Gazdar et al. 1985], and Bresnan and Kaplan's Lexical-Functional Grammars LFG.

CSLI-4 makes a perfect couple with CSLI-3, continuing to present syntactic approaches and unification-based implementation, suitable for all the grammatical formalisms discussed in the books.

The landscape in the valley of syntax is governed by GB, as the highest achievement towards universality. GB realizes a rich set of universal principles, the grammars of the particular languages being obtained as parametrizations of a Universal Grammar. All the other syntactic approaches (including GPSG, LFG, logic-based grammars) could be labeled as stages in the evolution of Chomsky's ideas from observational to descriptive and to explanatory adequacy. In their trend to universality, explicitness, and rigor, they inevitably decreased in specification of empirical detail. The linguistic pole for all the contemporary syntactic theories or tools is the effort to attain the *lexical meaning,* as a min-max (or equilibrium) principle: minimality, coming from semantics, and maximality, coming from syntax. Another basic idea is that clause structure is largely predictable from the semantics of predicates: these theories agree in deriving canonical structures from lexical semantics and it is (somehow) surprising "how little needs to be stipulated beyond lexical meaning" (T. Wasow).

CSLI-4 reveals the strong developments in unification-based implementations, stemming from different research directions but converging to grammars in which declarative and procedural interpretations can coexist. The grammatical version of unification, viewed as a (directed acyclic) graph-combining process, suggests many other linguistically and logically relevant operations: generalization (as the dual of unification), disjunction, negation, overwriting. Along with GPSG and LFG, Martin Kay's Functional Unification Grammar, logic-based grammars (Definite Clause Grammar, Extraposition Grammar, Gapping Grammar, etc. [Dahl and Saint-Dizier 1985]), Shieber's PATR-II grammars represent a "least common denominator" of the various unification-based formalisms but are still powerful. Appendix A in CSLI-4 contains the machine-interpretable form as an instructive example, handling increasingly complex constructs. As a corollary of all the formalisms and implementations, even those not (strictly) based on unification, like Wehrli (1984), is the emphasis on lexical properties in syntax and semantics.

This pair of books represents an important and useful effort on the part of the authors to bring these linguistic theories and tools, as well as the implementation trends, to the computational linguistics community.

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References

Dahl, Veronica and Saint-Dizier, Patrick, Eds. 1985 *Natural Language Understanding and Logic Programming.* North-Holland, Amsterdam, New York, Oxford.

Gazdar, Gerald; Klein, Ewan; Pullum, Geoffrey; and Sag, Ivan 1985 *Generalized Phrase Structure Grammar.* Harvard University Press, Cambridge, Massachusetts.

Wehrli, Eric 1984 A Government-Binding Parser for French. Working Papers No. 48, Institut pour les Études Semantiques et Cognitives, Université de Genève.

Multilingual Aspects of Information Technology

Paul A. Bennett, Rod L. Johnson, John McNaught, Jeanette Pugh, J.C. Sager, and Harold L. Somers

Aldershot: Gower, 1986, ix+146 pp
ISBN 0-566-03513-8; £17.50

This is a book for a first acquaintance with computational linguistics. It gives an overview of some of the main fields of interest, namely machine translation, natural language interfaces, and the lexicon.

The book is directed towards user-oriented applications, especially systems on the market and under development. Some basic theoretical linguistic questions encountered in such development work are mentioned rather than discussed, and the book does not tell its readers too much about more fundamental research.

In accordance with this practical scope, the topic of the lexicon is presented in two distinct chapters, one on general lexicology and lexicography and the other one on terminology and terminography, and no link is established on a level of word linguistics.

The machine translation chapter introduces the basic terms, for instance in the field of system design (interlingual, transfer, direct; or machine-aided human vs. human-aided machine translation). This chapter is also the most explicit one with respect to implementation principles. The authors mention, among others, the advantages of modularity in structured programming. Another type of structured modularity is undoubtedly as important as this: the conceptual distinction between grammar and programming, with a formalism level as the interface. There are too many publications on the market which do not distinguish for example syntax, parsing formalism, and parser in a clean way. The authors of this book seem to make distinctions of this kind, and they also advocate a sound degree of modularity between the various parts of grammar (syntax, semantics, ...). In an introductory book, however, the principles of these distinctions should, to my taste, be made explicit. There are so many bad examples.

