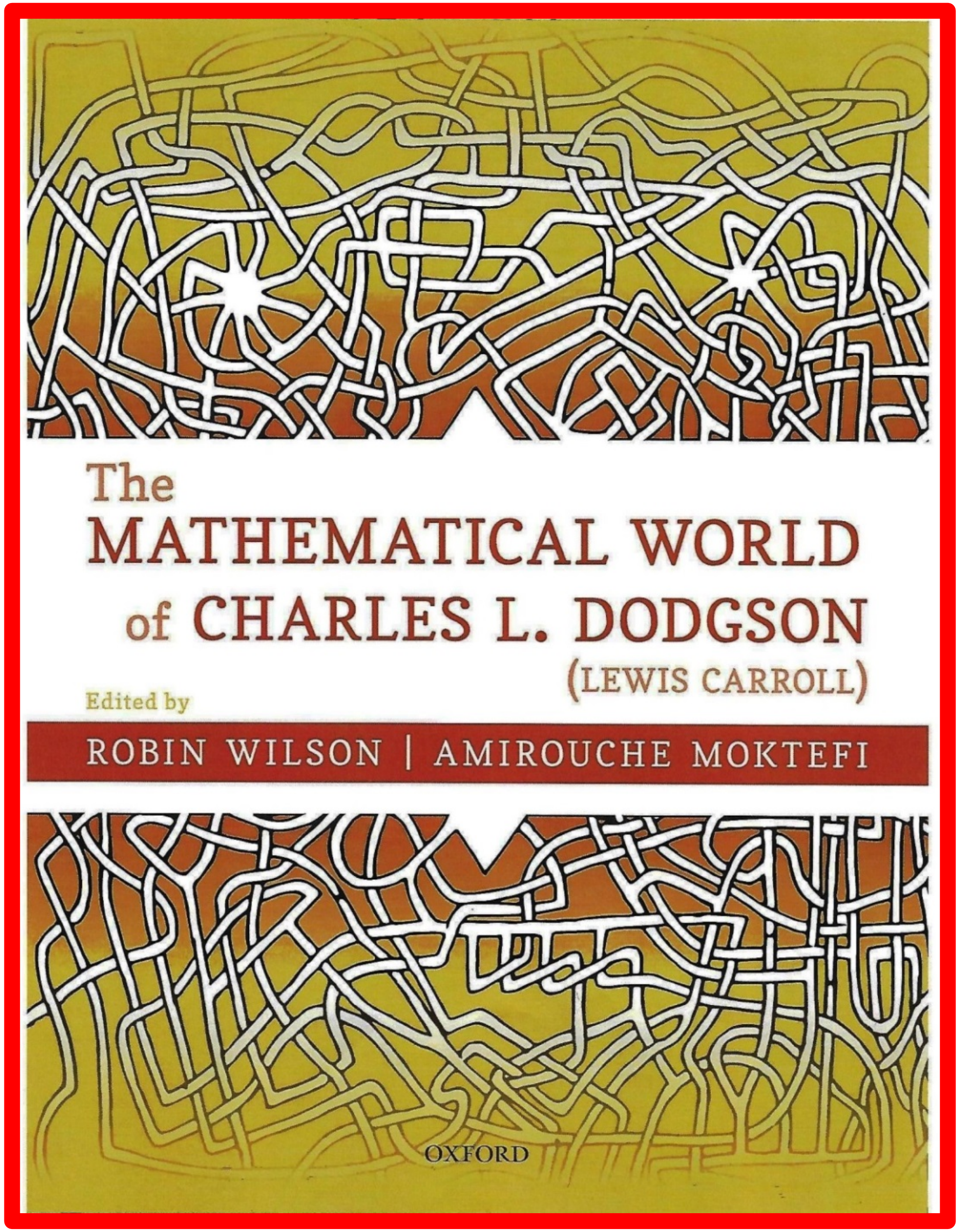


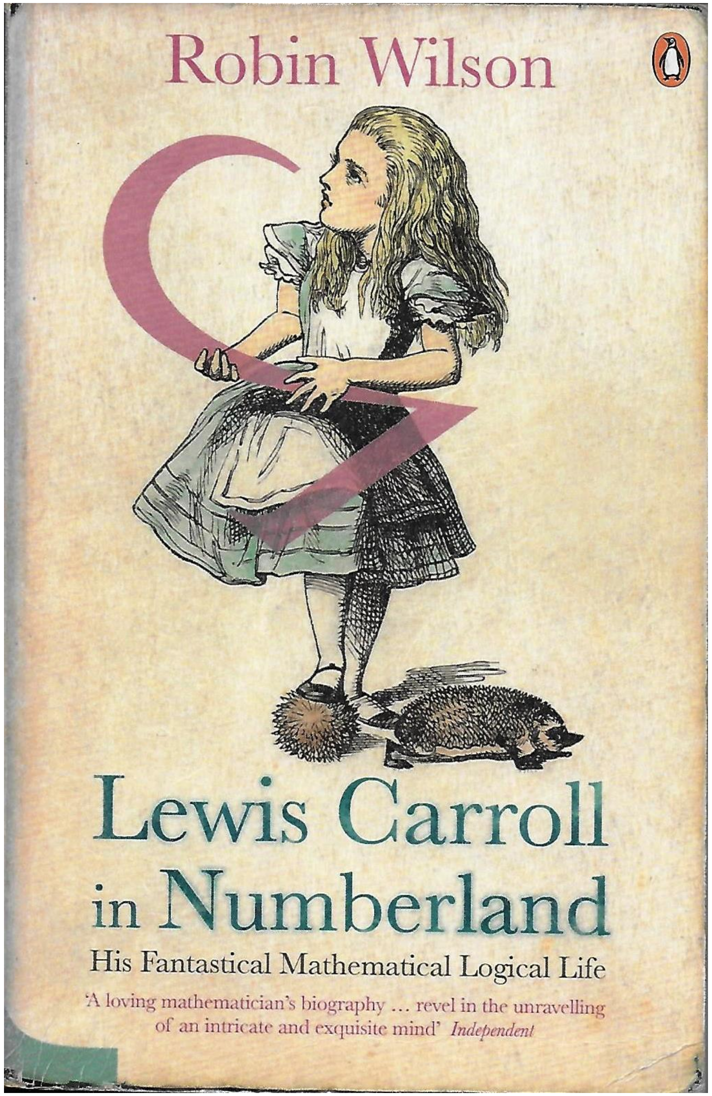
Lecture & book launch

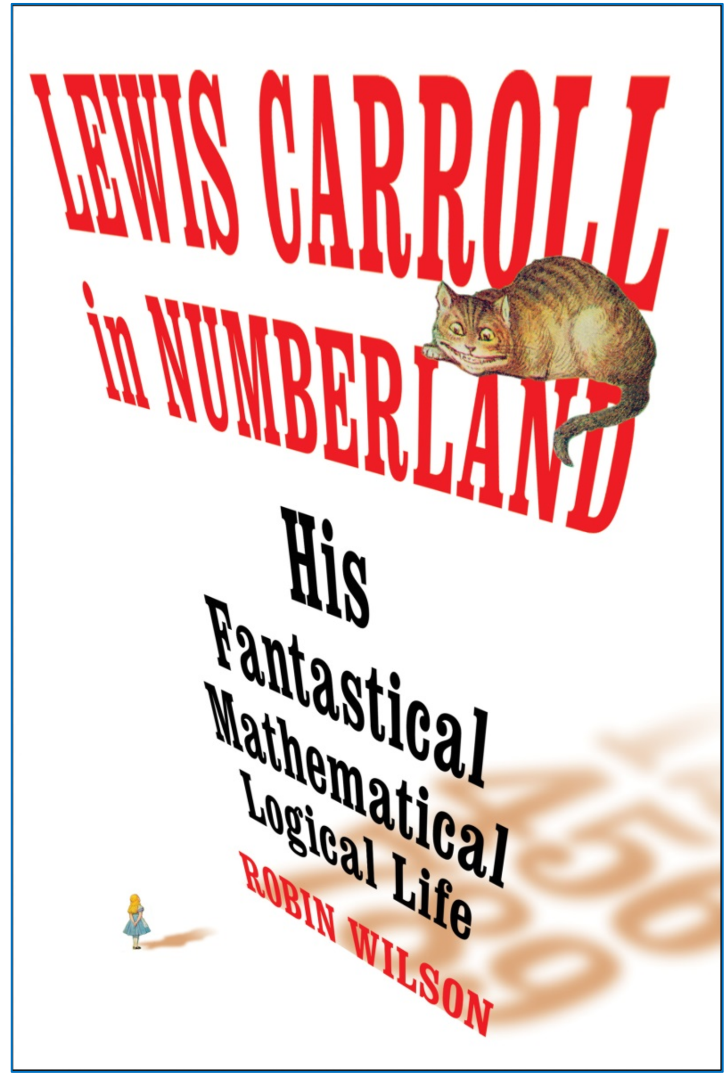
Gresham College

21 October 2019

Robin Wilson & Amirouche Moktefi

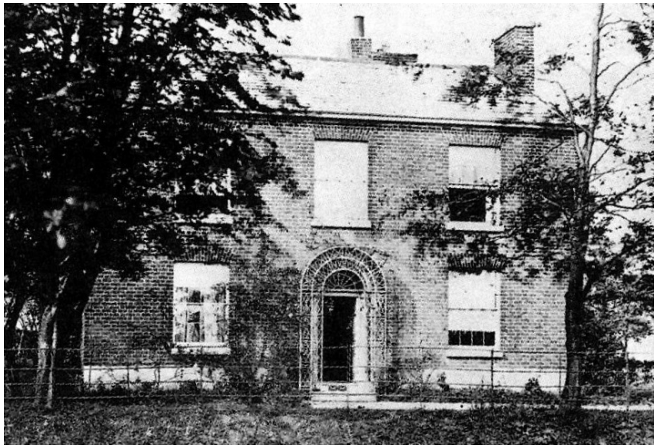
Lewis Carroll in Numberland





Contents

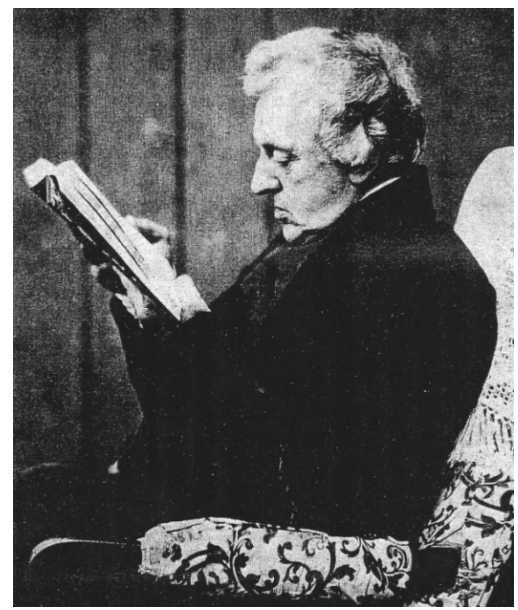
Early Years



Daresbury ↑ and Croft Rectory ↓

