the visit was by no means unsuccessful. Dr. Eric Lindsay was much impressed by the progress made by some of our junior members.

Our officers for the oncoming year are: Chairman, Mr. C. MacMahon; Vice-Chairman, Mr. Alec Scott; Hon. Treasurer, Miss R. J. MacCaw; and Hon. Secretary, the indispensable Mr. John H. McElderry.

BOOKS RECEIVED

Theoretical Astrophysics. Edited by V. A. Ambartsumyan, President of the Academy of Sciences of the Armenian S.S.R. Translated from the Russian by J. B. Sykes. Pergamon Press (London, New York, Paris, Los Angeles), 1958. Pp. XVI + 645, with 75 figures and 36 tables in the text, 3 appendices, a bibliography of 183 entries, an "index of stars", index of symbols, index of names and index of subjects. Price £6. 15s.

The book contains nine parts, comprising 36 chapters, written by four authors who are well-known Russian astrophysicists: E. R. Mustel (Parts I, II and III, a total of 400 pages); V. V. Sobolev (Parts IV, V, and VI, a total of 119 pages); A. B. Severnyi (Part VII, 30 pages); V. A. Ambartsumyan (Parts VIII and IX, a total of 66 pages.)

Mustel's chapters are written at great length and with great mathematical detail; they pre-suppose a complete knowledge of basic astrophysics, as well as a fair previous knowledge of the theoretical branches considered; most of his information is based on Unsöld's and Aller's books, to which also frequent reference is made. The author is undoubtedly competent in his subject and presents his various problems correctly. However, a certain lack of system in presentation, the disregard for the shortcomings of a student who is not always adept in these special matters, and the lengthy treatment renders these chapters unsuitable for a textbook at a graduate level; only an accomplished astrophysicist will be able to master their content.

On the contrary, Sobolev's contribution is systematic and easily readable; it has a good style and conforms to what is believed to be the standard of a good textbook.

Severnyi's rather too short contribution is equally clear and readable; unfortunately, it is out of date and, quite intentionally, presents its subject —the theory of stellar interiors—essentially as it was a quarter of a century ago.

Ambartsumyan's two concluding parts reveal a non-uniformity of presentation. There are chapters devoted to stiff mathematical treatment of particular problems, with a disregard for their historical and factual setting; and others, of a light, almost popular, style, briefly touching on the surface only of the various phenomena and failing to convey the present state of our knowledge as completely as could be expected from an advanced course in astrophysics.

The coverage is far from being complete. With due allowance for

possible differences in opinion as to what should be included under the rather vaguely defined title of "astrophysics", some of the omissions cannot be justified. Thus, the term "zodiacal light" does not occur in the book nor is its theory discussed, although on p. 380 the text comes very near to this topic; nothing about "comets" can be found; in planetary photometry, only a very theoretical one-sided article is inserted, with a non-exhaustive application to Venus and a short reference to Jupiter (omitted from the index of subjects); Mars and the moon are not mentioned.

The number of tables and figures is rather small, as compared with the volume of the text; this, however, agrees with the scarcity of factual data given in the book. On the other hand, the wealth of mathematical expressions is overwhelming; there are 1220 numbered and many unnumbered equations. Sample checks by the reviewer did not reveal any misprints or mistakes in the equations; it seems that these are reliable and can be used with confidence for reference. Some inconvenience is caused by the notations; the Index of Notations (pp. 634, 635) is very incomplete and the reader, unable to memorize all the symbols, or consulting for reference an isolated portion of the book, may have to go backwards over a considerable length of the text, to find out the meaning of a particular notation.

The text also appears to be practically free from misprints.

It may be supposed that the unevenness in coverage is explained by the preference for topics pursued by Russian astrophysicists. This is only partly true. Although researches by Russian workers are given considerable prominence, their representation is also incomplete. If the lack of mention of Gerasimovitch, one of the most outstanding Russian theoretical astrophysicists, can be explained by the political implications of his tragic fate (*cf. Irish Astr. J.*, 4, p. 163, March 1957), the omission of Fessenkov from the Index of Names (p. 636) has no such explanation.

