A life in Mathematics

R. A. Bailey
University of St Andrews

Kochi, India
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If you like Maths, do not let anyone else put you off.

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Nobody told me that girls couldn't do Maths until I was already so engrossed in it that there was no turning me back. I was lucky in that way.

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I now think that "do not give up" is an important quality for a mathematician.

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This taught me that data entry has to be done very carefully, and should always be checked.

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Scientists (a bit later): Sorry, we had made a copying mistake, we have corrected it now.

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I was hopeless at Applied Maths. So, as we approached the exams at the end of the first year, my college tutor arranged for me to have some special extra tutorials in Applied Maths, just so that I would be able to pass those exams.

Working with people at the same level

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At the end of my first term, the French teacher left unexpectedly when her husband had a new job.
I suddenly had to become the French teacher as well as the Maths teacher!

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I think that the Junior Algebra Seminar was as helpful as my earlier undergraduate meetings.

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Doing this sort of careful checking is an essential skill for a mathematician.

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One thing I learnt about was Latin squares. I will tell you a little about them.

What is a Latin square?

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Let n be a positive integer.
A Latin square of order n is an $n \times n$ array of cells in which n symbols are placed, one per cell, in such a way that each symbol occurs once in each row and once in each column.

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The symbols may be letters, numbers, colours, . . .
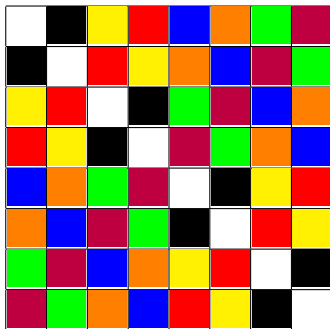
E	B	F	A	C	D
B	C	D	E	F	A
A	E	C	B	D	F
F	D	E	C	A	B
D	A	B	F	E	C
C	F	A	D	B	E

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"...on any given field agricultural operations, at least for centuries, have followed one of two directions, which are usually those of the rows and columns; consequently streaks of fertility, weed infestation, etc., do, in fact, occur predominantly in those two directions."

R. A. Fisher,
letter to H. Jeffreys,
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(selected correspondence edited by J. H. Bennett)

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This assumption is dubious for field trials in Australia.

An experiment on potatoes at Ely in 1932

E	B	F	A	C	D
B	C	D	E	F	A
A	E	C	B	D	F
F	D	E	C	A	B
D	A	B	F	E	C
C	F	A	D	B	E

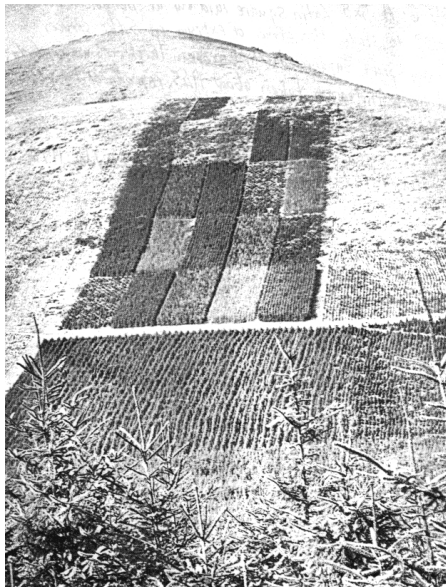| Treatment	A	B	C	D	E	F
Extra nitrogen	0	0	0	1	1	1
Extra phosphate	0	1	2	0	1	2

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Treatment	A	B	C	D	E	F
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Of course, the experimenter has to know what units the quantities of nitrogen and phosphate are measured in.

A forestry experiment in a Latin square of order 5
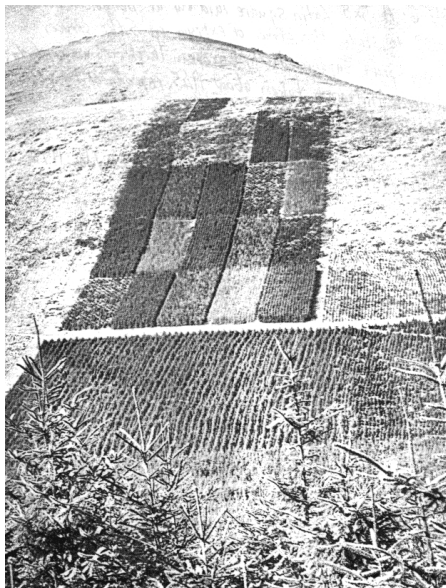
Experiment on a hillside near Beddgelert Forest, designed by Fisher and laid out in 1929

©The Forestry Commission

An experiment on 16 sheep carried out by François Cretté de Palluel, reported in *Annals of Agriculture* in 1790. They were fattened on the given diet, and slaughtered on the date shown.