Charles Lutwidge Dodgson
was born on 27 January 1832

The third of 11 children
and the eldest boy



The Revd Charles Dodgson

Entertaining his brothers and sisters

Magic tricks

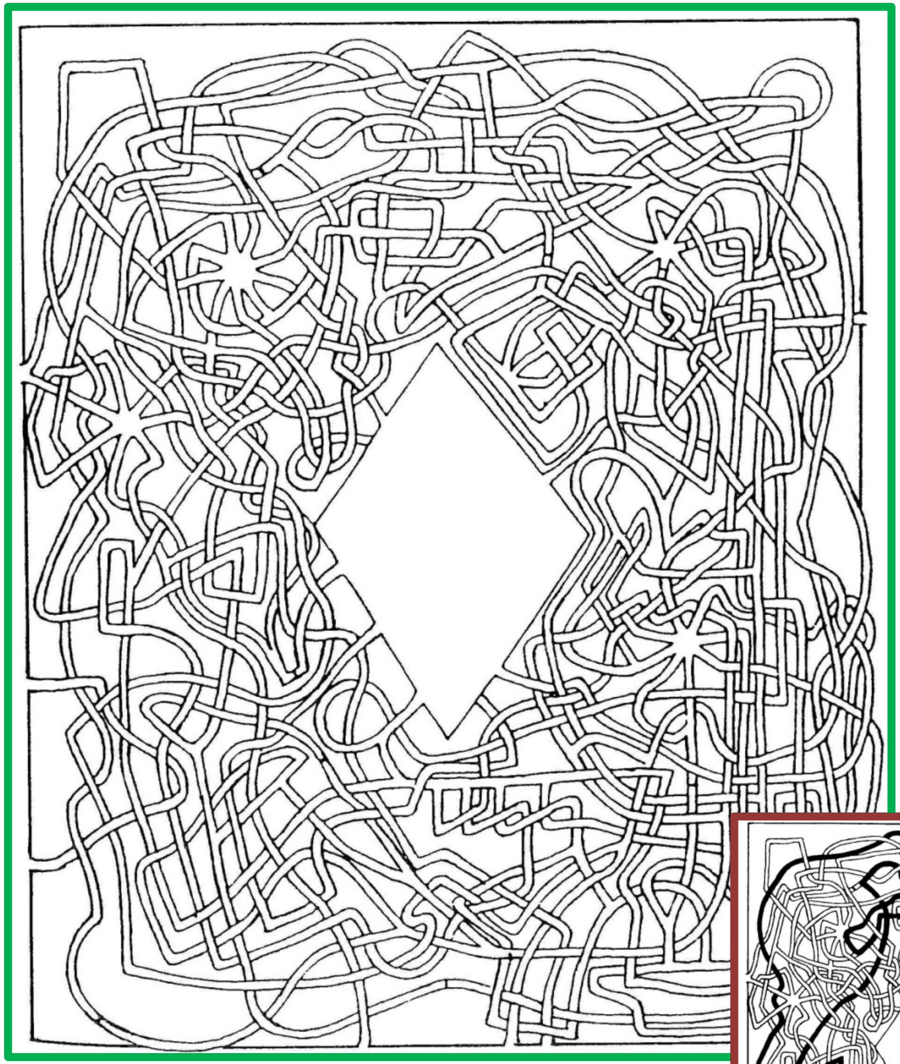
Model railway

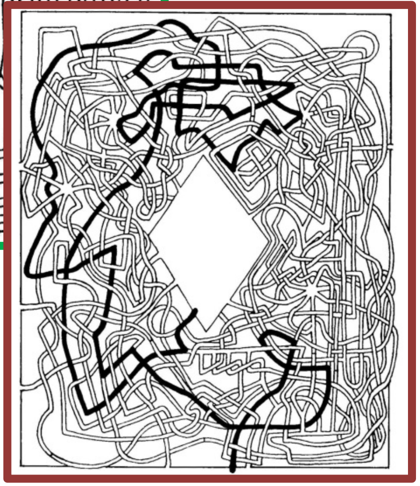
Puzzles

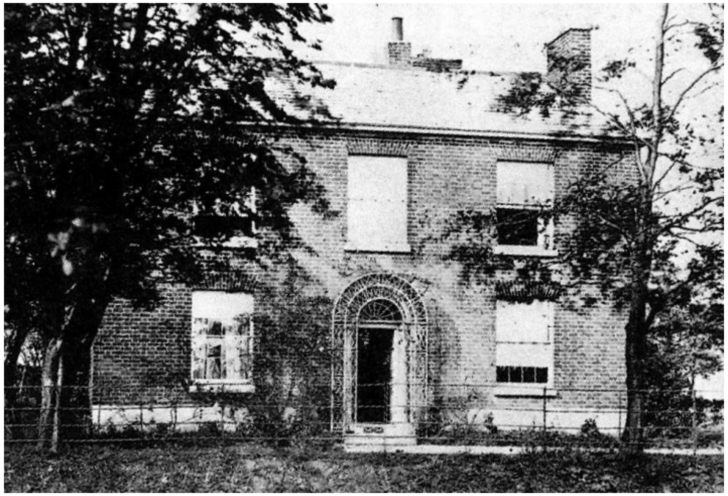
Family magazines

Mazes

. . .







