Knot Theory and its Applications. Kunio Murasugi. Birkhäuser Verlag AG, Klasterberg 23, PO Box 133, CH–4010, Basel, Switzerland. 1996. Pages 323. SFr 98, DM 118.

Even though mankind has been using knots ever since the dawn of civilization, the so-called theory of knots which came into existence as a special branch of three-dimensional topology is approximately only a hundred years old. It had some reasonable initial development followed by a slow growth for a few years. And then, with its multifarious applicability in other sciences, it has grown so much and also growing rapidly that today it can be treated as a separate branch of Mathematics in its own right.

All these days, anyone who wanted to know what knot theory is always started with the excellent, 1962 survey article 'A quick trip through knot theory' by R. H. Fox or with the book *Introduction to Knot Theory* by Crowell and Fox. However, even these two expositions demanded quite a bit of preparation in algebraic topology and indulgence from the reader. For instance, the knowledge of fundamental group and the presentation of groups was very essential. Not so any more. The present volume by KM is a proof that anybody can acquire a decent knowledge of a lot of useful knot theory without much expertise in algebraic topology. Today, if somebody approached me for some elementary knowledge of knot theory, I can place KM's book in her/his hands without any hesitation.

Mathematically speaking a knot is merely a smooth embedding of a circle in the 3-dimensional Euclidean space. One can project the entire knot onto a plane to obtain a smooth curve with only finitely many points of overlaps. We can also arrange this projection in such a way that at each of these overlaps, only two of the strands meet and they are perpendicular to each other. By making a small cut while drawing one of the two strands at the meeting point, we indicate which one lies underneath the other. Such a projected plane figure is called a regular knot projection.

The entire knot theory can be carried out from studying such a regular knot projection. Thus, many ideas and concepts about knot theory can be understood by merely drawing appropriate plane figure. Since we are not interested in the actual length of the knot etc., it is fairly obvious that we can introduce a number of operations on the knot which alter it considerably and yet treat it as 'equivalent' to the given knot. These operations are called elementary knot moves.

How far one can go on like this? KM could come up with a whole neat volume written in this style without much technicalities. He declares his intentions of keeping the book totally devoid of all clumsy technicalities and he has succeeded in it. The equivalence of knots, sums of knots and prime knots, knot-cobordism and slice knots, what it means to construct knot tables, and the fundamental problems of knot and link theory are explained in the first three chapters. The classical knot invariants such as the minimum number of crossings, the bridge number, unknotting number, the linking number, colouring number, etc. occupy the next chapter. It all looks so soft so far. However, already, the author points out many open problems which have defied solutions for all these days.

In chapter 5, the theory comes to one of the major turning points in its history. The Alexander polynomial has played a very important role in the classification of knots. Classically, one introduces this concept via the so-called free differential calculus of the presentation of the knot-group or through covering spaces. This approach is quite technical and not surprisingly, KM avoids it and introduces the Alexander polynomial through the Seifert matrix. Thus chapters five and six deal with Seifert surfaces, s-equivalence and Alexander–Conway polynomial, signature of a knot and its usefulness in detecting chirality of knots. The author does not forget to point out the efficiency of Conway's method in making the Alexander polynomial more computer-friendly. It is remarked that this is a case of technology catching up with the mathematical theory.

Chapter 7 contains a satisfactory classification of those knots which can be drawn on the surface of a standard torus.

In chapter 9, the author comes up with another important step in the development of knot theory, again due to Conway, viz. the theory of tangles. The next logical step is the study of braids and the relation with the knots and links. An important theoretical result here is Markov's theorem. It says how two different braids arising from the same knot are related, viz. by the so-called M-equivalence.

We are naturally led towards the great revolution – the Jones Polynomial, serendipitously discovered by V. F. Jones in 1984. An important aspect of the Jones polynomial and its subsequent offshoots is in the fact that they have unlocked connection of knot theory with various applicable disciplines. Of course, it is not necessary to go through the same route as Jones took via the study of operator algebras to understand Jones polynomial. One has to merely axiomatize the skein relations and that is what is done in chapter 11. After discussing the basic properties of the Jones polynomial, KM already includes open problems. For example, it is not known whether there exists any non trivial knot with its Jones polynomial equal to 1. The chapter includes discussion of some of the other offshoots such as the HOMFLY polynomial, the Kauffman's polynomial, etc. It concludes with proofs of three of Tait's conjectures about alternating knots.

The next three chapters treat relation of knot theory in three applicable disciplines – the statistical mechanics, molecular biology and chemistry. These chapters are useful to people working in either areas.

The last chapter treats the most modern concept in knot theory – Vasileiv invariants. Indeed, these invariants are assigned to even a wider class of objects, viz. singular knots and as such they are more powerful than all the invariants considered so far. However, it is not known whether Vassileiv invariants form a complete set of invariants for a knot. Examples of knots not distinguishable by any given finite set of Vassileiv invariants are included.

The book contains two tables, one giving knots up to eight crossings and the other containing Alexander and Jones polynomials for these knots. Notes containing eighteen footnotes is included. As the author points out the bibliography is strictly for the work referred in the body of the book, other references on the subject can be obtained from these sources in turn.

