is now becoming a mature one—just as we have
lost our only X-ray observatory!

This review was written while I enjoyed the
hospitality of the Space Sciences Office, Los
Alamos National Laboratory.

RICHARD C. HENRY

ASTROPHYSICAL FORMULAE, Second Edi-
tion, by Kenneth R. Lang (Berlin: Springer-Verlag),

After having carefully read large portions of Astrophysical Formulæ, I must confess my utter
amazement at the completeness and absolutely
clear presentation of the whole range of modern
astrophysics in this book. Here we find a very logical
presentation of the formulæ of astrophysics
starting from first principles and with careful
attention to historical development and the citation
of the original references. This is unmistakably a
monumental work, but as we shall see, not one
without its limitations.

How is it possible to review this long (783 pages)
and very tightly-written compendium in a mean-
ingful way? The approach I will take is to ask
whether the book succeeds in its basic task: to
permit an astrophysicist or a physicist to find and
understand in a short amount of time the basic
equations, concepts, and literature of a topic he
has not previously studied.

The book covers the full range of modern astro-
physics. The first chapter on continuum radiation
starts from first principles of electromagnetic fields
and Maxwell's equations to discuss bremsstrah-
lung, synchrotron radiation, scattering processes,
and radiation in astrophysical plasmas. Mono-
chromatic radiation processes in atoms and mole-
cules, including such topics as radiation transfer,
line intensities and broadening, and spectra, con-
stitute the second chapter. In the following three
chapters Lang discusses gas processes (thermody-
namical problems in astrophysics, hydrodynamics,
shocks, accretion, instabilities, etc.), nuclear astro-
physics and high energy particles (nuclear pro-
cesses, abundances of the elements, creation and
destruction of high energy particles), and finally
the topics of astrometry and cosmology (coordinate
systems, time, distance scales, magnitude scales, general relativity, and gravitational radia-
tion). Clearly the book is all-encompassing, in-
cluding both observational and theoretical aspects
of each topic.

I am impressed with the precision and concis-
ness with which each topic is presented. When
discussing a specific formula, Lang clearly states
what is assumed, who first derived the equation or
identified the concept, what the symbols mean,
and whether the formula is empirical or can be
derived from previous equations in the book. His
attention to historical references must be strongly
commended. Often, but not always, he gives a
verbal explanation for the equation and discusses
some of its consequences. These points are essen-
tial for meeting the basic task of the book, since
most readers will look at individual sections out
of context, and they need to understand specific
formulæ without searching back over many pages
to find how each symbol is precisely defined.
However, some important terms are defined but
not properly explained in words. Some examples
are the Gaunt factor (p. 44), the effective recombina-
tion coefficient (p. 106), and the Rosseland and
Planck mean opacities (p. 184). Also Lang
does not always say why an effect occurs. One ex-
ample is the Razin effect (p. 40). Each reader can
identify a few topics and references that have been
overlooked, but no one can say that Lang has ig-
nored a significant portion of the field. I could
quibble about individual statements such as es-
imates of solar magnetic fields (p. 186) or mis-
prints in a few equations (e.g. Eq. 2-221), but
these quibbles pale by comparison with the extreme
clarity of the presentation.

My major complaint concerning the book is
that it is becoming dated. The First Edition (pub-
The so-called Second Edition (published in 1980)
contains corrections of many misprints and errors,
but otherwise no changes or additions to the origi-
nal text. The only new material in the Second
Edition is a 50-page list of supplemental referen-
ces (up to 1979) divided by chapters, but otherwise
with no hint as to which sections of the book
these new references apply. This approach is
almost useless. Instead, the publisher should have
permitted the author to write a true Second Edi-
tion. A number of sections consisting of basic
physical concepts need not be changed, but addi-
tional references to new discoveries and especially
to new data and computations are vitally neces-
sary. For example, many tables contain data that
have superseded. Some particularly egregious ex-
amples are Table 1 (absorption cross sections),
Table 20 (interstellar molecular lines), Tables 23–26
(molecular rates), Table 35 (white dwarfs), Table

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