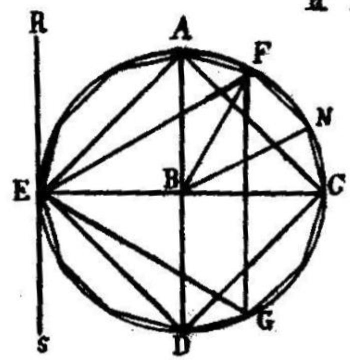
Early education

From his father the young Charles learnt mathematics, Latin, Christian theology, and English literature . . .

When Charles was a very small boy he went to his father and showed him a book of logarithms with the request, 'Please explain'.
'You're much too young to understand anything about such a difficult subject.'
But he thought this irrelevant, for he still insisted:
'*But*, please explain!'.

Early interest in geometry

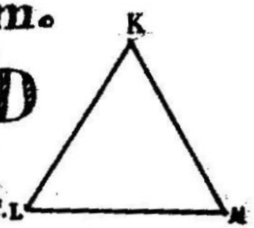
How to trisect a right angle



Problem.

C.L.D

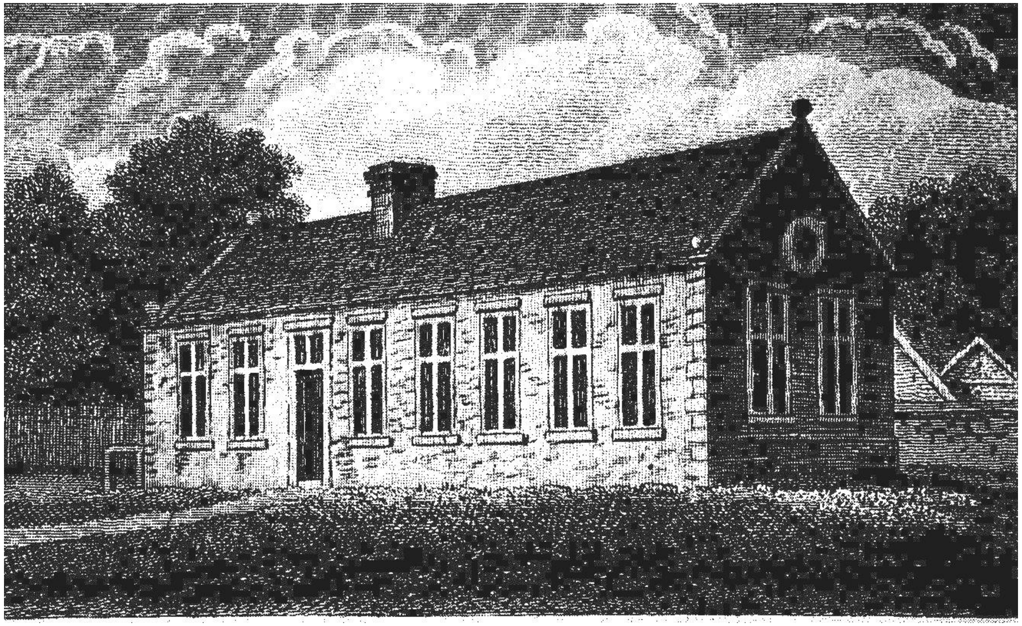
Dec: 1844.



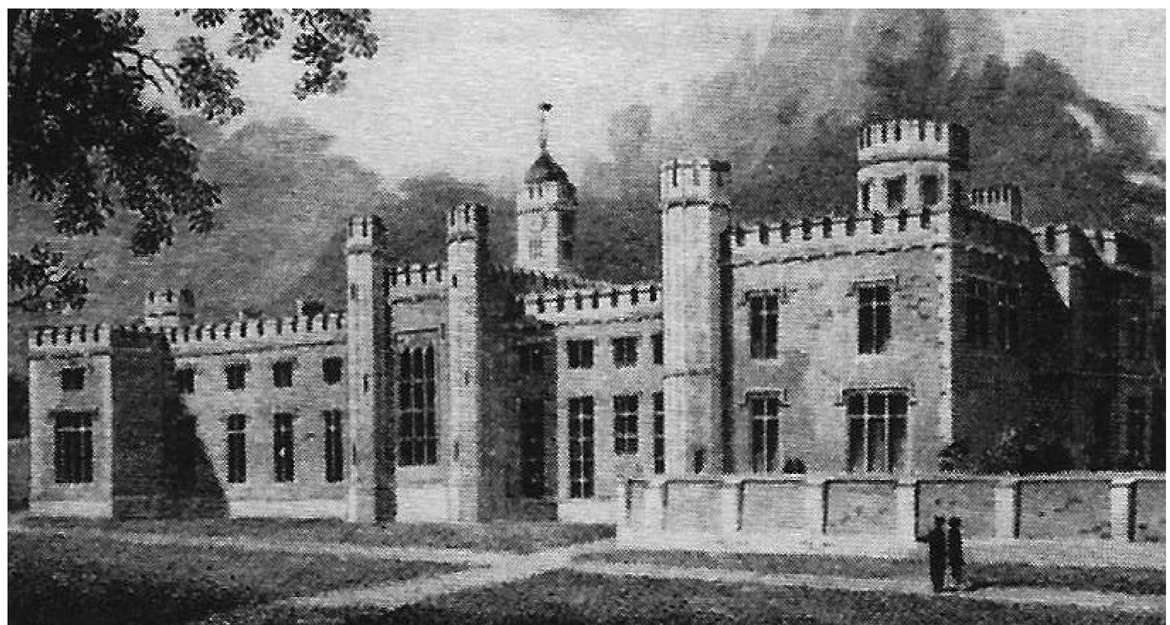
To trisect a right angle, that is, to divide it into three equal parts.

Let there be a right angle ABC, it is required to trisect it.