It goes without saying that, one could

not have given proofs of many results, with such a self-imposed restriction of avoiding technical details. Nevertheless, the author has done a very good job, the only exception being chapter 8, in which the author attempts to outline aspects which are more topological in nature such as the Dehn's surgery, branched coverings, etc. A typical exercise in this chapter asks the reader to show that the torus is not a covering space of a 2-dimensional sphere. One fails to understand the kind of audience the author may have in mind, in including such exercises immediately after giving the definition of a covering space. The book can do well without these eighteen pages. This book is translation of the original Japanese version. Even though I do not know Japanese, I feel that there is a lot of scope for an improvement in the translation.

Although this book may not impart any lasting education in knot theory to the reader, it will not fail to inspire and inform substantially. With so many results in one single place, it may be used as a good reference book also.

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Lysozymes: Model Enzymes in Biochemistry and Biology. P. Jolles, ed. Birkhäuser Verlag, Basel, Switzerland. 1996. 449 pages.

Fleming's discovery of lysozyme preceded his discovery of penicillin and both are part of scientific folklore. It was in 1922 that Alexander Fleming reported his discovery of lysozyme in the nasal mucous to the Royal Society. However, when the word lysozyme is currently used, it generally means the enzyme from hen egg white (HEW). Pierre Jolles, who sequenced the HEW enzyme in the early sixties, has been working with lysozymes from various sources and has now put together this comprehensive book on this enzymatic activity.

Lysozyme is widespread in nature. By definition, lysozyme activity consists of hydrolysis of a ß-glycosidic bond between the C–1 of *N*-acetylmuramic acid and the C–4 of *N*- acetylglucosamine of the bacterial peptidoglycan. Analysis of known 75 complete and 13 partial amino acid sequences shows that there are 20 invariant residues. In addition to conventional lysozyme (called lysozyme c for chicken type or conventional type), other distinct types of lysozymes also occur. Lysozyme g (after the Embden goose, the specie in whose egg white it was first discovered) is also widespread, though in bird egg white only. Some lysozyme c, notably from pigeon egg and horse milk have few aspartic acid residues critically positioned, enabling them to bind calcium and are called calcium-binding lysozyme c. The two lysozyme c families along with α-lactalbumin form a lysozyme c superfamily. Evolutionary analysis points to a common ancestor and places the divergence event prior to 400 million years. The question whether lysozyme g also shares the common ancestor is still debatable. However, v-type lysozymes (viral type from phage infecting both gram-positive and gram-negative bacteria), on the basis of similarities between their three-dimensional structures with lysozyme c, are believed to share this remote common ancestor.

Several other phage lysozymes encoded by phages infecting gram-positive bacteria called CH-type lysozyme (first investigated in Chaloropsis) belong to a totally unrelated family. A striking observation which emerges out of these evolutionary studies is that only acid catalysis seems to be essential, the rest of the catalytic process is based upon 'broadly scattered interactions (electrostatic, H-bonding, . . .) and substrate distortions' (p. 58).

The role of lysozyme in bacterial cell wall lysis was elucidated only in 1964. 'An intriguing question, not yet answered, is how the cell controls this dangerous enzyme from premature or unbalanced action. . . although it is clear that they are involved in the metabolism of bacterial cell wall' (p. 63). Equally fascinating is their presence in plants. 'All lysozymes also have chitinase activity but not all plant chitinases are lysozymes. However, for many chitinases, it is not known whether they also possess lysozyme activity' (p. 75). As fungal cell walls contain chitin, it is believed that chitinase activity is used by plants to combat fungal pathogen.

Lysozyme (c-type) is ubiquitous in insects, normally present in blood. In this context, the role of lysozyme as an active defence molecule has been questioned, since in most bacteria, the peptidoglycan layer is not directly accessible to this enzyme. It may be that the main role of the enzyme is in cell wall lysis after the bacterium has been killed.

Both in flies and cows, lysozyme also has a digestive role. Whereas typical lysozymes are basic, ruminant enzymes are neutral and Drosophila midgut lysozymes are even acidic.

Thus this book, consisting of twenty-two chapters, looks at lysozymes from the perspective of protein chemistry, enzymology, protein crystallography, molecular biology, immunology and pharmacological and therapeutic applications. The authors, drawn from various parts of the world, represent a unique wealth of experience.

An attractive feature of this book is that it also captures a sense of history of the growth of ideas. McKenzie's recall of editorial opposition to Campbell's opinion that 'α-lactalbumin may have evolved by gradual modification from lysozyme' is a case in point (p. 365). The lucid discussion on the catalytic mechanism by Karplus and Post nicely illustrates the usefulness of theoretical methods in establishing enzyme mechanism. As few biochemists are familiar with the area of molecular dynamics, the inclusion of this chapter is welcome.

Analysis of formation of disulfide bonds in this enzyme shows that there exists a restricted search of structures and a nucleation in the folding pathway. 'Folding of both denatured and denatured/reduced lysozyme is characterized by transient folding species possessing structural properties of the molten globule state: high content of secondary structure, no tertiary fold and appearance of hydrophobic structures' (p. 144). Imoto has described protein engineering work on c-type lysozyme (p. 163 onwards). Although references to the work on T4 lysozyme by Mathew's group have been provided, a little more extensive discussion on the latter would have been welcome. Also missing is the early chemical modification with the enzyme.

HEW lysozyme was the first enzyme