

beard; you did not. I am grateful. But if I could only say that you had *eaten* my charm, ah—then!’ ‘Well,’ I replied, ‘say so if you like,’ and our interview ended” (p. 291).

Like most Europeans who have lived long amongst them, our author learnt to regard with very kindly feelings the simple-minded natives who with all their faults are endowed with many noble qualities of head and heart. The Persian is here described as “hospitable and obliging, as honest as the general run of mankind, and especially well disposed towards the foreigner. Home virtues amongst the Persians are many. He is very kind and indulgent to his children, and as a son his respect for both parents is excessive. But the full stream of his love and reverence is reserved for his mother; and an undutiful son or daughter is hardly ever known in the country” (p. 314). Here of course follows a flood of anecdotes, some of which serve also to illustrate the character of the Armenians, of whom he has little good to say. “I will not trust myself,” he writes, “to give my opinion of the Armenians. Of course I have known brilliant exceptions; but when I say that I indorse all that Morier, Malcolm, Lady Shiel, and the standard writers on Persia have said of these people, I need not add that my impression is unfavourable in the extreme. They possess one good quality, however, thrift” (p. 316).

In a work professing to give little more than personal experiences, valuable because derived from a lengthy residence in every part of the country, it would be unfair to look for any systematic information regarding the physical features, products, or natural resources of the land. Nevertheless, many useful details connected with these points occur here and there, and the statements made regarding the abundance and extraordinary cheapness of good provisions in all the fertile provinces would seem to justify the conclusion that Persia is not yet quite “played out.” Cheese and butter at twopence a pound, flour and bread at a penny in the towns and much less in villages, eggs at ninepence per four or five dozen, quails and partridges at fourpence a brace, hares at fourpence each, lamb and mutton at proportionately low rates, make Persia “the poor man’s paradise, in fact, to live in, the cheapest country in the world” (p. 298).

The work is furnished with a convenient glossary and an index, which contains some rather amusing entries; but there are neither maps nor illustrations beyond a solitary *chupper-khana* (posthouse) facing the title-page. But no such attractions were needed to render the “Land of the Lion and Sun” a far more entertaining book than most of our fashionable three-volume novels.

A. H. KEANE

CHLOROPHYLL CORPUSCLES AND PIGMENT BODIES IN PLANTS

Ueber die Entwicklung der Chlorophyllkörner und Farbkörper. By A. W. F. Schimper. (*Bot. Zeitung*, 1883.)

Ueber Chlorophyllkörner, Stärkebildner und Farbkörper. By A. Meyer. (*Bot. Centralblatt*, 1882.)

CONTRIBUTIONS to a more exact knowledge of the contents of the vegetable cell have increased of late to an extent which justifies the hope that some generalisa-

tion of the facts may before long be possible; meanwhile, botanists must have experienced a feeling akin to dismay at the scattered condition of much of the literature, and the apparent hopelessness of collating the facts dealing with normal and abnormal cell contents. The works of Strasburger, Schmitz, Schimper, and others have already cleared the way to a better comprehension of many details, especially with regard to the cell nucleus and starch grains; but with each step it has been felt that the pushing back of the phenomena towards a common cause has raised other difficulties hitherto unforeseen.

In the isolated position of such structures as chlorophyll grains and pigment corpuscles as unexplained cell contents, we have an illustration of wide significance in this connection, and the attempt to bring all such bodies as these and the “starch-forming corpuscles” of Schimper into definite relationship one with another must be welcomed as promising much simplification of nomenclature and discussion, the more so, since these relationships are now shown to be genetic, and therefore real. Schimper in Bonn, and A. Meyer in Strasburg, proceeding independently, have arrived at the conclusion that the chlorophyll corpuscles, “starch-forming corpuscles,” and pigment bodies of the higher plants are simply the more or less modified and mature conditions of certain minute protoplasmic structures found together with the nucleus in the youngest cells of any meristem.