Produce AB to D and make BD equal to AB, and make BC equal to AB and produce CB to E and make EB equal to BC, and join AE, ED, DC, CA. Because AB is equal to BD, and BE is common to the two triangles ABE, DBE, and the angle ABE is equal to the angle DBE, therefore the base AE is equal to the base ED; and in like manner it may be proved that all the four AE, ED, DC, CA are equal, therefore AEDC is equilateral, and because the ~~two~~ three angles of a triangle are equal to two right angles, and that the angle ABE is a right angle, (for ABC is a right angle, and EC is a straight line) therefore the angles BAE, BEA are equal to one right angle and because BA is equal to BE, therefore the angle BAE is ½ a right angle, and in like manner it may be proved that the angle BAC is ½ a right angle, therefore the angle EAC is a right angle, and in like manner it may be proved that the angles AED, EDC, DCA are also right angles, therefore AEDC ~~[illegible]~~ has all its angles right angles, and it was proved

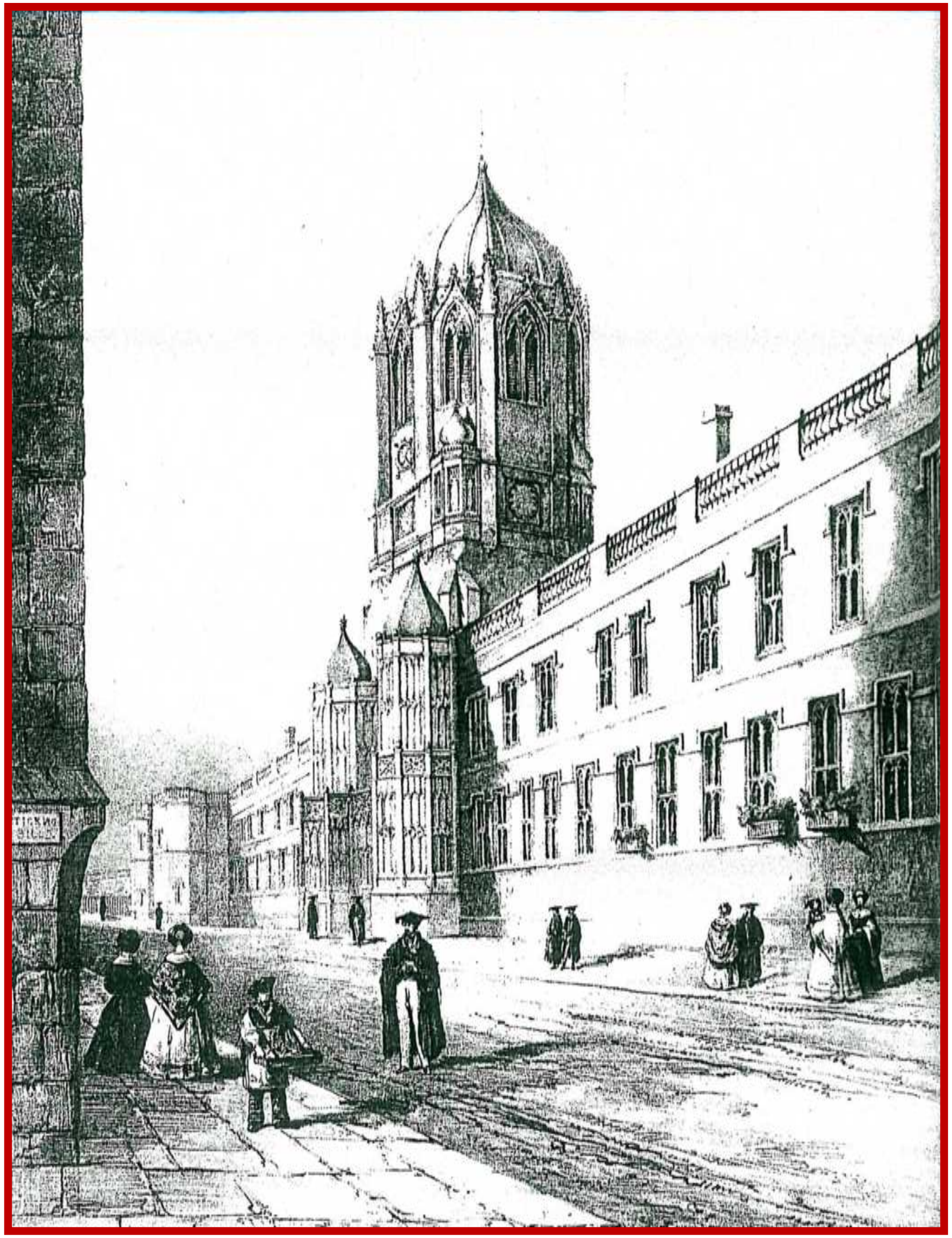


Schooldays at Richmond and Rugby



Examples from Francis Walkingame's Arithmetic text

- What is the cube root of 673373097125? Ans. 8765.
- If from London to York be accounted 50 leagues, I demand how many miles, yards, feet, inches and barleycorns? Ans. 150 miles, 264000 yards, 792000 feet, 9504000 inches, 28512000 barleycorns
- If 504 Flemish ells, 2 qrs. cost 283 l. 17s. 6d., what must I give for 14 yards? Ans. £2265 : 8 : 4.
- The spectators' club of fat people, though it consisted of 15 members, is said to have weighed no less than 3 tons – how much was that per man? Ans. 4 cwt.



Christ Church Oxford

(c.1850)

Matriculated 23 May 1850

(exam in Latin, Greek and mathematics)

Took up residence 24 January 1851

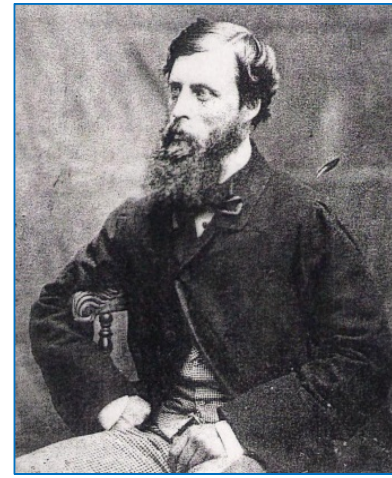
A Trio of Examinations

Dodgson took a four-year Honours Degree:

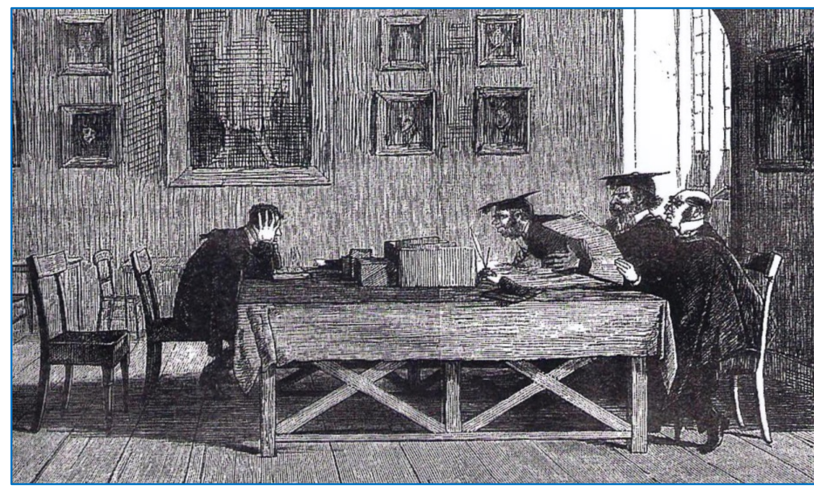
Responsions (1851)
('Little-Go': Latin, Greek, Biblical texts, and Mathematics)

Moderations (1852)

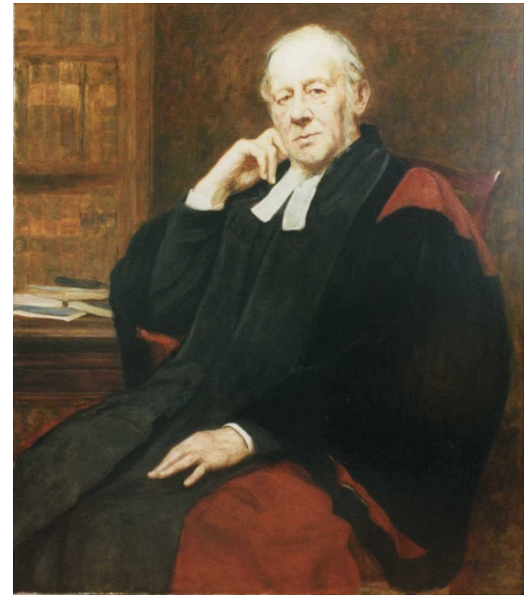
Finals in Classics
and then (for Honours)
Mathematics (1854)



Baden Powell & Robert Faussett



Finals reading party with Bartholomew 'Bat' Price



Twinkle, twinkle, little bat

Finals examinations Oct/Nov 1854

Ten papers in pure and applied mathematics

Geometry and Algebra
Calculus
Astronomy, Optics, etc.

