The white stars are considered to be in a more diffuse state than our Sun, and hence in an earlier stage of development. The subdivision represented by Bellatrix, which has a characteristic spectrum of the 'Orion type,' is placed first in the order of stellar evolution. Considerable space is devoted to the question of which class of spectrum corresponds to the highest temperature of the radiating photosphere, and numerous lines of evidence are adduced to support the view that this is found in case of the stars with spectra of the solar type. The argument based upon the relative extension of the continuous spectrum into the ultra-violet region, the extension of the solar type being regarded by the authors as the greatest, is not wholly convincing, as the difficulty of securing identical conditions of exposure, atmospheric absorption, etc., in the case of different stars of different types, is very great. But emphasis is well placed upon the importance of taking into account more fully than has hitherto been done the large diminution in the star's effective radiation from the integrated effect of the selective absorption of its atmosphere; that is, from the absorption represented by the very numerous dark lines in spectra of the solar type.

Attention is drawn to the important effect of the convection currents in stellar atmospheres, and their increasing activity in the region where the dark lines originate, as the stars advance in age. This increase is assigned as a possible cause of the diminished prominence of the hydrogen lines in the spectra of the second and later types.

The reasons for the presence of certain particular lines of certain particular elements in the spectra of stars at different stages are considered by the authors to lie in the conditions of the absorbing region, as to density and composition, particularly the mixing of various vapors. The absence of the metallic lines from the spectra of the first type is attributed in part to the slight convectional effects in the very diffuse atmospheres of these stars, so that as a result of diffusion hydrogen and the lighter elements preponderate in the region where absorption occurs; and in part to a slow temperature gradient, so that the vapors just above the photosphere might differ in temperature too little from the photosphere for their lines to be seen as dark on the continuous spectrum.

The effect of density of the vapor is quite fully considered, particularly in connection with the laboratory experiments of the authors on the behavior of the calcium lines.

The twelve half-tone plates which illustrate the volume are admirably done, and represent extended and skilful work by the authors in their arrangement. Plate II. contains reproductions of numerous 'historical spectra,' as they are well named, obtained by the authors between 1876 and 1895. These are fully described in Chapter VII. The remaining plates receive a 'preliminary discussion' in Chapter VIII.

The treatment of the subject as a whole is qualitative rather than quantitative, and is not mathematical, so that the general reader can follow the clear and philosophical reasoning of the authors without the necessity of a previous familiarity with technical symbols.

Artistic head pieces and initials appropriate to the subject, the hand work of Lady Huggins, complete the adornment of the volume. The work has received the Actonian prize of the Royal Society, and the election of Sir William Huggins to the presidency of the Royal Society at this time will be recognized as highly appropriate.

Edwin B. Frost.

Annual Report of the Chief of the Bureau of Steam Engineering of the U. S. Navy Department, 1900. Washington, Government Printing Office. 1900. 8vo. Pp. 128, pl. 17, folded.

This report, apart from its importance as detailing the work in applied science of one of the most important bureaus of the U. S. Government, has a peculiar interest at the moment to all who have become aware of the tendency illustrated, for example, in the operation of the National Observatory and of the Coast Survey, toward amateurism in all branches of the Government service. The Engineer-in-Chief of the Navy, Admiral Melville, is one of the most competent expert professionals in the Navy, or outside it, in his department, and his report, while giving an admirably condensed account

of the operations of his bureau during the official year 1899–1900, exhibits a state of affairs, in a vitally important department of public service, which must intensely interest, and at the same time alarm, every patriotic citizen.

The report includes a statement of the appropriations, and, in detail, the expenditures, of the branch of that departmental organization which is entrusted with the employment of two and a half to three millions of dollars annually in the design, construction, repair and maintenance of the naval machinery of our whole fleet. It gives an outline of the work in hand and an account of that performed during the past fiscal year, details of the inspection of contract work, and of the conduct and results of trial trips of new vessels in the Navy and of old craft repaired. It considers the character, numbers and efficiency of the personnel of the engineer department of the Bureau and of the fleet, the effect of recent and of proposed changes, and especially of such as affect the organization of the Navy Department and the crews of our vessels.

This Bureau has expended in the year reported upon over $2,500,000, of which about one-half represents costs of labor and one-half expenditures for materials. In addition to extensive work in the designing of new machinery, the Bureau is compelled to examine and report upon several thousands of detail drawings submitted by contractors. Some conception of the extent and importance of this work may be obtained when it is known that, for a single ship, the *Kearsarge*, about 600 drawings were made of approved constructions and an uncounted number of proposed variations or expanded details. Even small craft, like the torpedo-boats, require almost as much work, though on a smaller scale, as they have nearly as many working parts as the largest vessels. There are seventy vessels under construction, or about to be contracted for. For all this work, and for the operations of the fleet, large numbers of engineer and constructing experts are needed; but, meanwhile, the number available, which has for years past been entirely inadequate, is constantly being reduced by retirement, death and resignation; no proper arrangements having been made for its maintenance.

