of using this to provide an electronic form of the Bulletin (*e.g.* as a postscript file). Concern was expressed about the impact this could have on membership. It was agreed that R. Timoney will initiate the process of establishing a home-page. The Mathematics Departments of the various institutions in Ireland will be requested to add a pointer to the I.M.S. page in their own home-pages.

The meeting closed at 1.20pm.

Eugene Gath
University of Limerick.

THE I.M.S. SEPTEMBER MEETING 1995

Eugene Gath

The eighth September meeting of the Irish Mathematical Society took place on 7th and 8th September 1995 on the University of Limerick campus. The lectures were held in the new Foundation Building, in a theatre adjacent to the University Concert Hall. The attendance at the meeting was approximately 60, of whom 35 travelled from outside of Limerick. Visitors were accommodated in the Plassey Village, adjacent to the campus.

The meeting was opened by Dr Edward Walsh, President of the University of Limerick. He talked briefly about the applicability of mathematics, embellished with an anecdote about his experiences of learning trigonometry. One of the guest speakers, Prof. Chris Budd from the University of Bath gave a lecture on impact oscillators, illustrating a model with a new type of bifurcation process, which has applications to the safety of fuel rods in nuclear reactors. Dr Andrew Fowler of Oxford University spoke on the dynamics of ice sheets, including an investigation of the effect of the melting of the ice caps during the last Ice Age. The standard of the talks was excellent and a wide variety of topics was covered: algebra, analysis, numerical analysis, fluid and solid mechanics, differential equations, theoretical computer science, dynamical systems, differential geometry, operator theory, mathematics education *etc.* Three speakers travelled from Britain and one from Northern Ireland. Serendipitously, there was, concurrent with the I.M.S. meeting, a *Z Users' Meeting* also taking place in the Foundation Building. One of their speakers Prof. David Gries, head of the Department of Computer Science at Cornell University, gave a short talk at the I.M.S. meeting.

The full program was:

Thursday 7th September, 1995

Dr E. Walsh (President, University of Limerick)   *Welcoming address*
Dr D. Hurley (IMS President)   *Opening Remarks*
Dr S. O'Brien (University of Limerick)   *Industrial coating flows*
Prof. C. Budd (University of Bath)   *Grazing bifurcations in impact oscillators*
Prof. M. Hayes (University College Dublin)   *Directional ellipse method for solution   of partial differential equations*
Prof. T. Laffey (University College Dublin)   *Some combinatorial properties of matrices   with nonnegative entries*
Prof. D. Gries (Cornell University)   *The consequences of teaching proof to mathematics   students using the calculational approach to logic*
Dr C. H. Chu (Goldsmiths' College, London)   *Exponential functions*

Friday 8th September, 1995

Prof. John O'Donoghue (University of Limerick)   *The mathematics of numeracy*
Dr M. Mac an Airchinnigh (Trinity College Dublin)   *Applied constructive mathematics in computing–   monoids and their morphisms*
Dr D. Hurley (University College Cork)   *Symmetric Attractors*
Dr A. Fowler (Oxford University)   *Large scale oscillations in pleistocene ice sheets*
Dr M. Stynes (University College Cork)   *Efficient solution of convection–diffusion problems   using PLTMG*
Prof. J. Miller (Trinity College Dublin)   *Demonstration of Mathematica package for polynomial   root magnitude determination*
Prof. S. Sen (Trinity College Dublin)   *Abelian sandpiles*
Prof. A. Wickstead (Queen's University Belfast)   *When do positive operators span the bounded ones?*
Dr A. Hegarty (University of Limerick)   *Shishkin meshes for the numerical solution   of convection–diffusion problems*
Dr D. Wraith (University of Notre Dame)   *Exotic spheres with positive Ricci curvature*
Prof. F. Hodnett (University of Limerick)   *Closing remarks*

The conference banquet was held in Goosers' restaurant, in Ballina, Co. Tipperary –the 'other side' of Killaloe. The I.M.S. sponsored a free bus service from the University to Killaloe and back. An optional cruise on the Shannon and the southern tip of Lough Derg was arranged for before dinner. As one may recall, the remnant of Hurricane Iris drenched the country on Wednesday 6th September, but luckily the weather was warm and sunny just in time for our cruise the following evening! Of those who didn't join in the cruise, some took a walking tour of the town of Killaloe, with its historic cathedral *etc.*

The meeting was sponsored mostly from a variety of sources within the University of Limerick. Bank of Ireland and Aer Rianta (in honour of their 50th year at Shannon) also gave generous donations. The Department of Mathematics and Statistics provided stationery, secretarial support and postage. The organizing committee would like to gratefully acknowledge these, and to thank all the speakers and everyone who contributed to the success of the September Meeting 1995.

Conference organizers:
Eugene Gath, Gordon Lessells, Stephen O'Brien.
Department of Mathematics and Statistics,
University of Limerick.

SPACE-FILLING CURVES AND RELATED FUNCTIONS

Stephen M. Buckley

In this paper, we shall investigate several questions related to space-filling curves. We start with a question whose answer has been known (although not widely known, it would appear) for rather a long time.

Question 1. *Do there exist continuous functions $f : [0,1] \to \mathbb{R}$ which take on each of uncountably many values uncountably often?*

The answer is "yes"; in fact the first component of any space-filling curve (Peano curve) is such a function. A recent rather simple example of such a curve can be found in [8]; for more information on space-filling curves, the reader should consult [7].

Here we shall give two rather different methods of constructing examples of functions answering our question. Some examples using the first construction have zero derivative almost everywhere, while the second construction always leads to nowhere-differentiable examples. We use the notation $f^{-1}(y)$ to denote the set of all pre-images of y.

We begin with the "digit coding" construction. The example we give maps the unit interval onto itself and takes on all its values uncountably frequently. First note that any function continuous on a closed subset S of $[0,1]$ (with respect to the subspace topology) can be extended to a function continuous on the whole interval simply by filling in the omitted open intervals with continuous interpolating functions (for instance we can "join up the dots" in a linear fashion, and extend the function in a constant fashion at an omitted end-segment). Thus it suffices to find a continuous function $f : S \to [0,1]$ such that $f^{-1}(y)$ is uncountable for all $y \in [0,1]$