SECOND PUBLIC EXAMINATION.

I.

Geometry and Algebra.

1. Compare the advantages of a decimal and of a duodecimal system of notation in reference to (1) commerce, (2) pure arithmetic; and shew by duodecimals that the area of a room whose length is 29 feet $7\frac{1}{2}$ inches, and breadth is 33 feet $9\frac{1}{4}$ inches, is 704 feet $30\frac{3}{8}$ inches.

2. Planes which are perpendicular to parallel straight lines are parallel to one another: and all planes which cut orthogonally a given circle meet in one and the same straight line.

3. Solve the following equations:

$$(1)\quad \frac{x+\sqrt{a^2-x^2}}{x-\sqrt{a^2-x^2}}=b.$$

$$(2)\quad \left.\begin{aligned} x^3-y^3&=98 \\ x-y&=2 \end{aligned}\right\}$$

$$(3)\quad \left.\begin{aligned} \frac{x}{a}+\frac{y}{b}&=1 \\ \frac{z}{c}+\frac{x}{a}&=1 \\ yz&=bc \end{aligned}\right\}$$

4. The difference of the squares of any two odd numbers is divisible by 8.

5. Shew that in a binomial, (whose index is a positive whole number,) the coefficient of any term of the expansion reckoned from the end, is the same as the coefficient of the corresponding term reckoned from the beginning.

6. In a given equilateral triangle a circle is inscribed, and then in the triangle formed by a tangent to that circle parallel to any side and the parts of the original triangle cut off by it, another circle is inscribed, and so on *ad infinitum*. Find the sum of the radii of these circles.

[Turn over.

Letter to Mary Dodgson, December 1854

My dear Sister,

. . . I have just been to Mr. Price to see how I did in the papers, and the result will I hope be gratifying to you. The following were the sum total of the marks for each in the First Class:

Dodgson 279
Bosanquet . . . 261
Cookson 254
Fowler 225
Ranken 213

He also said he never remembered so good a set of men in. All this is very satisfactory.

Your very affectionate brother, Charles L. Dodgson

Tutoring at Christ Church

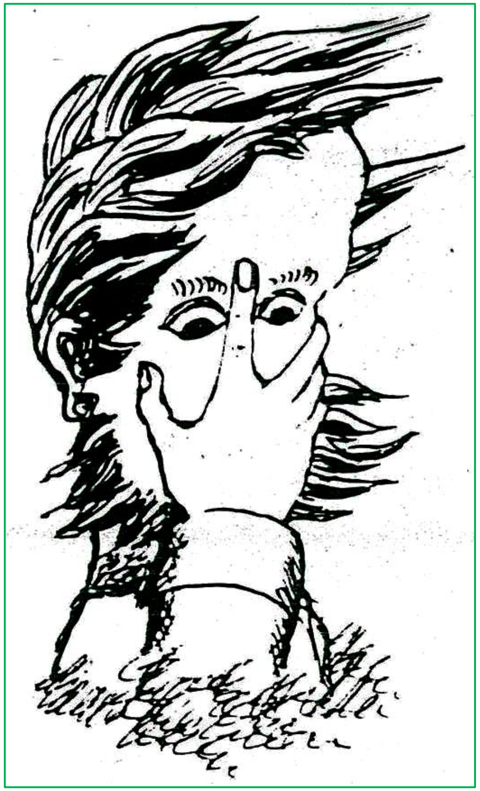
"Got a note from Leighton, a gentleman commoner, who wishes to be taught some arithmetic for his Little-Go – as well as the second book of Euclid . . ."

A new Dean at Christ Church

Dean Henry Liddell

Alice

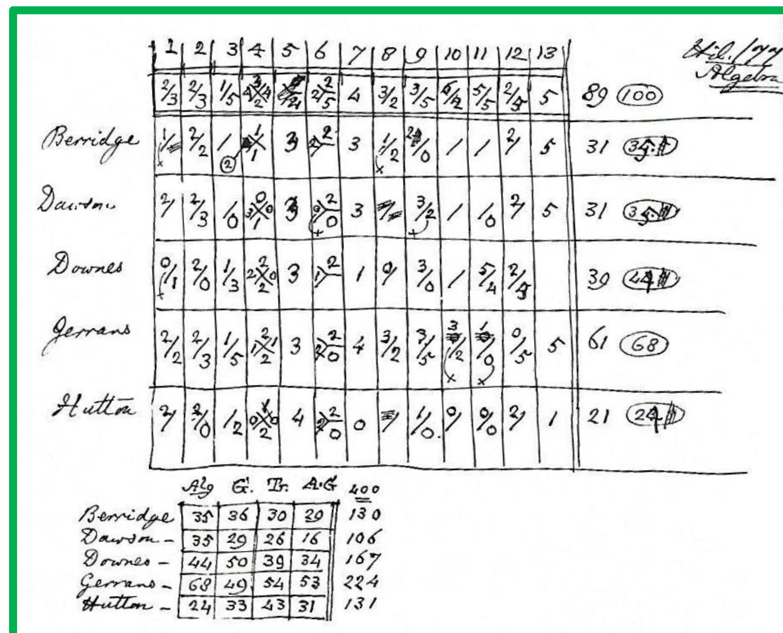
Edith, Lorina, and Alice



College Lecturer : 1856-81

"I have five pupils, whose lectures need preparing for:
Blackmore in for a First at Easter,
doing end of Differential Calculus.
Rattle in for a First in Mods this time,
needs special problems etc. and very probably
high Diff: Cal:, a little Int: Cal: and Spherical Trig . . ."

"I am weary of lecturing and discouraged.
I examined six or eight men today
who are going in for Little-Go,
and hardly one is really fit to go in.
It is thankless uphill work,
goading unwilling men
to learning they have no taste for . . ."