It may be noted that by far the greater portion of the book is still based on the results of Western research. This fact is partly concealed by omission or insufficient quotation of the authors, especially in Parts I-III; thus, the name of H. N. Russell occurs there only once, on p. 391, in the term "Russell-Saunders coupling"; in the Index of Names, Russell is only referred to on p. 568, in connection with the theory of the photometry of Venus—a side-line of his. There are many examples of authors' names being mentioned in connection with some less important work, whereas their more outstanding contributions are presented anonymously. Thus, on p. 54 it is simply stated that "In 1939 it was discovered that . . . . . the absorption of radiation by *negative hydrogen ions* becomes . . . . important"; however, the author of this outstanding discovery, R. Wildt, is mentioned only on p. 358, in connection with a formula for chronospheric density distribution, and without reference to literature. This example is typical. On the other hand, Part IX differs from the rest of the book in quoting profusely the names of Western authors.

These circumstances should be viewed in the light of the claims made in the preface to the Russian edition dated 1952 (pp. XI, XII). It is stated there that the subject of theoretical astrophysics "has been developed particularly in the USSR", and that in this field "Soviet scientists now occupy *the* leading place in the world" (italics by reviewer). Undoubtedly, the contribution of Russian astrophysicists is important, and it is a handicap that Western scientists are developing their discipline without being much influenced by their Eastern colleagues. On the contrary, the perusal of the book under review will convince the reader that our Russian counterparts are eagerly watching developments in the West. As a result, all new ideas and methods originating in the West are followed up by the Russians; numerical applications are made, often by introducing more mathematical detail. In most cases, however, the mathematical refinement is rendered illusory by uncertainties in the basic data, and the pursuit of better results ends with disillusioned typical remarks like "Unfortunately, the results of the above-mentioned calculations are as yet purely qualitative" (p. 303), or "This hypothesis, however, requires further development". The book abounds with such honest admissions of the futility of the too-mathematical approach. As to new ideas and methods, there are, undoubtedly, some of genuine Russian origin, like Ambartsumyan's concept of stellar associations. The claim, however, for *the* leading place in the world, cannot be upheld and is more than exaggerated.

"Soviet scientists . . . . . are guided by the method of dialectical materialism, and always link their work to reality . . .". This pronouncement in the preface (p. XI) discloses a handicap inherent in contemporary Russian research. The genuine scientist is guided only by the urge to find *the truth*, and we believe that our Russian colleagues do not differ in this respect from their Western counterparts; the link with reality is also common to science in general, as well as the negation of dogmatism. The prescription of "the method of dialectical materialism", however, introduces an element of dogma; by defining in advance what is correct and true, the acceptance of the method leads to a deviation from pure science. In many lines of research this circumstance may be of no practical consequence; in others, however, there is always a danger that the scientist will clash with the prevalent dogma, and, if not prepared to become a martyr, he will be under pressure to avoid certain undesirable topics or conclusions. Some incompleteness in the book may be partly due to this cause.

The book may not only be considered an anthology of Russian astrophysical research, showing their specific regions of interest and methods of approach, even when much of it is inspired by Western example; for the professional astrophysicist it may be a useful guide to specific problems, showing these in a light which is different from what he has been used to.

The contents of the book may be briefly described as follows, a few critical remarks being currently made.