Where, for example, about twenty-five inspectors are needed, fifteen are to-day compelled to do the work as best they can, with evident risk to the efficiency of the service; where about thirty officers are needed at the Navy yards and stations, fourteen carry the burden, with similar risks to the service. 'The present force of engineer-officers is everywhere overtaxed,' but there is no way provided by which to relieve these officers or to add to their numbers, in a proper manner, the needed additional expert and experienced officers, possessed, as they should be, of an ample scientific and technical training and varied earlier experience. The ideal preparation is obviously some such preliminary general and special scientific education as is now, as a matter of course, presupposed in civil life, a professional apprenticeship and later experience in actual work of design and construction, and opportunities to exhibit that capacity for scientific work and for the management of productive organizations which, only, insures professional success, alike, in public and in private business. In fact, the tendency seems to be, in this as in so many other branches of the public service, to permit the most important affairs to drift into the hands of incompetents or, at best, of amateurs, personally clever, often, but entirely unequal to the conduct of affairs demanding special education, special experience, and native talent properly cultivated and developed by the common and essential process of evolution under the unsparing system of selection which obtains in a career of any sort in everyday life.

The Chief of Bureau protests, for example, against a proposed consolidation of the long-established bureaus of the Navy Department, in which a branch of the work of the service, as mechanical engineering, naval construction or navigation, is entrusted to a body of experts in that branch, presided over by a selected expert-chief detailed from the list of most experienced, talented and distinguished officers in the service. This must result, as is pointed out very clearly and convincingly, in either the introduction, as a general supervising officer,

of one who is expert only in his own special field or of one who has no expert knowledge of any branch. In the first case, the outcome would be what is seen in so many other governmental departments already: the subordination of able and competent men to an official without the ability to direct and who is made an official superior over men, each in his own department, without superior. In the second alternative case, the Secretary of the Navy, usually a man without any expert knowledge of the technical work of the service, will have, interposed between himself and the men who are competent to advise him, each in his own province, an officer equally incompetent with the Secretary himself—with the added and fatal disadvantage of giving to the new incompetent, authority over men technically educated and fully competent.

The vital principle that every important business should be conducted by an expert in that business is, in this case, ignored. Either course would, in the opinion of those most competent to judge, insure inefficiency in the operation of the naval service, of that arm on which the nation most relies to defend its honor and its rights in conflict with a foreign foe. But the most dangerous of foes is the amateur, in the position of an expert, controlling an important branch of public service.

The 'Personnel Bill,' passed by Congress as an emergency measure during the excitement attending the outbreak of the war with Spain, and which consolidates the whole Naval Engineer Corps with the Line of the Navy, seems to have worked a mischief in a similar manner. Amateur talent is entrusted with duties and responsibilities which can only be safely assigned to experts of high scientific education, thorough professional training and ample experience. The members of the old Engineer Corps are dying off and the whole business of engineering is nominally becoming shifted into the hands of line-officers without other than amateur knowledge of the business, and with obvious danger to the whole naval service. Either the law is defective or it is not found practicable to secure its intended results; but, whichever may be the fact, the important outcome is danger of sacrifice of the vital interests of the Navy to amateur incompetence. Nor is there the excuse in lack of knowledge of the danger, in advance. Every report of the chiefs of bureau of earlier years, for a generation past, has included a warning, often earnest and impressive, of this coming danger; while, throughout the whole period, the steady reduction of the numbers of officers in this most vitally important of all divisions of the modern naval personnel has been progressing, and the dangerous change has been advancing toward a crisis, despite the constant warnings, not only of all chiefs of bureau, but of substantially all old members of the wrecked corps.

The constant danger to the Naval Observatory and its personnel through amateurism has been as constant a subject of protest, in the same manner and with no better result; but this introduction of amateurism into the seagoing navy is even more serious and is certain to result in more serious disaster.

R. H. Thurston.

A Record of the Geology of Texas for the Decade ending December 31, 1896. By Frederic W. Simonds, Ph.D., Professor of Geology in the University of Texas—Transactions Texas Academy of Science for 1899, Vol. 3, Austin, Texas, October, 1900.

This work is deserving of more than passing notice for Professor Simonds has not only given a most painstaking and complete bibliography of the geology of the Texas region, but as truly expressed in the title a record of the same. Each of the 466 works noted is accompanied by an intelligent abstract or synopsis, so that this book becomes of greatest value to any one wishing to ascertain information concerning the Texas region for the decade ending with the year 1896. The task of compiling such a work at Austin, so remote from good library facilities, must have been enormous, and is a credit to Professor Simonds, the Texas Academy of Science and the University of Texas.

It is gratifying also to note that this work is but one of the recent manifestations of the quickened and improved condition of the University of Texas. Within the past ten years this institution has been gradually acquiring a faculty of progressive and able men and has made