, and cotton of which, have been gradually exported the mineral elements of the soil, on which the growth of these plants depended? Should not all the resources of science be put in requisition at once, both to find means, before it be too late, of restoring to cultivated fields the mineral elements of their virgin fertility, of which they are rapidly deprived, by the cotton exported to foreign lands? and, also, to ascertain and make known modes of so diversifying the employments of the people, as to withdraw a portion of the surplus capital, already invested in agriculture, and to open new channels for profitable investment? No state can long prosper, in which all classes depend chiefly on one engaging business.

These considerations have, by a steady decline in the price of cotton, and an equally steady increase in its production, forced themselves on the attention of our most enlightened citizens. They begin to ask such questions as these:—What success does the State possess of fertilizing exhausted soils? Without them, can she continue indefinitely the cultivation of cotton? At present prices, can the middle and northern cottoneers earn a subsistence by its cultivation? If not, what physical resources will enable them to engage in such a variety of business, that the products of each man's industry will properly find a market near home?

We all know that the establishment, a few years since, of a cotton manufactory near Centerville, (a neighborhood, in which there appeared, to most men, to be not a single source of wealth,) has since been productive of most important effects. It has retained in Alabama large sums of money, given employment to hundreds of persons, and consumed a portion of the cotton raised in the State. But it has done much more. It has rendered necessary, in the immediate vicinity, a tan yard, a manufactory of shoes, a tailor's shop, a blacksmith's shop, a saw mill, a grist mill, a store, a tavern, &c. And, as much waste cotton is now thrown away, a paper mill will certainly be erected soon; this will not only afford a market for 1½ the rags in the neighborhood, and supply central Alabama with paper, but lead ultimately to numerous other manufactories. In this statement, there is no exaggeration. It is, moreover, an apt illustration of the effects of an application of the principles of science and of art to the great purposes of life, in every country. And if a geological survey should have so other effect, than that of directing the attention of all classes, from cotton fields and hog styes, to other occupations of our fenced State, the capital of the undertaking would be recovered in the public treasury, more, much more, than an hundred fold, through the increased wealth and prosperity of the people.

Governments cannot, without transgressing their authority, control the employments of their people. It is their duty, however, to devise and cherish measures for directing public attention to new or unknown sources of wealth. How can this be done so effectually as by a geological survey? Geology, aided by mineralogy and chemistry, teaches the kind, composition, qualities, distribution, and uses of all substances, organic and inorganic, found in the earth's crust. It sustains, therefore, most important relations to many of the pursuits of life. Next to chemistry, it is the most useful

of the physical sciences. Like chemistry, it is eminently practical. In a geological survey, chemistry, geology, mineralogy, and botany, combine their powers, and make united efforts, to render available and useful to man all the treasures deposited in the earth, for his benefit, by infinite numberless.

Since 1838, many intelligent citizens have labored assiduously, zealously, to induce Alabama to join other States and nations, in promoting the cause of scientific researches, which characterize the present age. For fifteen years, the civilized world has presented a most remarkable spectacle. To this period, future historians will point as the dawn of a new era, in which governments ceased to vie with each other in war and plunder, and began to unite in executing magnificent explorations, with a view to the diffusion of knowledge, the improvement of art, and the amelioration of the condition of man.

Can it be, that any reading man in Alabama, has so exclusively confined his attention to politics, as to be ignorant of the effects of such researches on the character, employment, and wealth of the governments that fostered them? Mayn't think the future prosperity of Alabama depends on the cultivation of cotton. It has injured, and it will continue to injure her, could we place her with her vast mineral resources, north of the line where cotton matures, science and art would soon make her as prosperous as her domain is large. This is the secret of the ascendancy of Ohio, and other northern States. In spite of a cold climate and its attendant disadvantages, they accumulate, more rapidly than Alabama, all the elements of national wealth.

To those, who oppose the measure, on the ground of its trifling cost to an embarrassed people unaccustomed to taxation, let me remark, that Alabama would assuredly appreciate properly any effort, though attended with some expense, to elevate the character of their State, to develop her mineral wealth; and especially to convince her credulous, that her resources are so great, as to render regulation wholly impracticable, except for a few years.

To those, who oppose it on the ground that science is theoretical, let me say, imagine some good man, who, in days of yore, opposed appropriations of public funds for scientific researches in astronomy, now need to life, and made fully sensible of the extent to which that science has benefited the commerce of the world. What emotions of regret would overwhelm his soul! Would not such a man see that, while navies had rotted, warlike movements had perished, and the very monuments of the wealth of once powerful nations had been effaced by time, the little sums that had been parsimoniously granted for scientific investigations, had gradually accumulated a vast unperishable fund of practical sciences, in astronomy, whose aid succeeding ages may draw increasing stores of wisdom, and wealth, and power, and peaceful enjoyment? Such a man would feel, that science and its results being indeed in the world; and that every discovery of philosophy is, indeed, a victory gained, not by man over his ruined fellow man, but by man over the elements,—over those things which oppose the execution of the first injunction imposed on Adam and his race, to increase and multiply; and to replenish the earth and subdue it.

Here, I must conclude this subject. Much could be added; but, having done my duty, by calling public attention to the importance of the proposed survey, I now commit its farther investigation to the legislature of the State.