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A Manual of Dyeing: for the use of Practical Dyers, Manufacturers, Students, and all interested in the Art of Dyeing — [Source link](#)

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Weierstrass, to whom it is due, has never been printed ; and the only published proof, besides the one which Dr. Forsyth gives, appears in a paper by M. Phragmen in vol. vii. of the "Acta Mathematica," and is on entirely different lines. Whether either proof is entirely satisfactory is a point on which differences of opinion may conceivably occur, though of course there is no doubt as to the truth of the theorem itself.

Chap. xiv., which is headed "Connectivity of Surfaces," is purely geometrical, and strictly has nothing to do with the theory of functions. It was however necessary for the author to introduce such a digression if the following chapters dealing with Riemann's theory were to be understood, since there is no treatise to which reference could be made for the various theorems and results that have to be used. The chief properties of a Riemann's surface, regarded as arising from an algebraical equation between the variables, are discussed in Chap. xv. Though there is no difficulty in conceiving the geometrical nature of a Riemann's surface from a description, the relation between the surface and the set of functions (algebraische Gebilde) whose study it is intended to simplify is not so readily grasped at first by the student ; and it would not perhaps have been amiss to have dealt with this relation in one or two simple cases, at some length, as an introduction to this part of the subject. In Chap. xvi., the surface still being regarded as defined by a given equation, the properties of uniform functions on the surface, and of their integrals, is investigated.

From this point to the end of the book we have to do, more or less directly, with the fundamentally new conception of Riemann which has been so wonderfully developed during the last ten or fifteen years. The Riemann's surface, as defined by a given equation, affords a most convenient means of study of a system of connected functions. Suppose, however, the surface to be given quite independently of any equation. The possibility at once suggests itself that the surface may serve as the definition of a set of connected functions. Riemann's own demonstration that this is the case has since been shown to be faulty, but the conception is an invaluable one, and it has been placed on a secure foundation by Schwartz (and others), by means of the so-called existence theorem. Chap. xvii. is entirely occupied with the proof of this theorem, and in Chap. xviii. follow the investigations with respect to the form and nature of the integrals and uniform functions, so shown to exist, on a Riemann's surface given arbitrarily.

Chaps. xix. and xx. deal at length with the theory of conformal representation. This forms one of the most obviously interesting parts of the subject, and is also one of those which lend themselves most readily to the purposes of application ; and it is to be noted that, although owing to necessities of arrangement these chapters occur near the end of the book, the author suggests that, on a first reading, Chap. xix. should be taken at an early stage.

The last chapter in the book gives an introduction to the theory of automorphic functions, the previous one being taken up by a necessary digression on groups of linear substitutions. Dr. Forsyth follows M. Poincaré in actually obtaining analytical expressions for the functions in the form of the ratio of infinite series, analogous to the expressions for elliptic functions as ratios of the theta-

functions. These analytical expressions, though of great interest, are too complicated in form to be readily used for deducing the properties of the functions they represent, so that their properties must be inferred from their quasi-geometrical definition by means of a "fundamental region" ; and this is essentially the method of dealing with them used by Prof. Klein.

In thus shortly stating the contents, or rather the headings, of the successive chapters some risk is run of representing the book as a mere compilation. Nothing could possibly be further from the truth. From the nature of the case it is inevitable that the greater portion of the book should be taken up with detailing the results of other writers, but Dr. Forsyth has done this in a most independent way. The book is instinct all through with an original spirit ; in numerous instances, where clearness or conciseness were to be gained, the author has modified or completely altered the usually-given proofs, while, as has been already stated, the various parts of the subject have been brought together, and the many different ways of dealing with them have been used, in such a way that the theory is presented to the reader as a connected and harmonious whole. Dr. Forsyth is to be warmly congratulated on having brought to so successful a conclusion what must have been an extremely arduous task. If it is not ungracious to "ask for more" so soon, we may express the hope that he will now go on to deal, as completely and successfully, with functions defined by differential equations.