slaughter date	Breed			
	Ile de France	Beauce	Champagne	Picardy
20 Feb	potatoes	turnips	beets	oats & peas
20 Mar	turnips	beets	oats & peas	potatoes
20 Apr	beets	oats & peas	potatoes	turnips
20 May	oats & peas	potatoes	turnips	beets

An experiment where treatments can be applied to individual leaves of plants in pots.

	plant			
height	1	2	3	4
1	A	B	C	D
2	B	A	D	C
3	C	D	A	B
4	D	C	B	A

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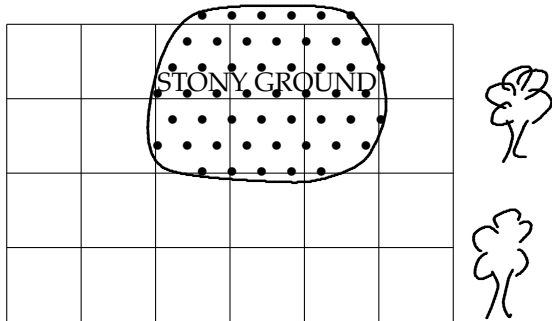This was founded by Sir John Bennet Lawes in 1843.

trees $\rightarrow$

Broadbalk

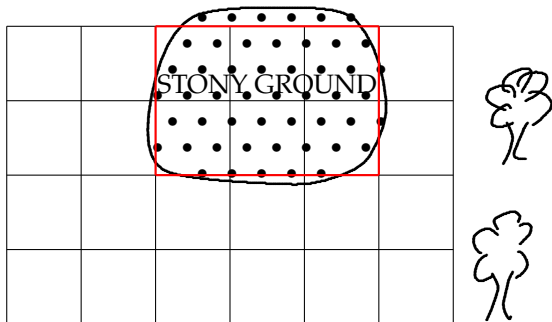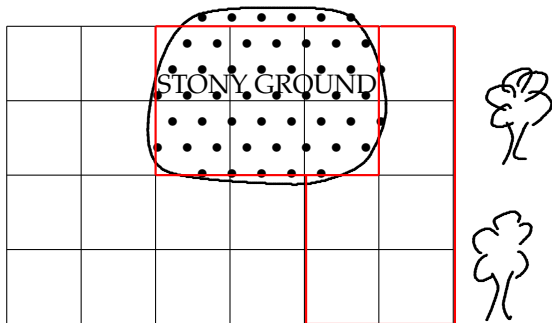I worked in the Statistics Department there from 1981 to 1990.

Blocking

We have 6 varieties to compare in this field.
Crows nest in the trees, and may damage nearby crops.
How do we avoid bias?

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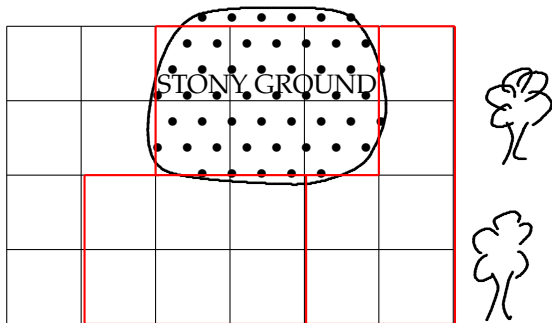STONY GROUND

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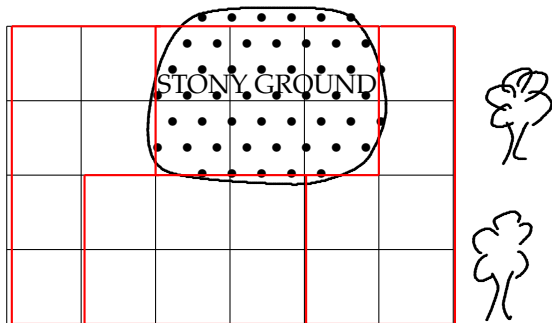Partition the experimental units into homogeneous blocks
and plant each variety in one plot in each block.

This is a Latin square with six treatments.

Unintended consequences

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RAB: There is nothing special about 6.
I can give you a Latin square like that for any size.

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But if you found something strange, you were allowed to change it.

Strange data

On one occasion, I looked through the data
(this is what mathematicians do!)
and noticed that the yields in the last 12 plots out of 72 started
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So I was allowed to add a dummy variable to the data analysis
to allow for this. This explained what was going on, and made
some sense.

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Design of Comparative Experiments

Association Schemes: Designed Experiments, Algebra and Combinatorics

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Combinatorics is the mathematics of patterns like Latin squares.

Continuing research

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You also have many opportunities to present talks about it at international conferences. This has brought me to India more than once.

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Bose died in the USA in 1987.

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This included a Bose Memorial Session on 14 December, where participants shared their memories of Bose.

Closing Remarks

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In this changing world, we cannot predict in advance what these jobs will be.