Part I, "The Theory of The Radiative Equilibrium of Stellar Photospheres and the Continuous Spectrum of Stars". Chapter 1, *Introductory remarks*

(pp. 1-2). Chapter 2, *Basic concepts of the theory of radiation. The equations of transfer* (pp. 3-9). Chapter 3, *Radiative equilibrium of the stellar photosphere. The solution of the equation of transfer* (pp. 10-21). Chapter 4, *The theory of radiative equilibrium for an absorption coefficient independent of the frequency* (pp. 21-31); on p. 30, the sources of the temperature estimates of the sun and stars are not given. Chapter 5, *The coefficients of continuous absorption* (pp. 31-56); on p. 33, no references are given as to the sources of the abundance data of Table 1 (this is partly remedied on p. 230). Chapter 6, *The distribution of energy in the continuous spectra of stars for an absorption coefficient depending on the frequency* (pp. 56-75); on p. 60 occurs the first reference to Russian work. Chapter 7, *The structure of stellar photospheres* (pp. 76-85); on p. 76, the assumption of pure radiative equilibrium is not realistic. Chapter 8, *The application of the laws of thermodynamic equilibrium to stellar photospheres* (pp. 86-106).

Part II, "The Formation of Absorption Lines in the Spectra of Stars". Chapter 9, *The mechanism of the formation of absorption lines in stellar atmospheres* (pp. 107-118). Chapter 10, *The solution of the equations of transfer for frequencies inside absorption lines* (pp. 118-127). Chapter 11, *The coefficients of selective absorption* (pp. 127-147); on p. 144, the symbol n has two different meanings. Chapter 12, *The application of the elementary theory of contours. Curves of growth* (pp. 147-170). Chapter 13, *The interpretation of observed contours of absorption lines in stellar and solar spectra* (pp. 170-198); on p. 180 it is stated that turbulent cells are "moving in various directions with various velocities"; evidently, this refers to motion *inside* the cells, or to that of turbulent packets, and not to the cells themselves; on p. 197, ι Herculis is called a "non-rotating star"; this statement is too categorical, and certainly incorrect; apparently, what is meant is that rotational broadening of the spectral lines has not been detected, which may correspond to slow rotation, or to pole-on orientation. Chapter 14, *The variation of absorption-line contours from the centre to the limb of the solar disc. Non-coherent scattering. Central residual intensities* (pp. 198-217). Chapter 15, *Methods of studying the chemical composition of stars. The results of investigations* (pp. 218-235); on p. 221, the source of Table 8 is not stated; on p. 232, the principles of spectral classification are not explained—a difficult question even for experts and one that is in urgent need of theoretical elucidation; on p. 235 it is said that the percentage of hydrogen in stars of large and small velocity dispersion is "almost the same"; what is meant is that hydrogen is the most abundant element in both classes of stars; at present there is no way of determining the exact abundance of hydrogen in stellar atmospheres or of ascertaining its equality in different stars. Chapter 16, *The interpretation of the spectral sequence. The absolute-magnitude effect. The scale of effective temperatures* (pp. 235-255). On p. 235 it is stated that the Harvard classification of spectra "depends on only *one* parameter" (italics by the author); the original Harvard classification depended on several parameters, which caused considerable confusion until the introduction of one-parameter systems; on pp. 236 and 246, "spectral class" is referred to as a definite stellar parameter, yet nowhere in

the book is the term defined.

Part III, "The Physics of the Solar Envelopes". Chapter 17, *The structure of the solar photosphere. Granulation. Convection* (pp. 256-265); on p. 265, there is an interesting original idea ascribed to V. A. Krat, explaining the superexcitation of lines of high excitation potential by fluctuations of local temperature brought about by granulation. Chapter 18, *The electrodynamics of the Sun's atmosphere* (pp. 265-289). Chapter 19, *Sunspots and faculae* (pp. 290-308); on pp. 298-300, the explanation of the low temperature of the sunspots as a consequence of the magnetic field is an interesting idea, although somewhat obscurely presented. Chapter 20, *Prominences* (pp. 308-340); quite a good chapter, setting up problems which yet remain without a solution; on p. 315, Fig. 52, the ordinates (apparently heights) are not defined. Chapter 21, *The chromosphere. Flocculi. Chromospheric flares* (pp. 341-378); on p. 341 it is stated that at a height of 15,000 km, "the density of matter would have to fall practically to zero" which is rather vague; a quantitative estimate should have been given; on p. 344, it is not easy to find out the meaning of the symbols in Table 14; on p. 354, the statement that coronal radiation is not sufficient to explain the high degree of ionization of hydrogen in the lower chromosphere is not substantiated. Chapter 22, *The corona and the radio emission of the Sun* (pp. 378-399) is again quite good; on p. 387, the sentence ". . . the probabilities of forbidden transitions are relatively large" is ambiguous; apparently, relative probabilities of radiative *versus* collisional de-excitation are implied.