As a first superficial introduction to computational linguistics the book is certainly good, but the word "multilingual" in the title appears to be a bit misleading. Machine translation is of course multilingual, but what the authors report about terminography and natural language interfaces is only in some accidental cases more

than monolingual, and these cases can be seen as monolingual language processing augmented with elements of machine translation. Even the lexicography chapter is for a good deal concerned with monolingual aspects, but what the authors do say about multilingual lexicons is to the point. Their argument that the meta-text of a monolingual dictionary is in another language, and that thus every explanatory dictionary is multilingual, only contributes to a confusion of ideas. The meta-text is a special style, but this text type is of course part of the same language.

A more regrettable shortcoming is the fact that the book is not multilingual in scope. The authors openly admit that they have made efforts not to refer to literature which is not in English. An introductory book should not narrow its readers' horizon in this way. There are already too many (computational) linguists, for whom "natural language" is a synonym for "English". It seems preferable to emphasize that linguistics is not only the science of language but also of languages. Computational linguistics is developing in that direction as well.

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Electronic Synthesis of Speech

R. Linggard

Cambridge University Press, 1985, ix+149 pp.
ISBN 0-521-24469-2; $29.95

Speech synthesis has become, in the last ten years or so, a field of substantial commercial as well as intellectual interest. The Compleat Computational Linguist must ultimately include speech synthesis (and recognition) in his purview, just as theoretical linguistics must ultimately explain the regularities in speech. The field has been difficult to cover because important facets of it come from such widely divergent disciplines as electrical engineering and phonetics, and because there have been no general and easy introductory text or reference books. *Electronic Synthesis of Speech* goes a long way toward easing this last difficulty.

Linggard intends this book to be "a comprehensive text and reference source for scientists and technologists working in the field" and also suggests that it should be useful as a "textbook for courses on speech processing" (p. vii). The first two chapters cover history and phonetics, and the other four chapters treat mathematical and computational aspects of synthesis.

I don't think this book would do as a sole reference or course text book, although it would be very useful if augmented with other sources. Because it attempts a broad coverage of speech synthesis in a small volume, it doesn't cover any single subject in depth. It would be difficult to teach from this book because of its lack of exercises and problems for the student. But overall, it's a good book. The references are numerous and useful, and it is especially satisfying to see synthesis set in its historical context.

Linggard's coverage of the engineering aspects of speech synthesis is excellent, although for a thorough understanding you should consult the original technical papers, which he references quite well. (A good collection of these is in Flanagan and Rabiner (1973).) Spot checking several of his numerous equations and their derivations turned up no apparent errors. It is refreshing to see the basic equations for speech production derived from a true mechanical model rather than from an electrical analog.

I would guess from this book that Linggard's home discipline is engineering, because his coverage of phonetics (Chapter 2), in contrast, is errorful and misleading. Don't get your phonetics from this book; buy another, on phonetics alone. (Ladefoged (1975) would be a good selection, and Ruhlen (1976) has an excellent introductory chapter on phonetics.) Linggard can also be faulted on his short discussion of the pre-historic evolution of speech (pp. 2-3), which is speculative, superfluous, and probably wrong.

It is often unclear if Linggard's comments on phonetics are meant to apply just to English or to speech in general. In addition, I think many of his details are mistaken or misleading. Here is a sampler:

On page 23 is Fig. 2.4, Linggard's main presentation of speech sounds. It is a table of IPA (International Phonetic Association) symbols for sounds, illustrated with example words. This table is quite misleading and insufficient, especially for speakers of non-upper-class British dialects. The legend to the figure reads "Some suggested IPA symbols for the phonetic transcription of English"; one must read the text carefully to discover that they are really only symbols for RP (Received Pronunciation) English, a minority upper-class British variety of speech. He gives the word *further* as an example of the sound /ə/ (called "schwa"), and his symbols for the diphthongs in *peer, pair, boar,* and *boor* use /ə/ for the second part, or off-glide, of the vowel; the student might think that /ə/ sounds like *r*, but it doesn't. RP has dropped some /r/s and changed others to /ə/. The peculiarities of RP should have been discussed and the table should have covered more general English.

There are also some discrepancies between vowel symbols in his table and the table for RP presented in Hughes and Trudgill (H&T; 1979: 26):

	Linggard	H&T
bat	a	æ
bet	e	ɛ
load	əʊ	ou