

## Reviews

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**Discovering geometry with a computer**, by Heinz Schumann and David Green. Pp. 282. £19.95 (accompanying disk £3.00, Mac or DOS). 1995. ISBN 0-86238-373-0 (Chartwell-Bratt).

This unusual, possibly unique, book is very timely, given the recent appearance of geometry software for personal computers.

As many readers will probably be unfamiliar with such software, I should probably begin by saying a little about what it does.

Computer geometry software enables one to make geometrical constructions on the computer screen. Starting by placing 'basic' points and lines, one proceeds using commands to construct objects such as perpendicular bisectors, parallels, circles with given centre and point on circumference, etc, and builds up a complete construction. Anything constructible on paper using classical Euclidean methods can be reproduced, some examples being the various centres of a triangle, the regular pentagon, various configurations of touching circles and the Peaucellier cell linkage.

There are various crucial differences from working on paper, however. Obviously, the computer's drawing is very accurate, so phenomena such as concurrence, collinearity and tangency really do occur when they should. Equally useful is the computer's filing system, enabling work to be saved for later recall, or prepared in advance for later use with pupils, or reverted to an earlier stage of a 'messed up' construction. Various objects may be differently coloured so as to clarify parts of interest, and intermediate construction lines may be hidden (in any case, the construction arcs needed on paper to execute a basic command such as 'perpendicular bisector' are not shown on the computer). Angles and lengths may be measured. Printed output of even higher quality than that on the screen is available.

The construction 'history' behind a drawing may be shown.

The above features would already make a computer geometry program a powerful and motivating teaching tool, but possibly the most striking feature is what the authors call the software's 'drag mode'. All this means is that the basic points and lines used to initiate the construction may be 'grabbed' with the on-screen cursor and 'dragged' elsewhere, the whole construction being redrawn for each intermediate position. Properly used, this can be an incredibly powerful teaching feature, as it naturally brings out the properties of a construction which are conserved from one configuration to the next - and these are just the features which are the subject of geometrical theorems. The concept of 'locus' becomes very natural, as it is possible to turn on a trace of the path of a particular constructed point while the construction is varied. A final uniquely 'computer' feature is to be able to define a possibly complex construction as a 'macro': a new command available for subsequent use. Thus, although 'draw circumcircle of triangle' is not a built-in command, it can easily be added if required.

I hope the above convinces those who have never seen such software that it is well worth investigating. The leading programs around at the moment are Cabri-Géomètre, Geometer's Sketchpad and Geometry Inventor, available on either or both of Macintosh and PC.

And so, eventually, to the book. It is essentially a commentary on the teaching opportunities opened up by geometry software, with specific reference to Cabri-

Géomètre, though offering much that is of general applicability. The authors' educational credentials are impeccable, and many will know David Green as an active member of the MA. Detailed discussions of specific teaching points occur frequently throughout the text, particularly where the computer offers approaches not possible otherwise. Given the current lowly status of geometry in the National Curriculum, I suspect that much of the classroom experience derives from Heinz Schumann, and is perhaps a salutary reminder of what we have discarded in this country!

The text is only part of the book, however, as it is illustrated with nearly 1000 geometrical diagrams drawn by the software (and reproduced at very high quality).

Many diagrams are necessary to convey on the static page the dynamic aspect of the screen image, and they do so very successfully. The mind boggles at the effort involved in producing such a book, which would surely be impossible without modern software which places the tools of publication directly in the author's hands.

The text is not particularly linear, and the Preface states that the chapters are largely independent of each other. There are two introductory chapters for those new to the software. Several chapters address specific teaching approaches, as in

'Discovering theorems by varying geometrical figures',

'Angle theorems as invariance properties', 'Discovering theorems by generalising geometrical figures'.

'Exploring drag mode geometry' and 'Designing geometrical microworlds'. Others focus on specific aspects of geometry, such as 'Producing and using loci' or

'Generating geometrical figures with line symmetry'. Even a microworld for investigating non-Euclidean geometry is suggested!

An immense repertoire of geometrical theorems is touched on at some point or other in the book; in this it is not unlike David Wells' classic Penguin Dictionary of Curious and Interesting Geometry. The authors clearly love their subject, and the challenge of putting it over to each new generation of young mathematicians. Their vast experience in doing so comes over clearly, even if occasionally their discussion can appear a little erudite (the language was occasionally over my head).

One essential point to make is that much of the book's impact would be severely diluted without the accompanying disc. This contains around 500 geometrical figures and macros to be loaded into Cabri-Géomètre, and much the best way to appreciate the book is to manipulate each one on screen at the appropriate point in the text.

They also constitute a vast ready-made teaching resource.

In conclusion, I can thoroughly recommend this book, and the software of which it writes. It is perhaps not overstating things to say that such software is so potentially powerful as to possibly influence the status given to geometry in the curriculum. This book can only enhance such an influence.

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