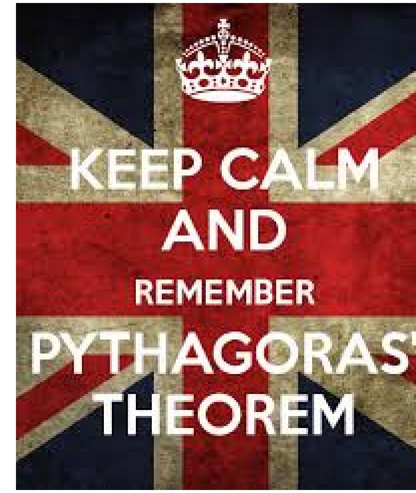
Choosing a new name

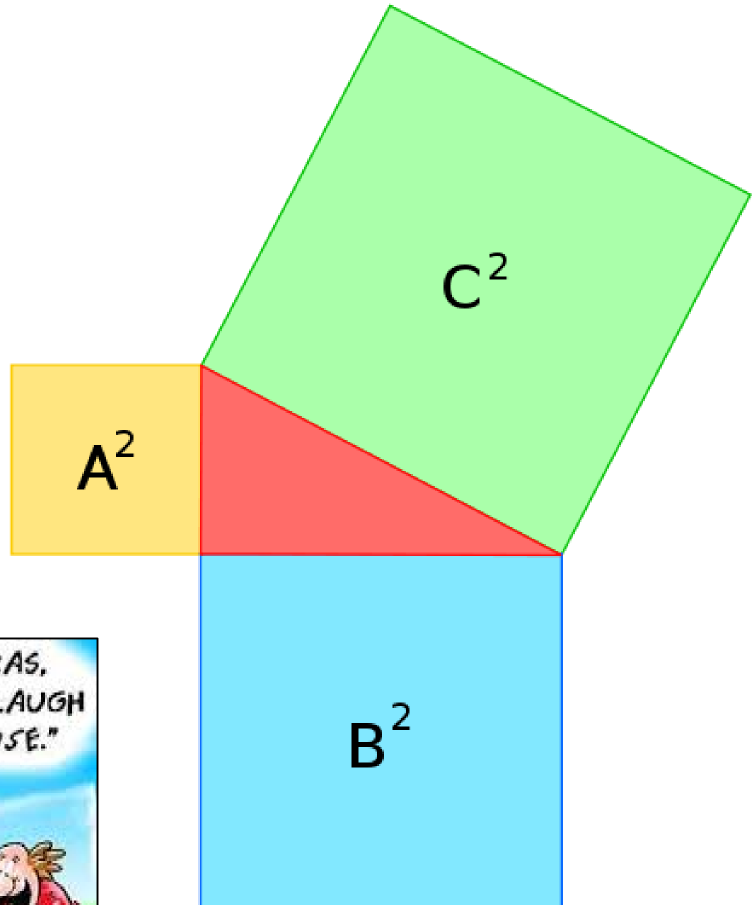
For his comic writings
Charles Lutwidge Dodgson
adopted the pseudonym
of ‘Lewis Carroll’ in 1856:

‘Lewis’ derives from Lutwidge
(his mother’s maiden name,
and his middle name)

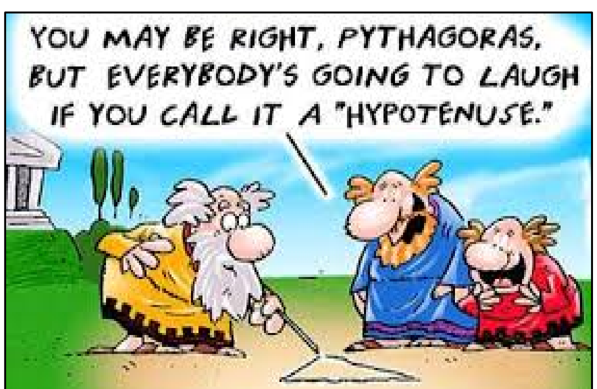
‘Carroll’ (short for ‘Carolus’)
is the Latin for Charles

The Pythagorean theorem





For a right-angled triangle, the area of the square on the hypotenuse (the longest side) is the sum of the areas of the squares on the other two sides



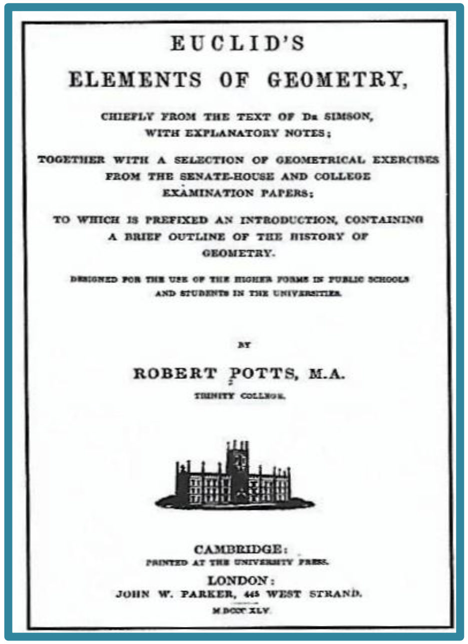
The Pythagorean theorem

It is as dazzlingly beautiful now as it was in the day when Pythagoras first discovered it, and celebrated the event, it is said, by sacrificing a hecatomb of oxen *[100 oxen]* – a method of doing honour to Science that has always seemed to me slightly exaggerated and uncalled-for.

One can imagine oneself, even in these degenerate days, marking the epoch of some brilliant scientific discovery by inviting a convivial friend or two, to join one in a beefsteak and a bottle of wine.
But a hecatomb of oxen!
It would produce a quite inconvenient supply of beef.

Euclid's *Elements* (c.250 BC)

- Most printed book after the Bible
- 13 books: geometry, arithmetic, . . .
- Logically organized
  – axiomatic and hierarchical
- Used for teaching for 2000 years
- Widely used in Victorian times
- Strongly supported by Dodgson
  (but not by everyone . . .)



EUCLID'S

ELEMENTS OF GEOMETRY,

CHIEFLY FROM THE TEXT OF Dr SIMSON,
WITH EXPLANATORY NOTES;

TOGETHER WITH A SELECTION OF GEOMETRICAL EXERCISES
FROM THE SENATE-HOUSE AND COLLEGE
EXAMINATION PAPERS;

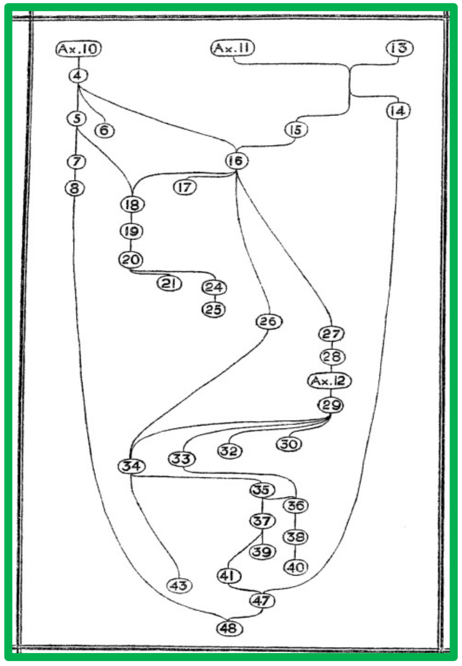
TO WHICH IS PREFIXED AN INTRODUCTION, CONTAINING
A BRIEF OUTLINE OF THE HISTORY OF
GEOMETRY.

DESIGNED FOR THE USE OF THE HIGHER FORMS IN PUBLIC SCHOOLS
AND STUDENTS IN THE UNIVERSITIES.

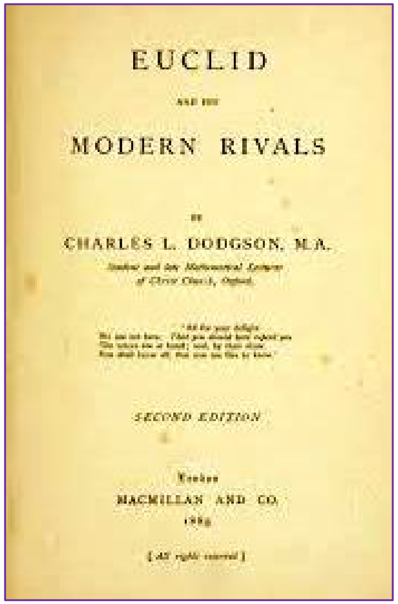
BY

ROBERT POTTS, M.A.
TRINITY COLLEGE.

CAMBRIDGE:
PRINTED AT THE UNIVERSITY PRESS.
LONDON:
JOHN W. PARKER, 445 WEST STRAND.
M DCCC XLV.



Euclid and his Modern Rivals


EUCLID

AND HIS

MODERN RIVALS

BY

CHARLES L. DODGSON, M.A.

SECOND EDITION

London

MACMILLAN AND CO.