Part IV, "Planetary Nebulae". *Introductory note* (p. 400). Chapter 23, *The mechanism of the radiation of the nebulae. The temperatures of their nuclei* (pp. 401-413). Chapter 24, *The physical state of matter in the nebulae* (pp. 413-434); in the footnote on p. 425 attention is drawn to the two-quantum emission of hydrogen as being possibly responsible for the continuous spectrum of the planetary nebulae. This new idea, originally due to Kipper, of the Tartu Observatory, would have deserved more consideration. Chapter 25, *Radiative equilibrium in planetary nebulae* (pp. 434-447).

Part V, "Novae". Chapter 26, *Nova outbursts and their interpretation* (pp. 448-466). Chapter 27, *The part played by the ejected envelopes in the evolution of novae* (pp. 466-477).

Part VI, "Stars with bright spectral lines". Chapter 28, *The formation of emission lines* (pp. 478-497); on p. 496, the remarkable excess of helium abundance over hydrogen in Wolf-Rayet stars is stressed. Chapter 29, *Problems of the physics of stars with bright spectral lines* (pp. 497-519).

Part VII, "The Internal Structure of Stars". This part is based practically on Eddington's (1926) and Chandrasekhar's (1939) books, with a few applications by Russian authors. The more recent developments, based on a realistic approach to the problems of convection and mixing, are not considered. Chapter 30, *Basic facts* (pp. 520-526); on p. 521, the statement "If the principal means of energy transfer inside a star is *by radiation* (as is true for the high temperatures existing inside stars). . . ." reveals a misunderstanding by the author of the importance of convection; the high temperature, invoked here qualitatively, does not prevent

the convective transport of heat (once convection has started) from being 10^5 times more efficient than radiative transfer; the failure to realize this is apparently one reason for the author's dislike of new developments; on p. 523, a graphical representation of the mass-luminosity relation is badly missed; on p. 524, the alleged "intensive mixing of matter which takes place in stars" is an illusion and an unfounded, arbitrary assumption which makes things very convenient mathematically; the author is completely out of date in this respect. Chapter 31, *The physical conditions inside stars* (pp. 526-540); based on Eddington's artificial assumption as to the connection between opacity and energy generation, the chapter passes rather lightly over Emden's polytropes; on p. 533, the statement that the hydrogen content in stars is estimated at 35% is out-moded, and that it is the same in the Sun's atmosphere is wrong; on p. 534, bottom, the two nuclear reactions cited are endothermic and are rather unfortunate examples to illustrate "the sources of stellar energy"; the Li + H reaction, referred to on p. 535 as "similar", is exothermic and, therefore, not at all similar to the other two; on p. 535, the "very simple reaction between light elements" consisting in "the formation of helium nuclei from hydrogen" is far from being simple. Chapter 32, *The internal structure of stars* (pp. 541-549); on p. 542, the author accepts convection and is in contradiction with his previous statements (p. 521); the statement that the condition of the onset of convection "has hardly been investigated yet" (p. 543), as well as those referring to the structure of giant stars (p. 544) and to the energy sources of white dwarfs (p. 549) are out of date and incorrect; with respect to the white dwarfs, on p. 549 it is suggested that "It is possible that the gravitational contraction of such dense stars may be the source of their energy", which, of course, is unacceptable because white dwarfs do not contract, and also because, if contraction were induced forcibly, its entire energy would be stored in the degenerate electrons, without leaving a surplus for external radiation.

