there is allocated a reference number. The other three sections, one for each of the languages German, French and Russian, lists these words and phrases alphabetically and also gives the reference number so that the equivalents can be found in the 'English' section.

The coverage of the field is comprehensive and the book is recommended as part of the reference library available to the crystallographer.

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**Oxide magnetic materials (2nd Ed.).** BY K. J. STANDLEY. Pp.viii + 254. Oxford Univ. Press, 1972. Price £5.50.

This book on oxide materials has both strengths and weaknesses. Its strengths lie in the subjects with which the author has had most experience. Chapter 9, for example, is an excellent exposition of the propagation of electromagnetic waves in a magnetized medium. Conditions for ferromagnetic and ferrimagnetic resonance are developed. Most of the discussion is on polycrystalline materials, but tables of results on single-crystal specimens of ferrospinels and rare earth garnet materials are given. Chapters 5 and 6 deal with magnetic and electrical properties mainly of ferrospinels and garnets. Chapter 8 deals with low-frequency applications and while not much recent work is described, it contains useful information for the non-expert. Of special interest is the explanation of the desirability of square-hysteresis-loop ferrites for magnetic core switches which have been so important in the development of big computers. Chapter 10 is on high-frequency ferrite devices and includes a description of the microwave gyrator and how it is used in the isolator and in circulators. These devices make use of the Faraday (nonreciprocal) rotation of electromagnetic radiation by the ferrimagnetic material.

Several of the chapters may be of more direct interest to the crystallographer. The first chapter gives a classification of magnetic materials according to five main groups. Two, weak ferromagnetism and metamagnetism, are omitted. The latter is relatively unimportant but I believe that the former *is* important and deserves to be listed separately inasmuch as it is really distinctly different from antiferromagnetism, especially on a magnetic symmetry basis. In his discussion of some weak ferromagnets in Chapter 11, the author does not mention anything about magnetic symmetry, and while he correctly cites a discussion of weak ferromagnetism by Moriya in 1963, he does not cite the 1957 work of Dzialoshinski, the first to establish clearly the existence of weak ferromagnetism and its relation to magnetic symmetry.

The author describes (p. 3) antiferromagnetism as 'balanced ferrimagnetism'. With this definition, $\{Y_2Ca\}$ $[Fe_2]$ $(Fe_2Si)O_{12}$ would be an antiferromagnet. This *should* be called a 'compensated ferrimagnet'. The reason is that the tetrahedral and octahedral sublattices are still each ferromagnetic; only the *interactions* between the crystallographically nonequivalent sublattices are antiferromagnetic. The antiferromagnetic space groups must require that each sublattice itself be antiferromagnetic; or conversely, no magnetic space group can *require* that two sets of nonequivalent sites have exactly *oppositely* directed spins.

Chapter 2 gives a brief survey of preparative techniques and is fairly well referenced. I would not choose the Verneuil process as 'a relatively quick method of preparing new oxide compositions as single crystals'. The first use of the flux technique was not in 1950; tiny emeralds were grown from a lithium molybdate flux in 1888. The method by which we prepared a substantial number of polycrystalline garnet specimens of laboratory size over the last decade and, in fact, the first specimen of yttrium iron garnet which gave the theoretically predicted 0 K magnetization, is not mentioned.

Chapter 3 discusses the important magnetic oxide crystal structures. The only way (p. 25) that 'apparently simple ferrite formed from, say, nickel and iron oxides may turn out to be mixed.... resulting possibly in the mixed ferrite $Ni^{2+}_{1-x}Fe^{2+}_{x}Fe^{3+}_{2}O^{2-}_{4}$' is by making a mistake in the initial proportions of nickel and iron oxides used. There are later and better lattice constants for almost all the garnets listed in Table 3·5 (p. 35). Geller and Gilleo did not imply a 'rattling' of ions in the YIG structure nor that 'forces maintaining it (the garnet structure) are relatively weak....'. Garnets are rather hard; the carbon atoms in diamond are inefficiently packed and diamond is very hard. It is well known, contrary to the author's statement on p. 36, that all garnet ions are not trivalent and even in many of such cases, the garnets have high resistivities. In reference to the orthoferrites the author states 'The subunits are not quite cubic since the cubic relationship $a=b=c/\sqrt{2}$ is not obeyed.' Of course, even if it were, this does not mean that the crystal is necessarily cubic. Chapter 11 also contains some crystallographic myths, the perpetuation of which does not seem to be hampered by scientific results. One of these is the 'slight' distortion which is far from being slight; another is the cubic phases which are far from being cubic as in the case of the $LaMnO_3$–$LaCrO_3$ system, in which no composition is cubic. $LaCrO_3$ itself does not become cubic below 1873 °K.

