precise, as to leave little doubt as to the nature and extent of the facts, whatever difference of opinion may exist as to the mode of their occurrence. We must ref er those who de­sire full details on these subjects to the writings of Scheele, Cruickshank, Gough, De Saussure, Huber, and Senebier, &c. The results of their labours are given, more or less com­pletely, in most of our chemical works, and are more fully detailed in Mr. Ellis’s “ Inquiries into the Changes induced on the Air by the Vegetation of Plants,” &c. parts i. and ii.

From these results we learn, that atmospheric air is use­ful to germination, from containing oxygen gas; that by the germinating process, the oxygen gas of the air is changed into an equal bulk of carbonic acid gas; and that the azotic portion of the air remains unchanged in composition, and generally unaltered in volume.

The nature and extent of the change induced on the air being thus ascertained, we have next to inquire into the mode in which it is brought about, that is, how the car­bonic acid is formed. Now, when the experiment is con­ducted in close vessels, no other substance, but the seed, is present that can afford carbon: and this fact, taken in connection with the circumstance that the seed actually con­tains carbon, and yields it, like other organized substances, to the atmosphere that surrounds it, authorises the conclu­sion, that, while the air supplies the oxygen, the seed yields the carbon by which the carbonic acid of germination is formed.

Granting, however, that carbon is afforded by the seed, and combines with the oxygen of the air, where. It may be asked, and in what manner, is this combination effected? A certain degree of moisture in the seed is necessary to enable it to yield its carbon; for, when perfectly dry, little or no reciprocal action goes on between the seed and the air. Neither does the living faculty of the seed seem ne­cessary to this combination; for carbon is afforded by seeds when they are confined by vessels in azote or hydrogen gas, and even under actual decomposition. We may therefore regard the formation of carbonic acid, in the first stages of germination, as purely chemical, and as taking place either on the surface, or within the substance of the seed. Now, from the dense structure of the investing tunics, and the circumstance of the vessels of the seed being already filled with fluid, we see no way in which air can enter the seed, so as to act either on its organized or inorganic matter ; and, consequently, we incline to the opinion, that the for­mation of carbonic acid takes place exterior to the tu­nics of the seed. Such, then, are the changes in compo­sition which the air employed in germination suffers, and such appears to be the mode in which they are accom­plished.

While these changes are produced in the air, others not less remarkable occur in the form and qualities of the seed itself; for not only are its organized parts gradually evolved, but its inorganic matter, besides being softened by the im­bibed water, acquires, in many seeds, a sweetish taste. These facts, which had long been observed in the process of malt­ing, were more distinctly ascertained by Cruickshank. He found that seeds of barley, when placed to grow in vessels, either of atmospheric air or of pure oxygen gas, acquired, in a few days, a sweetish taste, and were more or less com­pletely converted into malt.

In what manner then, or by what agency must we sup­pose this change in the inorganic matter of the seed to be accomplished? This matter, though denominated albumen, does not resemble the albumen of chemists. In vegetable physiology, the term comprehends the whole inorganic mat­ter of the seed, although that matter may contain no real albumen, but consist of several distinct substances, or “ proximate principles,” as they have been called. The principal ingredients of seeds, which afford nutrient matter to the embryo, are mucilage, starch, and sugar. For a full account of the chemical properties of these substances, we must refer to the writings of chemists; our limits permit only a very slight notice of them.

*Mucilage—*the soft and liquid state of gum—is inodorous and insipid; soluble in hot or cold water, but insoluble in al­cohol. *Starch (fecula)* is obtained from the flour *(farina)* of the more nutritive seeds. It is also insipid and inodorous: insoluble in alcohol, and even in water, unless raised to the temperature of 160°. If heated to 180°, the solution then jellies, and, by evaporation, may be reduced to a substance closely resembling gum. *Sugar* exists abundantly in the juice and fruits of plants; but in seeds. It is formed chiefly during their germination. It is soluble both in hot and cold water, and also in alcohol. Other ingredients, as *gluten,* albumen, and oil, are found in particular seeds.

Of the “ proximate principles” which contribute to ve­getable nutrition, chemists have attempted to ascertain not only the elements, but the proportions in which they enter into the several compounds. All agree in making these elements to consist chiefly of carbon, hydrogen, and oxygen, and in some instances also of nitrogen; but the proportions assigned by different analysts for the same substance differ scarcely less than those allotted for the composition of the different substances.

From the ultimate analysis of these substances, we derive little aid in explaining the chemical changes which they un­dergo ; and we must therefore recur to other modes of ac­counting for those alterations in their sensible qualities which germinating seeds exhibit. In the germination then of many seeds, the hard and insipid albumen is gradually reduced to a milky form, and acquires a sweetish taste ; while the organized parts become, at the same time, soft­ened and expanded, and prepared to take on those actions, and exhibit those specific forms, which constitute the de­velopment of the embryo. Now, the only agents which act simultaneously on the several parts of the seed, when this development occurs, are water, heat, and air ; and, as far as we have been able to trace their operation, the changes produced in the seed roust therefore arise, more or less, from the action of heat and moisture ; or from the loss of carbon ; or from some specific agency exerted directly by the oxygen gas of the air ; or arising indirectly out ot' its conversion into carbonic gas ; or from the combined opera­tion of these several agents. Let us then examine their operation, both separately and conjointly, and try to disco­ver the share which each exerts in the production of these changes.

It has been shown that neither heat alone, nor moisture alone, nor both united, are able to produce the development of the seed ; but that these agents contribute to bring it into a proper state for being acted on by the air. In what manner, then, does the air act on the germinating seed ? No direct effect can be ascribed to its nitrogen ; for that gas neither suffers nor produces change in germination, and the process goes on perfectly well either in pure oxygen gas, or in gaseous mixtures which contain no portion of azote.

But oxygen gas is essential to germination, and by that process is uniformly converted into carbonic acid gas. This disappearance of oxygen has led to the belief, that while a part of it was converted into carbonic gas, another portion actually *combined* with the seed, and contributed to its de­velopment. But it is well ascertained, that oxygen gas, by its conversion into carbonic acid, suffers no change of volume ; and as the bulk of that acid gas, produced in ger­mination, equals exactly that of the oxygen which has dis­appeared. It follows, that no portion of the oxygen, lost by the air, combines with the seed, but really exists exterior to it in the form of carbonic acid gas. The only other source from which the seed, in the experiments referred