addition to the orthodox chemistry the student learns about many things which are ordinarily included in a special course on physical chemistry: rate of diffusion, reversible equilibrium, mass action, catalysis, phase rule, thermochemical relations, dissociation theory, electrolysis and Faraday's law, free energy, theorem of LeChatelier, strength of acids, relation of monotropic and enantiotropic forms, hydrolysis, reaction velocity.

The dissociation theory is introduced in a very natural way. It is first shown that the hydrogen of an acid differs from the hydrogen of other compounds in that it always shows the same reactions quite irrespective of the nature of the acid radical. Certain other properties are characteristic only of the hydroxyl of bases and are further independent of the basic radical. All soluble chlorides react with silver nitrate to form silver chloride. The radical whose reactions are independent of the other radical forming the salt is defined as an ion, and the characteristic properties of these ions are then discussed. It is then shown that salts are electrolytes, and that the ions of chemistry are also the ions of electrolysis.

There is no question but that this book is the official sign of the beginning of a new era in teaching introductory chemistry. Hitherto physical chemistry has been an independent branch of chemistry rather than the science of chemistry. While physical chemistry has exerted an influence upon elementary, analytic, inorganic, and organic chemistry, this has been an influence from without. An occasional fact has been worked into the frame here, an opening for a new view has been made there; but this has been a case of patching old garments in a vain attempt to keep them decently presentable. It is evident that the whole teaching of chemistry must be put on a new basis and carried on along scientific lines. This has been done for elementary chemistry in the book now under discussion, and it is now possible for those teaching introductory chemistry to present their subject in a satisfactory way, even though they may not themselves have been trained in physical chemistry.

The time is ripe for such a change. Ostwald has been working up to it for years. In this country, as well as in Europe, there are universities and colleges where lectures on elementary chemistry are now being given by physical chemists along similar, though not identical, lines. Holleman has recently published a text-book which may be looked upon as a forerunner of Ostwald's volume. While the reviewer is not so sanguine as to expect that Ostwald's book will be adopted at once throughout the length and breadth of the scientific world, yet the time is surely coming when the right way of teaching the subject will be the general way.

The fact that this book will revolutionize the whole teaching of introductory chemistry is a striking illustration of Ostwald's ability as an expounder. Ostwald has done much brilliant scientific work; but his real strength is as a teacher. It is not an exaggeration to say that the first edition of his *Lehrbuch* created the science of physical chemistry. Horstmann had had a glimpse of the promised land; but it was Ostwald who led the chemists into it. Van't Hoff originated the modern theory of solutions, Arrhenius the theory of electrolytic dissociation, and Nernst the osmotic theory of the voltaic cell; but it is Ostwald who has developed these theories and who has forced their acceptance. It is to Ostwald that we owe the rejuvenation of analytical chemistry and we now owe to Ostwald by far the best text-book on introductory chemistry.

Wilder D. Bancroft.

Twelfth Annual Report on the Railways of the United States, for the year ending June 30, 1899. By the Statistician to the Interstate Commerce Commission. Washington, Gov't Print. 1900. 8vo. Pp. 712.

It is unfortunate that some such system as is employed by the Census Bureau, adapted to this special line of work, cannot reduce the period of waiting for these reports. The Commission dates its report for the year ending June, 1899, precisely one year later than that date and the shortening of this delay and waiting would have value in high ratio with the proportion by which the period of delay might be reduced. Undoubtedly the Commission and its employees do their best, however, and we must hope for some later Hollerith to

aid them in approximating coincidence of date of report with the close of the period reported upon. It is, nevertheless, a report worth waiting for. It gives us the mileage of all the railways of the country; a classification for the purposes of the report; data relating to equipment, number of men employed; capitalization and valuation of property, magnitude of the freight traffic, of the passenger movement, public service, earnings and expenses and profits, gross and net. A condensed summary follows and a general balance sheet. Railway accidents are discussed, recommendation made and a completely tabulated set of figures secured by the Commission is appended. It is a useful compendium to engineers, to railway men, to economists and to that rarer class, statesmen.

The total mileage, June 30, 1899, was 189,294.66 miles, a gain of 2,898.34 for the year. It is interesting to note that this increase has occurred mainly in the Southern States. The track mileage was 252,364.48, a gain of 4,831.96 miles, single track and sidings. This track is distributed among 2,049 railway corporations, of which about one-half are 'operating roads' and the balance leased lines or purchases, with 142 'private roads.' Of the total, 35 have been reorganized during the year, 20 have been consolidated and 42 merged in other lines, while 30 were abandoned, averaging, however, but 10 miles each. The larger systems are made up of a number of lines, each originally independent, and still holding, often, original charters.

Locomotives number 36,703, of which more than one fourth are passenger engines, one-half freight and the balance switching and special-service engines. Cars in service numbered 1,375,916, of which 33,850 were for passenger traffic and 46,556 assigned to the service of the company. Increasing economy of transportation is shown by a gain in density of traffic, both passenger and freight. Two-thirds of the trains were fitted with the train-brake, and nearly all with the automatic coupler, obviously an immense gain in safety over the conditions of but a few years since.