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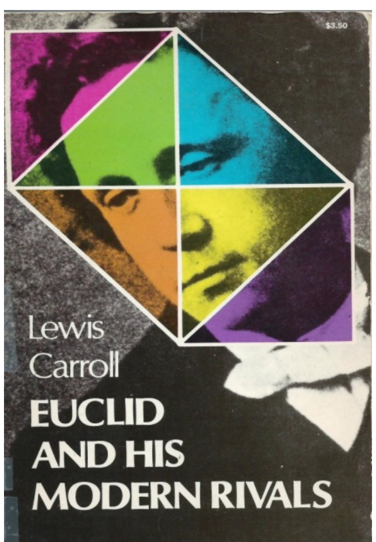


'Dedicated to the memory of Euclid'

Presented as a drama in four acts,
it compares Euclid (favourably
in every case) with a dozen 'rivals'

Four characters:
Minos and Rhadamanthus,
Herr Niemand, and Euclid himself

Rivals: A.-M. Legendre, J. M. Wilson,
Benjamin Peirce, Olaus Henrici, . . .

Other geometry writings

EUCLID

BOOKS I, II

EDITED BY

CHARLES L. DODGSON, M.A.

STUDENT AND LATE MATHEMATICAL LECTURER
OF CH. CH., OXFORD

SIXTH EDITION

London
MACMILLAN AND CO.
1888

PRICE TWO SHILLINGS

Dodgson's geometry books and pamphlets

1860:	*A Syllabus of Plane Algebraical Geometry*
1860:	*Notes on the First Two Books of Euclid*
1863:	*The Enunciations of Euclid I, II*
1865:	*The Dynamics of a Parti-cle*
1868:	*The Fifth Book of Euclid*
1872:	*Symbols, &c., to be Used in Euclid, Books I, II*
1872:	*Number of Propositions in Euclid*
1873:	*Enunciations of Euclid I–VI*
1874:	*Euclid, Book V*
1875/82:	*Euclid, Books I, II*
1879:	*Euclid and his Modern Rivals*
1885:	*Supplement to Euclid and his Modern Rivals*
1888:	*Curiosa Mathematica, Part I. A New Theory of Parallels*

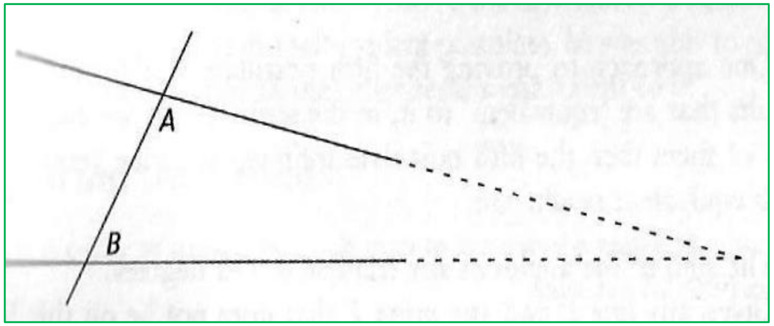
A
SYLLABUS
OF
PLANE ALGEBRAICAL GEOMETRY,
SYSTEMATICALLY ARRANGED, WITH FORMAL DEFINITIONS, POSTULATES, AND AXIOMS.

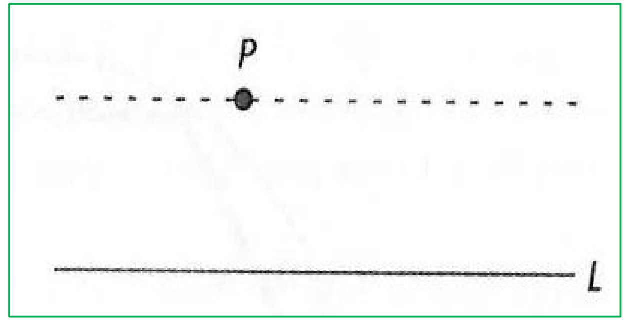
BY
CHARLES LUTWIDGE DODGSON, M.A.
STUDENT AND MATHEMATICAL LECTURER OF CHRIST CHURCH, OXFORD.

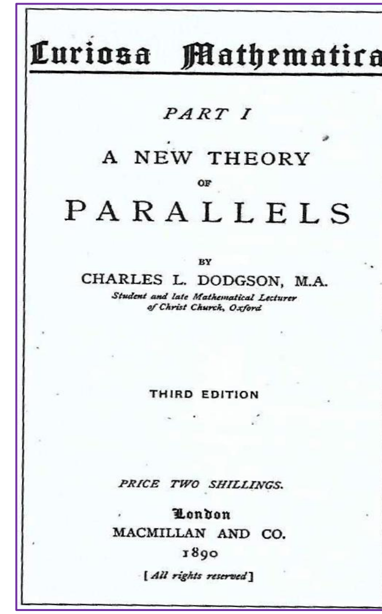
PART I.
CONTAINING
POINTS, RIGHT LINES, RECTILINEAR FIGURES, PENCILS, AND CIRCLES.

OXFORD:
PRINTED BY JAMES WRIGHT, PRINTER TO THE UNIVERSITY;
SOLD BY J. H. AND J. PARKER, OXFORD,
AND 377 STRAND, LONDON.
M.DCCC.LX.

The parallel postulate






Curiosa Mathematica

PART I

A NEW THEORY
OF
PARALLELS

BY
CHARLES L. DODGSON, M.A.
Student and late Mathematical Lecturer of Christ Church, Oxford

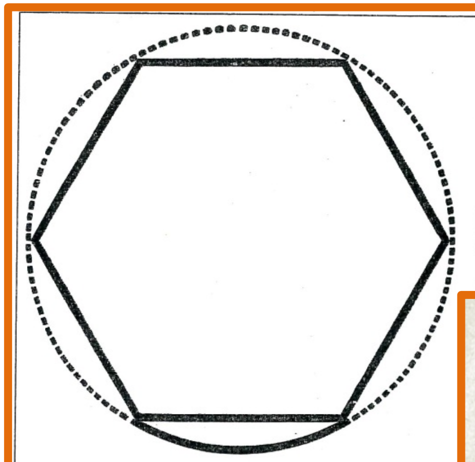
THIRD EDITION

PRICE TWO SHILLINGS.

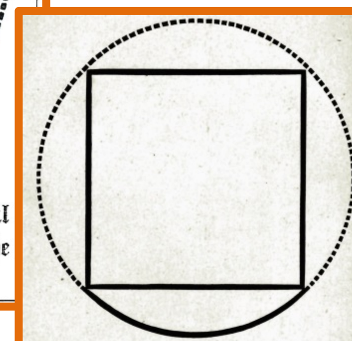
London
MACMILLAN AND CO.
1890

Minos: **An absolute proof of it, from first principles, would be received, I can assure you, with absolute rapture, being an *ignis fatuus* [a delusive hope] that mathematicians have been chasing from your age down to our own.**

Euclid: **I know it. But I cannot help you. Some mysterious flaw lies at the root of the subject.**



In every Circle, the inscribed equilateral Hexagon is greater than any one of the Segments which lie outside it.



In every Circle, the inscribed equilateral Tetragon is greater than any one of the Segments which lie outside it.

Alice's Adventures under Ground

Chapter 1

Alice was beginning to get very tired of sitting by her sister on the bank, and of having nothing to do: once or twice she had peeped into the book her sister was reading, but it had no pictures or conversations in it, and where is the use of a book, thought Alice, without pictures or conversations? So she was considering in her own mind, (as well as she could, for the hot day made her feel very sleepy and stupid,) whether the pleasure of making a daisy-chain was worth the trouble of getting up and picking the daisies, when a white rabbit with pink eyes ran close by her.