The book itself is beautifully printed and the figures, many of which must have required careful drawing, are well reproduced. The table of contents is sufficiently complete to form a sort of *précis* of the whole ; and lastly, we have to be grateful for three separate indices. The first of these, an index to all the technical terms used in the book, whether English or foreign, is a most useful addition ; especially for those who wish to use the book without reading right through it. W. BURNSIDE.

TINCTORIAL ART AND SCIENCE.

A Manual of Dyeing: for the use of Practical Dyers, Manufacturers, Students, and all interested in the Art of Dyeing. By Edmund Knecht, Ph.D., Christopher Rawson, F.I.C., and Richard Loewenthal, Ph.D. (London : Charles Griffin and Co., 1893.)

THE present work consists of three volumes, two of letterpress, interspersed with illustrations of plant, which run to over 900 pages, and a third volume containing specimens of dyed fabrics. It is a substantial contribution to an important branch of technology, and the authors have succeeded fairly well in meeting the requirements of the various classes of readers for whose use the work has been written. The first general impression produced on looking through the volumes is one of satisfaction that the subject is handled in a more scientific way than has hitherto been the case in such works. The only feeling of disappointment to which the consideration of the book gives rise is in no way attributable to the authors, but is due to the circumstance that so little is known about the scientific relationship between a colouring-matter and the fabric which is dyed thereby. All that is known about the theory of dyeing is ably stated in the introductory chapter, and one of the

authors (Dr. Knecht) has himself made some very interesting investigations in this field. But, in spite of all that has been written, the subject of dyeing has still to be taught as an art rather than as a science. The centres of the tinctorial industry in this country, such as Leeds, Manchester, Bradford, and Huddersfield, are now provided with Technical Schools, in which the dyeing department is made a special feature. If we might venture to offer a word of advice to those who are providing for this industry, it is that adequate provision should be made for the scientific side of the subject by the equipment of laboratories and the appointment of competent specialists for carrying on original investigation in connection with dyeing. The dyeing departments in those schools which we have had the opportunity of visiting are admirably equipped for instruction in the principles of the art, but the instructor has to devote so much time to this part of the work, and the students who attend are, as a rule, so ill-prepared in general scientific training that the instruction given cannot rise much above that handicraft level against which the writer has had so frequently to protest in connection with other branches of technology. Till this defect is remedied, the results achieved by our technical schools will not be commensurate with the endowment bestowed upon their equipment.

The work which has given rise to these reflections will go far towards placing the tinctorial art on a higher scientific level. It is not, as the authors state in the preface, "a mere 'cookery-book,' containing 'rule of thumb' recipes." A detailed analysis of its contents would be out of place in these columns, but a general idea of its scope may be given. The introductory chapter, as already stated, deals with the theory of dyeing. So far as wool and silk fibres are concerned, the authors consider that the evidence is in favour of a chemical as opposed to a purely mechanical explanation:—

"According to the mechanical theory, wool dyed with magenta, for instance, would simply absorb the unchanged hydrochloride of the dyestuff, and thus assume the same colour in the solution of the dyestuff. But experiment has shown that this is not the case. It absorbs the colour base, which is, however, in itself colourless. Where then does the colour come from? We can come to no other logical conclusion than that the colour base has combined chemically with some constituent of the fibre to form a coloured salt."

But this explanation does not enable us to see how the dyed "constituent" is combined with the other constituents of the fibre:—

"This objection is easily met by assuming that what is taken up *is* in chemical combination with some insoluble constituent of the fibre and is held by the rest of the transparent or translucent substance of the fibre in a state of *solid solution*."

Thus the theory advocated is partly chemical and partly in that debateable region where chemistry and physics have recently come into apparent collision. Researches in connection with the theory of dyeing have more than a purely technical value, and we hope that Dr. Knecht will continue the good work which he has commenced. With respect to cotton the authors state:—

"With the large numbers of direct cotton colours which are placed at our disposal, and which are continually increasing in number, the question becomes more and more

important from a theoretical point of view. It is not probable that it will ever be solved by vague theoretical speculations based on one or two known facts. In all probability the solution of the question will require much laborious work, including many quantitative determinations."

