that line of investigation. About two years ago, Prof. G. F. Becker published his 'Digest'; a year later my own 'Recalculation' appeared; and now comes a third volume on the subject by Professor Lothar Meyer and Dr. Karl Seubert of Tübingen.

A comparison of this new work with the other two shows, that, in general terms, it is intermediate between them in its character. Becker collected the data relative to atomic weights, and brought them into systematic shape, but attempted no thorough recalculation. Meyer and Seubert classify and recalculate the published weighings, and make many valuable reductions of apparent weights to absolute or vacuum standards; but, with a few exceptions, they do not attempt to combine the work of different investigators, and they reject the method of least squares as inapplicable to the data at hand. My own effort was to reduce determinations as far as possible to common standards, to combine all similar data into general means, and to compute from all the evidence the most probable values for the atomic weights of the different elements. In so doing, I applied the method of least squares, and I see as yet no reason for discrediting that manner of discussion. Each of the three volumes fills a definite place; and, in any future revision of the field, each will be found a useful supplement to the others.

In general, the results obtained by Meyer and Seubert differ but slightly from mine. In comparing the atomic weights of sixty-six elements, the difference between the two recalculations falls within a tenth of a unit in thirty-seven cases, and is greater than a tenth in twenty-nine; but among the latter are found most of the rarer and less perfectly known metals. In many instances the differences are due to a trifling fundamental difference in the value assigned to oxygen. The Meyer-Seubert value is O=15.96; mine is O=15.9633: and this slight variation in the third and fourth decimal places sometimes is multiplied among the higher atomic weights to an appreciable amount. Where the two recalculations agree, they serve to confirm each other: where they differ, they indicate the important fields for further investigation. Most of the differences, however, are mainly due to differences in the manner of computation.

In some respects the new recalculation is open to criticism. Inasmuch as Meyer and Seubert rarely attempt to combine the available data, they are, perforce, compelled, in dealing with each element, to select more or less arbitrarily the results of one investigation, and give it preference over all the others. This they do without assigning reasons for their choice; and such a lack of critical statement is much to be regretted. Again: the arrangement of the material is inconvenient, notwithstanding the fact that there is a well-classified index, both for elements and for authors. For example: aluminum, instead of being discussed in a division by itself, is treated in separate ratios on pp. 22, 23, 83, 139, 151, and 193; and a comparison of the results of different investigations is thus rendered a very troublesome matter.

Some omissions are noteworthy, and seem difficult to explain. Such, for example, are Cleve's determination of the atomic weight of scandium, Julius Thomsen's synthesis of water, and Russell's hydrogen series for cobalt and nickel. Russell's work on the oxides of these metals is given, and his results receive final acceptance; but wherein they are preferable to those of Lee is not stated. Another curious set of omissions occurs under antimony. Here are cited Professor Cooke's latest bromide series, and his set of results comparing the trisulphide with the chloride. But his syntheses of sulphide from the metal, and his valuable iodide series, are altogether ignored, while his earlier bromide series barely receives mention. Finally, nothing is said concerning Dumas' investigations upon the occlusion of oxygen by silver, although no recalculation of the atomic weights can safely ignore so important a factor.

F. W. Clarke.

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## *WILDER AND GAGE'S INTRODUCTION TO ANATOMY.*

*Anatomical technology as applied to the domestic cat: an introduction to human, veterinary, and comparative anatomy.* By Burt G. Wilder, B.S., M.D., and Simon H. Gage, B.S. New York and Chicago, *A. S. Barnes & Co.*, 1882. 25+575 p. l. 8°.

This book the authors state to have grown out of their needs as instructors of students preparing for practical work in human, veterinary, or comparative anatomy. To students of the first and second of the above classes there is no doubt it will prove extremely useful. It is probably correct to say, that, although containing a good deal of irrelevant matter, and blemished by the unnecessarily extensive employment of a novel terminology, it contains by far the best set of directions for the dissection of a mammal below man in the scale, ever published for the use of that large class who prefer or are compelled to enter

on professional study without any thorough preliminary training. The bodies of horses or oxen are large and costly for elementary work, and, owing chiefly to defective legislation, in many states anatomical material is apt to be scarce in medical schools. Hence, for many years, good directions for the anatomical study of some easily obtainable mammal of convenient size have been a desideratum. The lad who has properly dissected a cat knows already a good deal of human or equine anatomy. He has not to learn, in his so often disgracefully brief medical course, how to use his scalpel; he knows what a humerus and a cerebral hemisphere are; iliac artery and median nerve are not strange and unmeaning names to him. In consequence, he can from the first profitably confine himself mainly to those special points in human, equine, or bovine anatomy, which have direct bearing on the future practice of his profession.