Chapter 4 is titled 'Magnetization in Ferrimagnetic Materials'. The Néel theory of ferrimagnetism is given in some detail. The Yafet-Kittel theory is discussed and a diagram of a possible ferrimagnetic spin configuration is given. However, the model proposed by me which accounts well for the behavior of substituted yttrium and gadolinium iron garnets is not discussed explicitly. The Yafet-Kittel theory, which originally treated nickel-zinc ferrites, predicts that at a certain substitution of the diamagnetic ion, a transition from a ferrimagnetic to an antiferromagnetic ground state occurs. This prediction is based on molecular field coefficients of the original ferrospinel, in this case, nickel ferrite. As has been discussed elsewhere, this does not appear to be a completely tenable theory for substituted ferrimagnets even though it has merit. My model includes the different ground states, but allows random canting associated with the random substitution to occur in both ground states. It was pointed out in our early *Bell System Tech. J.* paper that this model would apply to the ferrites as well as to the garnets.

The author actually discusses the gradual weakening of *A–B* interactions (it should be the weakening of the *average* *A–B* interaction) and the canting but does not efficiently attribute this idea to anyone. On p. 72, it appears that he attributes it to Néel's 1950 paper. Néel's 1950 paper discusses the unsaturation of one of the sublattices upon large substitution of $Zn^{2+}$ for $Ni^{2+}$ but it does not mention or imply moment canting.

On p. 77, Table 4·6 gives data relating to the yttrium and rare earth iron garnets. These data are attributed to Pauthenet, Bertaut and Pauthenet, Rodrigue *et al.*, Geller and Gilleo and to Tebble and Craik. Tebble and Craik refers to a book on 'Magnetic Materials' and therefore is a secondary reference, which, incidentally, contains all the data in this book and then some. *None* of the data come from the Geller and Gilleo paper. In fact all the 0 K spontaneous moment data come from other papers of mine (not cited) as do the compensation temperatures of Gd, Tb, Dy, Ho and Er iron garnets. The YbIG compensation temperature comes from a paper by Henderson and White (not cited). The Curie temperature of yttrium iron garnet also comes from one of my papers (not cited). The remaining Curie temperatures of the rare earth iron garnets do not form a smooth curve when plotted against atomic number and I believe that it is unlikely that they would behave this way.

On p. 83, reference is made to the Gilleo (1960) model and also to a 1960 paper of mine in which I used this model. However, subsequent investigation proved that this model was inadequate to describe the behavior of substituted ferrimagnetic garnets and the new model mentioned above was developed (1962).

The typography of the book is very good. I have found about four mistakes, none being very serious.

The book was originally written to provide a means 'of directing the graduate student to the broad introductory treatment which he requires'. With some external aid, this book may serve that purpose.

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## Books Received

***The following books have been received by the Editor. Brief and generally uncritical notices are given of works of marginal crystallographic interest; occasionally a book of fundamental interest is included under this heading because of difficulty in finding a suitable reviewer without great delay.***

**Solid state physics 3. Theory of lattice dynamics in the harmonic approximation.** By A. A. MARADUDIN, E. W. MONTROLL, G. H. WEISS AND I. P. IPATOVA. Pp. xiii + 708. New York: Academic Press, 1971. Price £13.30.

The first edition of this book was published in 1963. This new edition, with an additional editor, Ipatova, incorporates new material and fills in gaps of the original version. The contents include Introduction; elements of the theory of lattice dynamics; applications of group theory to lattice dynamics; theory of the vibrational frequency spectra of solids; calculations of thermodynamic functions without the use of the frequency spectrum; dynamical theory of ionic crystals; scattering of X-rays and cold neutrons by lattice vibrations; the effect of defects and disorder on lattice vibrations; the effects of surfaces on the vibrations of crystal lattices; statistical mechanical properties of systems of coupled harmonic oscillators.

**Electron paramagnetic resonance.** Edited by S. GESCHWIND. Pp. xv + 584. 121 Figs. 17 Tables. New York: Plenum Press, 1972. Price $ 37.50.

Contents.
Chapters: 1. Jahn–Teller effects in electron paramagnetic resonance spectra. 2. Electron spin-lattice relaxation. 3. Dynamic polarization of nuclei. 4. Electron spin echoes. 5. Optical techniques in e.p.r. in solids. 6. Pair spectra and exchange interactions. 7. Electron paramagnetic resonance of color centers. 8. Covalent effects in e.p.r. spectra – Hyperfine interactions.
Index.

**Solid state physics literature guides. Vol. 2. Semiconductors, preparation, crystal growth and selected properties.** Edited by T. F. CONNOLLY. Pp. xiv + 218. New York: Plenum Press, 1972. Price $16.50

**Solid state physics literature guides. Vol. 4. Electrical properties of solids — surface preparation and methods of measurement.** Edited by T. F. CONNOLLY. Pp. xxiii + 96. New York: Plenum Press, 1972. Price $16.50.

These guides to the literature are based on the documentation of these subjects collected by the Research Materials Information Centre of the Solid State Division of the Oak Ridge National Laboratory. Each volume is a comprehensive bibliography of its subject, listing papers, reports, theses, patents *et cetera* up to 1971. The information has been catalogued and arranged in a way that is quick and easy to use, and the volumes should prove to be extremely useful works of reference.