Whereas botanists have assumed that chlorophyll grains, starch-formers, nuclei, &c., are produced free in the protoplasm of the cell, we are now called upon to note that such is not the case; but that these bodies arise from distinct structures present in the young cell from its earliest existence, and that any pigment (green or otherwise), starch grains (directly assimilated or not), &c., found in connection with the structures named, arise by later changes in the substance of the protoplasmic corpuscles produced by continuous growth and division of the few, minute “plastids” found in the young cell.

Meyer and Schimper agree in all essential points regarding the relationship and development of these bodies, and the slight differences in details and nomenclature between the two investigators in no way affect the main question.

To quote an example, we may take Schimper’s description of the development of the pigment bodies occurring in the flower of *Hemerocallis fulva*. The cells of the perigone contain brick-red crystalline needles or three-pointed tablets, which arise as follows:—

In the very young flower bud, the cells contain, besides the nucleus and cell-protoplasm, minute bodies which Schimper names *plastidia*—a general term for these bodies in all meristems, and independent of any function afterwards performed by them. When the flower bud is already green the *plastidia* nearest the light have acquired a distinct green colour, and function, no doubt, as chlorophyll corpuscles; all such green *plastidia* are called by Schimper *chloroplastidia*. The *plastidia* in the cells more deeply situated, however, remain pale, and may be called *leukoplastidia*. All stages intermediate between *leukoplastidia* and *chloroplastidia* occur. The small lenticular *chloroplastidia* increase in size, become flatter, and divide as the cell grows. They then become narrower and pointed, some becoming needle- or spindle-shaped;

a few remain broad, and finally acquire a triangular form with sharply pointed corners.

Meanwhile, the colour passes through intermediate dirty shades from green to brick-red; and, some time before the flower bud opens the ultimate shape and colour are attained, and the bodies are now called *chromoplastidia*. Many similar instances have established the connection between the three kinds of *plastidia*,¹ e.g. petals of *Senecio*, *Bellis*, *Tropæolum*, fruits of *Sorbus*, *Rosa*, *Lonicera*, &c.

The primitive *plastidia* are universally present in the meristems of the higher plants, and have now been found in so many seeds and embryos, that Schimper suggests that they no doubt exist in the embryo-sac and oosphere from the first. All the *chloroplasts* of the plumule and stem-axis, &c., arise by division of the *plastidia* in the *punctum vegetationis* of the young stem; these may be green from a very early stage, or acquire their green colour later, or remain colourless (*leukoplasts*). In cases where the *leukoplasts* form large starch grains, we have the *Stärkebildner* discovered by Schimper in 1880; all the kinds of *plastidia*, however, may be found in connection with starch grains, which often become resorbed later.

In the same way, all the *chloroplasts*, *leukoplasts*, and *chromoplasts* of the roots arise by division and differentiation of the few primitive *plastidia* in the *punctum vegetationis* of the radicle.

Since *chloroplasts* or *leukoplasts* are found at a very early age in the embryos of *Crucifers*, *Leguminosæ*, *Geraniaceæ*, and many others, Schimper considers it probable that they arise from primitive *plastidia* in the oosphere. *Chloroplasts* and *leukoplasts* (as starch-forming corpuscles) are visible in the embryo of *Linum austriacum* when it consists of eight cells only, and the minute starch-grains observed in the embryo sac and oosphere of that plant are no doubt contained in *leukoplasts*—which become green afterwards and are then visible. Schimper finds that the primitive *plastidia* may remain colourless as *leukoplasts*—which, if they form starch grains, are the *Stärkebildner* of his earlier papers—or may become *chloroplasts*, as is usual (but by no means universal) in cells exposed to light, which remain green, or pass over into *chromoplasts* (most flowers and fruits). Nevertheless, the order of change is not fixed, and no sharp lines can be drawn—thus, a *leukoplast* may become green, and function as a *chloroplast* for a time, and finally lose its colour again, and become a *leukoplast*.