For those who intend to study comparative anatomy, or who have a year or two to devote to preparatory scientific studies before entering a medical school, we cannot agree with the authors that the cat is a good animal to begin with. By those students who desire some scientific anatomical knowledge, and have time and opportunity to acquire it, so high a type as the mammalian ought only to be taken up after thorough study of several lower and simpler forms. It is in connection with this fact that we think it unfortunate that the authors have made such unsparing use of new names. To the scientific student a simple and uniform terminology, applicable to all vertebrates without confusion, is worth the trouble of learning. But the great majority of those who will find this book useful will be lads desiring to acquire some knowledge of anatomical technique and phraseology as an aid to future professional, specialized, non-scientific study of the body of man or of certain domestic animals. It would surely be better for this purpose that (to take an example) students should learn to know, read, and speak of the cavities in the encephalon as the ventricles of the brain, the name under which they will find them in their professional text-books, rather than be taught to call them procoelia, diacoelia, epicoelia, and so forth. So far as the employment in the laboratory of the book itself is concerned, we must add, however, that the nomenclature and terminology employed have proved much smaller obstacles to its usefulness than we expected. When we first got hold of it, and read such directions as 'dorsiduct the tail,' and such statements as 'the cranium is the caudal part of the skull,' we feared that the class on whom we proposed to try it would have a bad time. The men did grumble a little at first, but very quickly got to interpret easily all the new adjectives used in the text, and even to like them as facilitating brevity of description. This experimental evidence of the value of the nomenclature adopted may outweigh the apparent disadvantage of teaching students to call things by names which they will rarely if ever afterwards hear applied to them.

The first eighty-six pages of the book are occupied with introductory remarks on anatomical technology, and things in general. Many of them will be of great value to students who have to work without the supervision of a teacher; and also make the book a good one to put in the hands of a laboratory servant. It is very convenient to have directions for preparing injections and preservative liquids, for keeping the animals in good health, for anaesthetizing or killing them, and for cleaning and sharpening instruments, collected and printed as we here find them. There is, however, in these useful introductory pages, a considerable amount of superfluous matter. It may be necessary, though we doubt it, to inform the reader what is a fair price for a good scalpel or from what firms in the United States he may buy a suitable pair of scales; but an account of the metric system and metric bureau, and of good methods of exciting interest in metric measurements, is out of place in a dissector's handbook: a table of comparison of the ordinary and the metric weights and measures is quite enough. A discussion of the rules of simple arithmetic would have been as suitable, as an appendix to the formulae for interconverting the Centigrade and Fahrenheit thermometric scales, as is the account given of the metric system. Similarly, most of the 'Rules and aphorisms of general application' are about as much in place in an anatomical text-book as would be the sermon on the mount: they are admirable of their kind, but one is puzzled to know what they are doing in this gallery.

The book, however, is, in spite of some oddities, an honest piece of work, and will have permanent value: it is a real contribution to our knowledge of cat anatomy. Though many of its novelties in nomenclature are we believe unnecessary, and subjects are discussed which have no pertinence to the matter in hand, yet it will most undoubtedly prove of great use to a large class of students, and, we will add, to all teachers of vertebrate anat-

omy. We only wish the publisher had done as well as the authors. The illustrations are numerous, and probably sufficient to fulfil the end of helping the student in his work; but, from an artistic point of view, they are, with rare exceptions, simply atrocious.

## MINOR BOOK NOTICES.

*Guesses at purpose in nature, with especial reference to plants.* By W. Powell James, M.A. London, 1883. 192 p. 12°.

This is a little book of ten chapters, which has just reached us, and which we would notice with a word or two in addition to an announcement of its title. The author, we fancy, is a clergyman and merely an amateur naturalist. However that may be, his *guesses* are shrewd, and the way of putting them is taking. Considering the great number and variety of the facts he has collected, — the greater part from books, — he has fallen into few mistakes; so that the volume has more scientific value than is usual in such treatises.