The technical part of the work begins with Part II., dealing with the textile fibres of vegetable and animal origin, such as cotton, flax, hemp, jute, China grass, wool, silk, &c., not omitting Chardonnet's artificial "silk" prepared from nitrated cellulose. The third part is devoted to water from the dyer's point of view, and the fourth part to washing and bleaching. Parts V. to VIII. deal with the materials used in dyeing. All these materials are classified into the three groups, Chemicals, Mordants, and Dyestuffs, and are described under the collective (and most objectionable) name of "drugs." The acids and alkalis employed by the dyer are first treated of, then the mordants, which are discussed in a very thorough manner, no less than 150 pages being devoted to them. Three parts (VI., VII., and VIII.) are devoted to the natural, artificial organic, and mineral colours respectively.

The machinery used in dyeing forms the subject of Part IX., the investigation into the tinctorial properties of colouring matters that of Part X., and the concluding part treats of the analysis and valuation of the materials used by the dyer. There is an appendix of miscellaneous subjects such as weights and measures, thermometer scales, specific gravities, light and colour, &c.

The foregoing synopsis of its contents shows that the work is well calculated to fulfil the object which the authors had in view, viz. to serve "as a book of reference or *vade mecum* to the educated dyer." But it is not really for an individual class that this book is written; it appeals to several distinct kinds of readers. It may safely be asserted that there are few, if any dyers, in this country, however "educated," who could with equal intelligence follow every section of the work under consideration. The practical dyer who is most skilful in applying colouring matters to fabrics is generally hazy in his notions of chemistry, and absolutely ignorant so far as concerns the finer questions of the "constitution" of the complex products which chemistry has placed at his disposal. In order to understand properly the chemical portions of this manual a very sound foundation of chemical science must have been previously laid. On the other hand, a person who is thoroughly acquainted with the chemistry of dyestuffs would be worse than useless—he might be actually destructive—in the dye-house unless he had been trained in the application of colouring matters on a large scale. We are sometimes told that the practical dyer need know nothing of chemistry; that he would not do his work any better when possessed of such knowledge. There are still to be met with here and there so-called "practical" men who go further and assert that the possession of too much chemical knowledge would unfit the dyer for his work. But public opinion appears to be undergoing a healthy change in this as in other departments of technology. It may be long before we produce the ideal technologist who is equally acquainted with the chemical nature of his materials and the mechanical methods of applying them. It appears, however, that this combination of knowledge is just what is wanted in the industry. The joint authorship of the present manual perhaps

supplies the best illustration of this principle that could be furnished.

A word or two as to the illustrations, of which there are no less than 116 incorporated with the text. We notice with some regret the prevailing fault so common in technical manuals: no scale of size is in any case given. This perhaps is of no consequence to the practical dyer who is already acquainted with the "plant," but as the work is also intended for students the omission is serious. Much of the machinery also is of foreign make; it is to be hoped that this has not the same significance as the fact that by far the greater number of artificial colouring matters described in the seventh part are of foreign manufacture. In the art of dyeing this country still holds a very good position, and it is satisfactory to find that the authors have not had to go outside Yorkshire for the dyed patterns forming the third volume of their work.

Perhaps the best recommendation that we can offer in favour of the present manual is that there is nothing which in our opinion calls for very serious criticism. The chemical formulæ might, in many cases, have been more economically packed; in some instances "bonds" have apparently dropped out (benzoflavine, p. 469; Nile-blue, p. 486, and the oxazines generally; anthracene, p. 577, &c.). The authors formulate the so-called "bicarbonates" on p. 68 on the type $M'O(CO_2)_2$. The utility of the third volume would have been much enhanced if the pattern sheets had been paged and indexed separately, so as to have facilitated reference to any particular pattern. The appendix on light and colour (p. 881) wants amplifying in view of the importance of this subject to the tinctorial industry, and some account of Abney's researches on colour should have been given. This section would also have been made more intelligible by the introduction of a few illustrations of absorption spectra and the practical method of mapping them.

