noulli numbers and Bernoulli polynomials, Euler's summation formula etc., and Chapter V dealing with the theory of linear difference equations, the usual algebraic results as well as the principal results on asymptotics, due to Poincaré and Perron.

While the effort of making this work available to the English-speaking community is commendable, the reader must be warned that the translation is seriously deficient and unreliable. The Russian language being devoid of articles, there are the usual mistakes of choosing a definite article when an indefinite one is called for, and vice versa. More seriously, there are numerous instances of semantic distortion which result in statements often totally incomprehensible. For example, on p. 23 one reads "Denote by A the identity element, which is taken with a certain number A", as compared with the original "Denote by sign A the value 1 taken with the sign of the number A"; on p. 65 one reads "This property of the power of x is known as the complete power of x in the class of functions . . ." instead of "This property of the powers of x is called completeness of the powers of x in the class of functions. . ."; on p. 231, ". . . the great Russian mathematician P. L. Chebyshev" is demoted to ". . . the talented Russian mathematician P. L. Chebyshev"; on pp. 255–256 the reader must unscramble sentences like "Let the domain D go over in the plane of a complex variable w when $w = u(z)$ is mapped onto the simply-connected domain D_1". In the face of such blatant distortions and a great many other irregularities of translation, the only advice one can give to a dismayed reader is to double-check with one of the other available translations.

W. G.

4 [3].—Noel Gastinel, *Linear Numerical Analysis*, translated from the French, Academic Press, New York, 1971, ix + 341 pp., 23 cm. Price $15.00.

This is a translation of the author's *Analyse Numérique Linéaire*, published in 1966. The translator (unnamed) has taken a few mild liberties, but no doubt with the author's knowledge and consent. The foreword is abridged. In the original, there are chapters, sections, and some subsections, but in the translation only chapters and sections, and some of the titles are changed. One or two figures are omitted. Some theorems are formally stated and numbered in the translation that are not so stated in the original. Otherwise the translation is faithful.

The book itself is strongly algorithmic. The theory is developed from first principles (vector spaces, matrices, a postulational development of determinants) and proceeds to ALGOL programs. The theory is clearly, but succinctly, developed. There are a number of exercises, both theoretical and algorithmic.

Nearly all the standard methods for inversion, direct and iterative, are described, including some attention to SOR. For eigenvalues and eigenvectors, the coverage is a bit less complete. The chapter opens with a brief discussion of interpolative methods, not recommended, however, unless perhaps a very good initial approximation to a root is known. It is also implied in the original and explicitly stated in the translation that the root must be real, which is not strictly true.

After this, which is more or less an aside, the chapter continues with Krylov, Leverrier and Souriau's improvement, Samuelsen, "partitioning" (Bryan), Danilevskiĭ (where the author uses the "matrices of the second degree" that he had introduced in his thesis, a generalization of the reviewer's "elementary matrices"), reduction to triple-diagonal form, again by means of the matrices of second degree, Lanczos, and Givens. All these are methods of reduction. Finally come the power methods (but not backward, or the Rayleigh quotient), deflation, Jacobi, and LR, but QR receives only three lines at the end with a reference to Francis, who is named in the original but not in the translation.

It is a pity that the French consider an index of no value, and there is none in either the original or the translation. But apart from these minor quibbles, the translation is very good and the book fulfills its purpose excellently well.

A. S. H.

5 [3].—J. K. Reid, Editor, *Large Sparse Sets of Linear Equations*, Academic Press, New York, 1971, x + 284 pp., 24 cm. Price $16.00.

It is by no means uncommon that workers in disjoint fields will be faced with similar computational requirements, and that each group will develop its own techniques in ignorance of those developed by the others. A classical, and one might say glaring, example, is the method for finding eigenvalues proposed by the astronomer Leverrier in 1840, and rediscovered independently about a century later by a statistician, a psychometrician, and several mathematicians, admittedly with some improvements, even though Krylov in 1931 had described a method that was far superior.

The efficient handling of sparse matrices, a rather broader field, is another example. In 1968, a symposium was held at IBM, Yorktown Heights, in an attempt to establish communication, and a second took place there in the late summer of 1971. This volume reports the proceedings of a similar conference held at Oxford in April of 1970. The volume concludes with a somewhat discursive paper by Ralph A. Willoughby describing work at IBM and the organization of the 1968 symposium.

Principal subject matter areas represented here are structural analysis, power systems, linear programming and (more generally) optimization, and geodetics. Not surprising is the fact that Kron's "tearing", later formalized in what the reviewer calls "the method of modification", appears several times. One paper is devoted to "bi-factorisation", which is the simultaneous application on the left and on the right of what the reviewer calls "elementary matrices", those on the left differing from the identity only below the diagonal in one column, those on the right differing only to the right in one row. Joan Walsh gives a survey of direct and indirect (iterative) methods, Frank Harary discusses the use of graph theory, the editor (whose name is modestly omitted in the table of contents) discusses the method of conjugate gradients.

Some of the discussion following each paper is included, somewhat edited, as the editor confesses, and assuredly to the reader's benefit.

To develop a unified theory here may be impossible, and I, personally, was surprised to find as much unity and coherence in these papers as I did, and certainly for those interested in the subject, this volume is essential.

A. S. H.