Part VIII, "The Scattering of Light in Planetary Atmospheres". Chapter 33, *The theory of radiative transfer in planetary atmospheres* (pp. 550-564) is a purely mathematical essay, starting with a reference to Leonardo da Vinci, and ending with the only other two references, both to V. V. Sobolev. Chapter 34, *comparison of theory and observation* (pp. 565-572), covers the ground very incompletely.

Part IX, "Interstellar Matter". Chapter 35, *The dust component of interstellar matter* (pp. 573-602), is quite good; on p. 573, "the celebrated Russian astronomer Vasilii Yakovlevich Struve" is internationally known by his christian names Friedrich Georg Wilhelm; the russificated version of the name is new even to the reviewer, despite his close connection with the place where F. G. W. Struve originally worked; on p. 576, the improved determination of galactic absorption from the surface brightness of the Milky Way does not take into account the light scattered by the dust clouds (which are of a high albedo), and is therefore inaccurate; the value of one stellar magnitude per kiloparsec, found in such a manner, is too low, as appears also from the application of the improved direct method of P. P. Parenago (pp. 585, 586, reference not given)

which yields 2.4-3.4 magnitudes of absorption per kiloparsec in the galactic plane; on pp. 592-594, the conclusion as to accidental connection between the nebulae and their illuminating stars, allegedly based on statistical data of Table 35, is actually contradicted by the same data; namely, the ratios of observed to predicted numbers of illuminated nebulae, according to this table, are 450,000 ± 75,000 (spectra O-B_0), 250,000 ± 25,000 (B_1 = B_9), and 60,000 ± 15,000 (A — M); there is a clear systematic trend, contradicting the hypothesis of chance connection; the concluding pages (pp. 600-602) of the chapter are rather superficial. Chapter 36, *The gaseous component of interstellar matter* (pp. 602-615); on p. 605, it is not mentioned that the radio radiation of neutral hydrogen is due to spin reversal of the electron; on p. 607, turbulent Doppler broadening of interstellar lines is overlooked, and is rediscovered on p. 609; on p. 611, coronal radiations from stars are overlooked, which, however, would make the disparity between the number of Na and Ca II atoms even greater; the obvious conclusion following from the discrepancy is that there are indeed many more sodium than calcium atoms in the interstellar gas, owing perhaps to the greater volatility of sodium and its compounds; on p. 613, the formula for the calculation of nebular masses requires a more specific knowledge of the recombination coefficient, C, which is nowhere given in the book; on pp. 613, 614, the disclosure of the existence of giant gaseous nebulae is a new and important Russian contribution; their existence admittedly contradicts the hypothesis of chance connection between nebulae and stars (*cf.* pp. 592-594); the rest of the chapter, on pp. 614, 615, is anything but exhaustive in its treatment of the subject.

E.Ö.

Astronomischer Jahresbericht, Volume 56, 1958 (in German). Published by Astronomisches Rechen-Institut, Heidelberg (Grabengasse 14); also Walter de Gruyter & Co., Berlin, W.35; pp. XXXVII + 503; *German Marks* 60.00. Contains a complete list with brief abstracts, prepared by experts, of the world literature in astronomy for the year 1956. This is a publication of fundamental importance for the astronomer and astrophysicist, enabling him to find easily and quickly the references to work connected with any particular problem. During the war its publication was stopped and resumed only in 1948. Since then the work of overtaking arrears has been carried on by giant strides. This goal has now been reached; the staff and referees of the Rechen - Institut are to be congratulated on their splendid achievement.

Planetary Co-Ordinates for the Years 1960-1980, prepared by H.M. Nautical Almanac Office; pp. XIX + 160; published by Her Majesty's Stationery Office; 30s. net (bound).

The purpose of the volume is to facilitate the calculation of perturbations exerted on comets and asteroids by the nine known major planets. This is a continuation of the two previous volumes of Planetary Co-ordinates referred to the equinox of 1950.0. The quantities tabulated for each of the major planets are the heliocentric longitude, latitude, radius vector, and equatorial rectangular