

most chemists employ it, they generally write it in an elliptical form, shirking or ignoring the difficulties which the fully-expanded formula too obviously suggests. But, in spite of these drawbacks, we may say, without exaggeration, that no formula ever exercised such an influence upon the progress of organic chemistry. Right or wrong, final or only provisional, the benzene formula grouped round it the scattered facts: each member of the mysterious aromatic series found its proper place and appeared in its proper light; cases of isomerism were predicted, even to their exact number; and the synthesis of important natural compounds, so high in the scale of complexity as alizarin and indigo, was rendered possible. The obscure corner is now a vast field, cultivated alike by the scientific and by the practical chemist, and far exceeding in extent the whole of the rest of organic chemistry.

The present work opens with an account of the benzene theory. A very valuable feature in the mode of treatment is the way in which the historical method is employed. The much-enduring student of organic chemistry at the present day is generally loaded with facts; occasionally the teacher condescends to furnish him with reasons; but not one student in fifty has any idea of the historical genesis of the facts and reasons presented to him. The ordinary text-books do little or nothing to supply this want; the exhaustive records of facts, like Beilstein's "Handbuch,"<sup>1</sup> and the short text-books written for the student can neither of them, although for different reasons, spare the necessary space. Here the present work comes to our aid. Nothing could well be more instructive than the historical treatment of this very subject of the benzene theory as here given. The student is enabled to see how the views at present held have been evolved, step by step, from Kekulé's formula. And in this connection the earliest tentatives, however we may despise them now, are in their way as instructive as the latest and most carefully-considered deductions. Witness, for example, the historical tables which the authors give in illustration of "orientation in the aromatic series"—the determination of the position of the substituting atoms or groups in the derivatives of benzene. The reader can follow in detail the process by which errors of method or of experiment were gradually eliminated, until, ultimately, the present satisfactory condition of things was reached, in which the same problem, attacked by half a dozen independent methods, yields in every case the same result. The student who knows these things can give reasons for the faith that is in him, and he knows that, no matter how the theory itself may change, the relations worked out under the theory are permanent, and that when the new theory comes, these relations will find their places in it, differently expressed perhaps, but unchanged in their interdependence.

The descriptive portion of the work deals with benzene and its derivatives, using the latter term in its narrow sense, as excluding all derivatives which are homologous or derived from homologues. There are certain disadvantages in this arrangement: thus, it separates widely compounds which are closely related: toluene is not

treated of along with benzene, which it most closely resembles; the toluidines are separated from aniline, and so on. But no system of classification is perfect; and the authors, as practical teachers, have doubtless satisfactory reasons for adopting the foregoing arrangement.

There is little further to be said about the descriptive portion, the nature of which is sufficiently indicated by the above account of its scope. The information is very full. The interesting theoretical and historical discussions are continued throughout the volume, and impart to it a character of "readableness" rather unusual in a work of this nature. Finally, the student of technology will find the various manufacturing processes treated of in some detail.

#### OUR BOOK SHELF

*Photography the Servant of Astronomy.* By Edward S. Holden. (Reprinted from the *Overland Monthly*, November 1886.)

HALF a century ago the attention of astronomers was almost entirely confined to the study of the movements of the heavenly bodies; indeed, Bessel actually defined astronomy as consisting therein. But since then an entirely new department of astronomy has been developed, to which the name "Astro-physics" has been given, and this new department proceeds along three principal lines—spectroscopy, photometry, and photography. The great Observatory founded by the munificence of the late James Lick is to be chiefly engaged in the development of the third of these methods, though spectroscopy will also receive a large share of attention. Having therefore in view the chief purpose to which the great powers of his Observatory will be devoted, the Director of the Lick Observatory has here given a clear and concise account of the principal services which photography has rendered to astronomy in the past, and an analysis of those which may be expected from it in the future. A description of the facilities for photographic research possessed by the Lick Observatory completes this interesting and instructive paper. Prof. Holden mentions incidentally that Mr. Grubb's ingenious device for placing the observer in position for using the telescope, by raising or lowering the entire floor, will be adopted in the great dome of the Observatory.

*Observations nouvelles sur le Tufeau de Cipy et sur le Crétacé supérieur du Hainaut.* Par A. Rutot et E. Van den Broeck. (Liège: H. Vaillant-Carmanne, 1886.)

IN view of the stratigraphical gap that exists in this country between the Chalk with *Belemnitella mucronata* and the Thanet Sands, the papers thus re-issued in a collected form have an interest considerably beyond the district with which they immediately deal. The value of passage-beds being that they blur over the hard-and-fast lines laid down by our earlier conceptions, it may seem ungrateful to define the exact upward limit of deposits such as those which close in the Danian series. The observations of the authors, however, go to show that the Tufeau de Cipy of the Mons basin, which has been hitherto referred to the Maestrichtian—a fact incorporated in ordinary text-book information—is in reality intimately connected with the Montian. A close examination of 3000 kilogrammes of the conglomerate that forms its base has yielded rolled *Thecidæa* and Cretaceous Bryozoa; but the principal fauna, as indicated by casts of unrolled shells, is of distinctly Tertiary type, containing such representative forms as *Cerithium montense*, *Voluta elevata*, and *Turritella montensis*. The beds near St. Symphorien, correlated with

<sup>1</sup> *Handbuch* in German means, not a *hand-book*, but—*lucus a non lucendo*—an exhaustive treatise which in most cases it would be physically impossible to hold in the hand.