About seventeen years ago we had occasion to notice a work of a somewhat similar nature in these columns (vol. xiii. p. 283). No more striking illustration of the advancement in the art of the dyer could be furnished than by comparing that work (Crace-Calvert's "Dyeing and Calico Printing," by Stenhouse and Groves) with the "Manual" of Dr. Knecht and his colleagues. Other works have appeared since that time, some of real value, others mere compilations pandering to the examination fetish. It would be invidious to institute comparisons; suffice it to say that the present work will compare favourably with any treatise in this department of applied science.

R. MELDOLA.

A NEW MANUAL OF BACTERIOLOGY.

A Manual of Bacteriology. By George M. Sternberg, M.D., Deputy-Surgeon-General U.S. Army. (New York: William Wood and Co., 1892.)

A YOUNG and rapidly-growing science continually demands a series of new text-books for the use of those students who would keep themselves abreast of the times, and it is, perhaps, inevitable that, with the growth of knowledge, the text-books should assume more and more alarming proportions. The present work—a portly tome of nearly nine hundred pages—comes to us from across the Atlantic as the latest, the largest, and, let us add, the most complete manual of bacteriology which has yet

appeared in the English language. The volume combines in itself not only an account of such facts as are already established in the science from a morphological, chemical, and pathological point of view, discussions on such abstruse subjects as susceptibility and immunity, but also full details of the means by which these results have been obtained, and practical directions for the carrying on of laboratory work. It is thus, as stated in the preface, at once a manual for reference, a text book for students, and a handbook for the laboratory. And in the mind of the reader there may arise the question whether the attempt to combine the three has not resulted in a volume of somewhat too portentous a size.

Dr. Sternberg is well qualified for the task he has undertaken. Himself a well-known worker in bacteriology, and director of the Hoagland Laboratory in Brooklyn, his work is no mere compilation of the results of others, but embodies also the fruits of his own original thought and observation. The amount of labour involved in bringing together from the literature of different countries the facts necessary for a manual of this kind may be estimated from the fact that the bibliography alone fills over a hundred pages and contains 2582 references. The illustrations are numerous, clear, and accurate; many of them are printed in colours, and there are some good reproductions of microphotographs.

The work is practically divided into four parts, and of these the first is mainly occupied by an account of methods and of practical laboratory work, preceded by short sections on the history of the subject, on classification, and morphology. These are clear and concise, the basis of classification adopted being practically that of Baumgarten, in which the different genera are grouped under the three main headings of "micrococci," "bacilli," and "spirilla." The practical directions include staining methods, the preparation and sterilisation of culture media, and the various modes of cultivation, together with directions for experiments on animals. These subjects are dealt with very fully, and will be found to embrace all that can be required for laboratory work. A short section on microphotography concludes this part. Many English ears will resent the term "stick-culture," which is used as the equivalent of the German "stich-cultur"; and, indeed, in other instances it would have been possible to employ more euphonious translations of the original German terms. It may also be noted that in describing Chamberland's filter that gentleman's name is incorrectly spelt in every instance.

The second portion of the book deals with the biology and chemistry of bacteria, and the important subject of disinfection and antiseptics. Details are given of the modifications which may be artificially induced in the biological characters of bacteria, and especially of those by which attenuation of virulence can be produced in pathogenic species. The section on the products of vital activity contains an account of the various fermentations and decompositions known to depend on bacterial action, and is followed by one on the ptomaines and toxalbumins produced by certain species. The subject of disinfection is then treated at some length, embracing a description of the effects on micro-organisms of dry and moist heat of acids, alkalies, various salts, and coal-tar products, which is fully up to date and leaves little to be desired. The whole concludes with a useful summary of means of