The *Characeæ* seem to be the earliest plants in which all three forms of these bodies occur; the apical cells containing *leukoplasts*, and the antheridia red *chromoplasts*. Schimper suggests that if the oosphere is proved to contain already formed *plastidia*, it will support the view that the higher green plants owe their origin to symbiosis of green and colourless organisms. The author enters into no particulars, however, concerning this hypothesis, which appears by no means obvious in the light of other considerations.

¹ A. Meyer terms the bodies ana-plasts (=leucoplastidia), auto-plasts (=chloroplastidia), and chromo-plasts (=chromoplastidia) respectively. He uses the generic term *trophoplasts* to embrace all collectively. We may call them leuko-, chloro-, and chromo-plasts, since these names imply no functional peculiarities.

The following may be selected as further illustrations of Schimper's work:—

1. *Leucoplasts* arise from colourless *plastidia* (roots, &c.) or, more rarely, from *chloroplasts* (e.g. fruit of *Symphoricarpos*). They may become green *chloroplasts* (many embryos), or function as *Stärkebildner* (e.g. deeply-situated cells), or remain apparently without function (e.g. epidermis cells). In many flowers they become *chromoplasts*.

2. *Chloroplasts* (i.e. chlorophyll corpuscles) arise from the growth and division of primitive *plastidia* which are already green, or by the development of green colouring-matter in *leukoplasts* exposed to light. They often become *chromoplasts* later.

3. *Chromoplasts*.—All shades occur between pure carmine-red and greenish-yellow—never blue—the earlier statements being based on errors of observation.¹

The development of the colouring matter is frequently attended by a disappearance of the starch grains on or in the *leukoplast* or *chloroplast* from which the *chromoplast* arises. As sometimes occurs with other bodies, the spindles, needles, and tablets produced as the ultimate forms of the *chromoplasts* appear to proceed from a process of crystallisation of certain of the proteid contents of the *chromoplast* from a formless matrix of living protoplasm. In these cases the pigmented tablets, needles, rods, &c., must be regarded as crystalloids. More rarely the proteids of the *leukoplasts* and *chromoplasts* separate in the same crystalline form.

Schimper distinguishes three types of *chromoplasts*:—

1. The spherical type, found in the arillus of *Taxus*, fruit of *Solanum*, &c.

2. Two or more pointed needles, tablets, &c., of *Hemerocallis*, *Lilium*, *Tropæolum*, and other flowers. In the fruits of *Rosa*, *Lonicera*, &c., both these types occur together.

3. In this type the *chromoplasts* are rod-shaped—e.g. flowers of *Tulipa*, root of *Daucus*, &c.

No relations can be discovered between the form, &c., of any of these bodies and the natural groups in which they occur.

H. MARSHALL WARD

OUR BOOK SHELF

The Forests of England and the Management of them in Bygone Times. By John Croumbie Brown, LL.D. (Edinburgh: Oliver and Boyd, 1883.)

French Forest Ordinance of 1669, with Historical Sketch of Previous Treatment of Forests in France. Compiled and Translated by John Croumbie Brown, LL.D. (Edinburgh: Oliver and Boyd, 1883.)

THESE two little books, published almost simultaneously but in the order in which their titles are given above, have been written, as Dr. Brown tells us, "as a small contribution to the literature of Britain on subjects pertaining to forest science." The author has shown in previous writings on kindred subjects the scarcity of English literature on forestry as compared with that of France and Germany, and he again draws attention to this fact by copious extracts in "The Forests of England" from a little work of his on "The Schools of Forestry in Europe," published in 1877.

The forests of England, exclusive of their practical utility, have played a not unimportant part in the history

¹ Schimper points out how easily such bodies as these are altered by processes hurtful to the cell: they must be observed in perfectly fresh, uncut, and uninjured cells.