*An outline of qualitative analysis for beginners.* By John T. Stoddard, Ph.D, professor of chemistry in Smith college. Northampton, *Gazette printing company*, 1883. 4+54 p. 16°.

The general plan of this work will doubtless be recognized as one which gives the best results in teaching qualitative analysis. To a certain extent it is faulty in detail, both as regards convenience of arrangement and the selection of methods. Although this criticism applies more especially to the course of basic analysis, if advantage were taken of differences in solubility of certain barium, calcium, and silver salts of the acids, it would save the student much time and labor in general analysis. An appended list of the names and symbols of the more common reagents will be found useful.

*A short course on quantitative analysis.* By John Howard Appleton, A.M., Brown university. Philadelphia, *Cowperthwait & Co.*, 1881. 183 p., cuts. 12°.

The course of analysis presented in this work consists, with few exceptions, of a judicious selection of methods and determinations. The descriptions of processes and apparatus will undoubtedly be of much service in the laboratory, although considerable descriptive chemistry is introduced with which the student is supposed to be familiar before undertaking quantitative analysis. An exception will probably be taken to the completeness of the notes and explanations, which leave little opportunity for thought or study on the part of the student.

## WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

### MATHEMATICS.

**Alignment curves on the ellipsoid.** — Mr. C. H. Kummell describes several curves that represent the straight line, all of which, on the sphere, reduce to the great circle. The *vertical section* is traced by the surveyor at one end, who fixes points in range with the other end. The *proörthode* (*πρό, ὀρθός, ὁδός*) results, if the alignment at each point is determined at a point previously fixed, the distance between the two being infinitesimal. It is followed in chaining, or more roughly by the pedestrian in moving toward an object. In these two curves no back-sight is taken: they are differently related to the two ends, and do not return upon themselves. The *diorthode* (*διά*) is the locus of all points at which the vertical plane through one terminal point also includes the other. It is used in laying out primary base-lines, the points of which are determined by making fore-sights and back-sights differ always by 180°. This curve has been confounded with the preceding by Dr. Bremiker (*Studien über höhere geodäsie*, 1869) and others; but the proörthode is everywhere tangent to the vertical plane passing through one terminal point, while the diorthode, except at the ends, is not. The curve of shortest distance between two points, often called the 'geodetic line,' would more properly be called the *brachisthode* (*βράχιστος*). These names were suggested by Mr. W. R. Galt of Norfolk, Va.

Mr. Kummell shows the diorthode to be the intersection of the ellipsoid with a hyperboloid of one sheet. In the case of an ellipsoid of revolution, this is the parabolic hyperboloid. Taking the three principal axes, $a$, $b$, $c$, as axes of $x$, $y$, and $z$, he represents the points where the chord connecting the two termini of the proposed alignment pierces the planes $xy$, $xz$, $yz$, by $(x_z, y_z, 0)$, $(x_y, 0, z_y)$, and $(0, y_x, z_x)$, respectively, and introduces quantities, —

$$a_b{}^2 = 1 - \frac{a^2}{b^2}, \quad a_c{}^2 = 1 - \frac{a^2}{c^2},$$

and so, by cyclic permutation of letters, $\beta_c{}^2$ and $\beta_a{}^2$, $\gamma_a{}^2$ and $\gamma_b{}^2$; where the ratio of each of his first set of auxiliary quantities to one of his last gives one of the co-ordinates of position of those generatrices of the hyperboloid which are perpendicular to the co-ordinate planes. The equation of the hyperboloid is, —

$$\left(x - \frac{x_y}{\beta_a{}^2}\right)\left(y - \frac{y_z}{\gamma_b{}^2}\right)\left(z - \frac{z_x}{a_c{}^2}\right) = \left(x - \frac{x_z}{\gamma_a{}^2}\right)\left(y - \frac{y_x}{a_b{}^2}\right)\left(z - \frac{z_y}{\beta_c{}^2}\right),$$

and it passes though the centre of the ellipsoid.

The diorthode cannot be traced practically, because of the curvature of the earth. Mr. Kummell has investigated the locus of all points through which one tangent line meets the normals drawn at the two extremities, and finds its intersecting surface to be of