6th. The general relations of *Zoology* and *Animal Physiology.*

a. The breeds of domestic animals, and to the preservation of their purity.

b. To the rearing, feeding and general tending of stock.

c. To the agency of animal life in fertilizing the soil

d. To the attack of insects upon our cultivated crops —or

7th. The general indications of *Chemistry*—such as

a. That a fertile soil, in addition to various organic compounds, contains at least eleven different mineral substances.

b. That plants contain, usually, or in most of their parts, the greater number of the same mineral substances.

c. That the animal, as a whole, also contains them, but distributed throughout its several parts in a manner different from that in which they are found, either in the plant or in the soil.

d. That the plant standing, as it were, between the soil and the animal, prepares for the latter both its organic and its mineral food.

e. That an intimate and beautiful relation exists between the soil, the plant and the animal—or between the living and the dead things of nature—or

8th. The general indications of *Geology* and *Chemistry* conjoined—such as

a. That certain Geological formations are especially rich in some of the mineral substances found in and required by plants, and produce soils which with special treatment will prove fertile and profitable to the cultivator.

b. That others are especially defective in some of these substances, and form soils which are naturally unproductive.

c. That some abound in all kinds of mineral matter which plants require, and yet yield soils which are naturally unfertile.

I. Relations of Geology to Agriculture.

From any one of these general topics, I might select beautiful examples of the close bearings of science upon profitable farming—but time does not permit me to illustrate in detail any one of the general relations to which I have referred. A few observations, however, in reference to the special applications of Geology and Chemistry, will neither detain us long, nor prove, I believe, generally uninteresting.

In reference to Geology, I could have wished to point out to you the very close economical connection which recent discoveries have established between practical geology and practical agriculture—how the manufacture and abundance of valuable manures, for example, is actually dependant on the progress of geological discovery. I must be content, however, with a brief allusion to the geology of the United States.

There are few countries, indeed, which more clearly than your own, show the relations which geology bears to agriculture in all its branches. Your wide prairies are naturally distinguished from your vast forest lands, by the character of their soils, and these again by the geological structure of the regions over which they extend, and from which they are generally derived. The broad treeless zone of calcareous marl, or rotten limestone—called the prairie or cane-brake country—which crosses Alabama in an east and west direction,* owes its natural nakedness to the dry, waterless, chalky deposits, which for a depth of hundreds of feet form the uppermost rocks of the country; and the tenaceous, soapy, unctious quality of the soil, with which the carriage wheels of travellers in that state, in wet weather, become familiar, is owing to the same cause.

So your zones of differing timber, as you ascend from the alluvial swamps of the shores in your Southern states, across the eocene and cretaceous beds to the mica slate, gneiss and granite of the Appalachian chain, are the consequences and indications of diversities in geological structure. The swamp willow, the cypresses, (*thyoides* and *distïcha*) the swamp hickory, the green palmetto, the tall magnolia, the red maple, and the cotton wood of the lowest swampy spot—the hickory, oak, magnolia, beech, walnut, tulip tree, and holly, of the dry alluvial bluffs—the perpetual pines of the tertiary (eocene) sands—the naked prairie of the cretaceous marles—and the mixed oaks, hickory and pines which appear on the primary rocks—all these zones of different timber indicate the natural connection of the vegetation of a district with the nature of the rocks on which it rests.

Nor are these geological relations of vegetable life without their influence on the daily movements of your shifting population. I have elsewhere shown how directly the movements, the natural expansion I may call it, of our first class farmers in Scotland, is not only influenced but actually, as it were, prescribed, by the geological character of the district in which they have been brought up and to which they intend to move.† So it is among you. "Those who go southwards from Virginia to North and South Carolina, and thence to Georgia and Alabama, follow, as by instinct, the corresponding zones of country. The inhabitants of the red soil of the granitic region keep to their oak and hickory; the 'crackers' of the tertiary pine barrens, to their light wood; and those who inhabit the newest geological formations in the sea islands, to their fish and oysters."§

And to this illustration of a fact, which may be proved, I believe, by observation in every country of the globe Sir Charles Lyell adds a sentence, from which I am sure you will at once draw an important, practical lesson. "On reaching Texas, all these different classes are at fault, because the cretaceous in that country consist of a hard, compact, siliceous limestone, which defies the decomposing action of the atmosphere, and forms table lands of bare rock, entirely unlike the marles, clay and sand, of the same age, in Alabama.

The tillers of the red land, of the pine barrens, of the marshy prairies, and of the sea island swamps, are equally at a loss when they migrate to a country of which the soils and surface differ from all they have left. And how is this? Because they have no familiarity with those general principles of chemical science on which all culture on all soils depends—because, if they wish to continue the same kind of tillage, and on soils similar to those they have left, they have not such a knowledge of the general principles of Geology as would enable them at once to say, to this or to that country I must go, for there alone am I likely to find them.

In my own country, I have been accustomed to press upon the agricultural community the importance of such geological knowledge to them, because of the numerous colonies we possess in all parts of the world, and because of the swarms of emigrants we yearly send off to subdue and people them.* But to you whom I now address, who already occupy, or in connection with kindred blood are destined to subdue and people, nearly half a world—how much more important must such knowledge be! Your westward movement will continue for many generations, and how much surer will the way to wealth be to your hardy pioneers, if they have been taught in their early homes, not only how to choose land, but where to look for the kind they wish to buy, and how to till it best, whatever it may be, when it has come into their possession.

I ought, perhaps, to apologise for saying so much on

* Lyell's Second Visit to the United States, p. 42, 89.

† See an article in the Edinburgh Review for March, 1849.

§ Lyell's Second Visit to the United States, p. 116.

* See the Author's *Elements of Agricultural Chemistry and Geology, fifth Edition*, p. 616.