Employees numbered 928,924, or 495 per mile, a gain in two years of 105,448, with a *decrease* in number per mile of 20, indicating, again, gain in economy of operation. Their pay was $522,967,896, a gain of $27,912,278 for the employees' account during the year. This is 40 per cent. of the gross earnings and 60 per cent. of the operating expenses. "The fact indicates the extent to which wage-earners are interested in the conservative management of railways."

Capital aggregates $11,033,954,898, a gain of $215,400,867, more than twice that of the preceding year. Of the stock, $5,515,011,726, or 59.39 per cent., paid no dividends; but even this is better than the preceding year, in which 66.26 per cent. paid nothing. The funded debt, which passed its interest, amounted to $572,410,746, and was 10.45 per cent. of the total, a better statement than that of 1898, when 15.82 per cent. thus failed to meet its obligations.

Of the freight traffic, mines furnished 51.47 per cent.; manufactured products, next in order, 13.45; agriculture, 11.33; forestry, 10.89 — a distribution probably very surprising to many. The number of passengers carried one mile was 14,591,327,613, a gain of over 10 per cent.; the number of ton-miles of merchandise was 123,667,257,153, a gain of eight per cent. The gross earnings were $1,313,610,118; net, $482,090,923; net dividends, $94,992,909. Operating expenses aggregated $896,968,999, and practically an equal sum was distributed to employees and outside recipients as an addition to their incomes in form of wages, dividends, etc. The total surplus for the year was $53,064,877, to be compared with the *deficit* of the preceding year, $6,120,483.

Gross earnings were $7,005 per mile; operating costs, $4,570, and income $2,435. The revenue per unit was, per ton-mile, 0.734 cent; per passenger-mile it was 1.925, practically two cents. Per train-mile, the revenue was $1.01 for passengers and $1.79 for freight. Costs per train-mile are $0.9839.

Accidents remain a serious item, 7,123 people having been killed during the year and 44,620 injured, an increase for the year of four per cent. killed and over eight per cent. injured, notwithstanding the great increase in the use of automatic couplers, this being the dangerous point in railway operation. Of these totals, the passenger list of killed amounted to but 239, about three per cent., but employees con-

stituted one-third the list. Of the injured, passengers were about eight per cent. only, the employees nearer 80 per cent. A passenger must travel, on the average, over 60,000,000 miles to lose his life; in New England, however, he must travel 125,290,750 miles; in the southwest he may lose it at the end of 34,327,929 miles. The average traveler is hurt after traveling about 4,000,000 miles.

The report is a most important one, and should be carefully studied by all interested in any phase of the subject.

R. H. Thurston.

A Book of Whales. By F. E. Beddard. The Science Series. Published by G. P. Putnam's Sons, New York, and John Murray, London. 40 illustrations. 8vo. Pp. xv + 320.

The seventh publication of this well-known series is from the pen of the English editor, and attempts to gather into a comparatively small compass a general account of the Cetacea, and 'to illustrate by means of the group of whales a very important generalization, the intimate relation between structure and environment.'

In the absence of any other comprehensive work on the subject, the book will receive a hearty welcome. Teachers of anatomy and custodians of museums have long felt the need of some general work on the Cetacea, and there is a growing popular interest in all matters that relate to the life of the ocean. It is a pity, however, that the author did not make a good thing better by publishing a list of the more important papers bearing on his subject. American zoologists have contributed no small amount to the literature of the Cetacea, and Professor Beddard acknowledges the help he has received from the works of True, Cope and Scammon.

The introductory chapters make interesting reading. They deal with the external form and internal structure of whales, but assume that the reader has a general knowledge of the group and of comparative anatomy. The author himself is often not satisfied with the explanations that he gives for the existence of certain structures. It is indeed a hard matter to give plausible reasons for the existence of many devices of nature, and phylogenetic explanations based on hypothetical ancestors are not as convincing now as they were a few years ago.

The section on the stomach is especially interesting, and one is almost overcome when he reads of the amount of food that a hungry Cetacean can devour. The stomach of a 'bottle-nose' contained ten thousand beaks of squid, and a grampus contained thirteen porpoises and fourteen seals, all perfectly whole and intact. It is thought that large stones in the stomachs of certain whales may perform the same function that gravel performs in the bird's gizzard.

More than half the book deals with the various groups of Cetacea. The treatment is not technical, and the monotony of mere description is varied by anecdotes, historical reviews and what is now known as natural history.

The press work is of a high order, although the inversion of the figure of the right whale is evidence of some carelessness and gives the animal a most grotesque appearance. There are some other indications of lack of care in preparing copy and reading proof, but the general appearance of the book is good, and the text figures and many of the plates are excellent.

H. C. Bumpus.

GENERAL.

According to a plèbicite taken by the London *Academy* the 'Life and Letters of Huxley' is the most interesting book announced for publication this autumn. It is reported that in addition to this volume the letters exchanged between Huxley and Tyndall may be printed in full.

It is stated in the New York *Evening Post* that an interesting manuscript autobiography of the late Sir Richard Owen, the eminent paleontologist, has been discovered among a lot of old documents put up for sale in a London auction room. The existence of this manuscript was unknown and unsuspected, and it was only when the documents came into the hands of those familiar with the handwriting that its authorship was identified. A singular feature of the autobiography is that it is written, not in the first person, but chiefly in the third person, the author referring to himself as 'he' or to