There was nothing very remarkable in that, nor did Alice think it so very much out of the way to hear the rabbit say to itself "dear, dear! I shall be too late!" (when she thought it over afterwards, it occurred to her that she ought to have wondered at this, but at the time it all seemed quite natural); but when the rabbit actually took a watch out of its waistcoat-pocket, looked at it, and then hurried on, Alice started to her feet, for

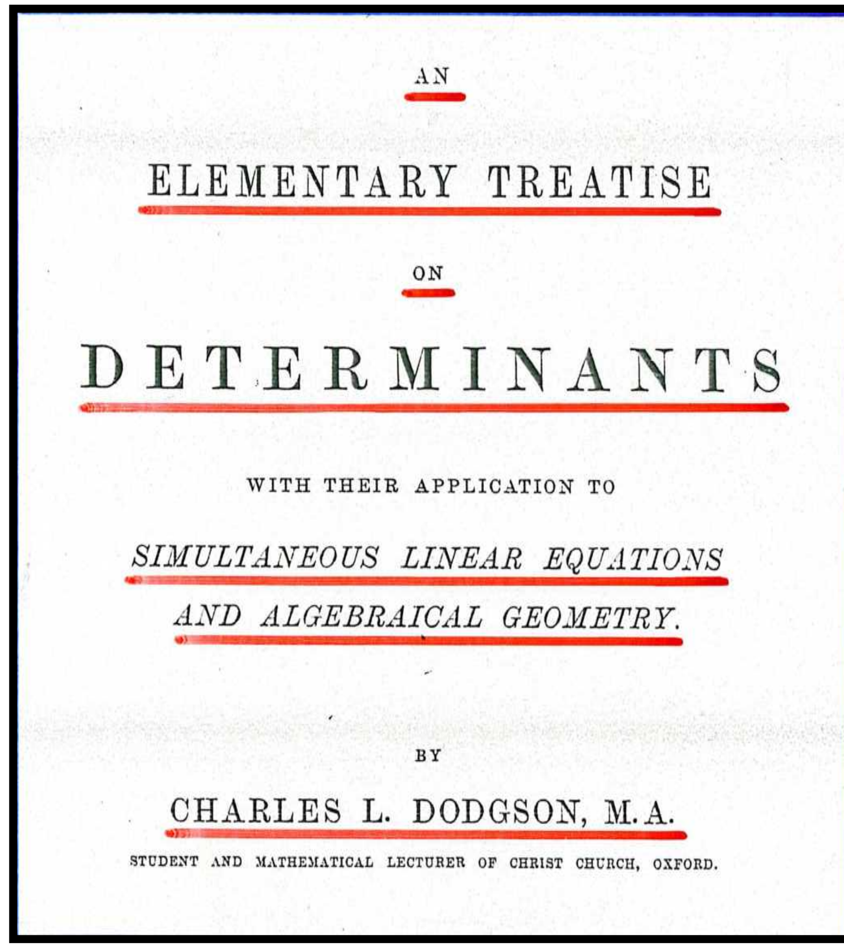
Alice's
Adventures
in Wonderland

published in 1865

Queen Victoria (1867)

‘Send me the next book Mr Carroll produces’

She was not amused . . .



AN

ELEMENTARY TREATISE

ON

DETERMINANTS

WITH THEIR APPLICATION TO

SIMULTANEOUS LINEAR EQUATIONS

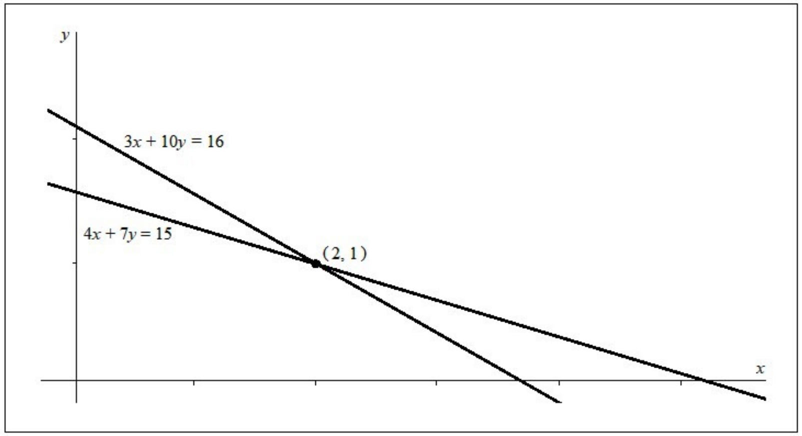
AND ALGEBRAICAL GEOMETRY.

BY

CHARLES L. DODGSON, M.A.

STUDENT AND MATHEMATICAL LECTURER OF CHRIST CHURCH, OXFORD.

Determinants



Solve the simultaneous equations:

4x + 7y = 15

3x + 10y = 16

Answer: x = 2, y = 1

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

$$A = \begin{pmatrix} 4 & 7 \\ 3 & 10 \end{pmatrix}$$

$$\det A = \begin{vmatrix} 4 & 7 \\ 3 & 10 \end{vmatrix} = (4\times 10) - (7\times 3) = 40 - 21 = 19$$

$$A_1 = \begin{pmatrix} 15 & 7 \\ 16 & 10 \end{pmatrix}, \quad \text{and} \quad A_2 = \begin{pmatrix} 4 & 15 \\ 3 & 16 \end{pmatrix}$$

Then

x = det A_1 / det A = 38/19 = 2

y = det A_2 / det A = 19/19 = 1

Determinants

As an instance of the foregoing rules, let us take the block

$$\begin{vmatrix} -2 & -1 & -1 & -4 \\ -1 & -2 & -1 & -6 \\ -1 & -1 & 2 & 4 \\ 2 & 1 & -3 & -8 \end{vmatrix}.$$

By rule (2) this is condensed into $\begin{vmatrix} 3 & -1 & 2 \\ -1 & -5 & 8 \\ 1 & 1 & -4 \end{vmatrix}$; this, again, by rule (3), is condensed into $\begin{vmatrix} 8 & -2 \\ -4 & 6 \end{vmatrix}$; and this, by rule (4), into -8, which is the required value.

The simplest method of working this rule appears to be to arrange the series of blocks one under another, as here exhibited; it will then be found very easy to pick out the divisors required in rules (3) and (4).

$$\begin{vmatrix} -2 & -1 & -1 & -4 \\ -1 & -2 & -1 & -6 \\ -1 & -1 & 2 & 4 \\ 2 & 1 & -3 & -8 \end{vmatrix}$$

$$\begin{vmatrix} 3 & -1 & 2 \\ -1 & -5 & 8 \\ 1 & 1 & -4 \end{vmatrix}$$

$$\begin{vmatrix} 8 & -2 \\ -4 & 6 \end{vmatrix}$$

$$-8.$$

$$\begin{array}{cccccc} - & + & - & + & - & + \end{array}$$

$$\begin{aligned}
x + 2y + z - u + 2v + 2 &= 0 \\
x - y - 2z \quad u - v - 4 &= 0 \\
2x + y - z - 2u - v - 6 &= 0 \\
x - 2y - z - u + 2v + 4 &= 0 \\
2x - y + 2z + u - 3v - 8 &= 0
\end{aligned}$$

$$\begin{vmatrix} 1 & 2 & 1 & -1 & 2 & 2 \\ 1 & -1 & -2 & -1 & -1 & -4 \\ 2 & 1 & -1 & -2 & -1 & -6 \\ 1 & -2 & -1 & -1 & 2 & 4 \\ 2 & -1 & 2 & 1 & -3 & -8 \end{vmatrix} \quad \begin{vmatrix} 2 & 4 \\ -1 & -2 \\ -1 & -2 \\ 2 & 6 \end{vmatrix} \quad \begin{vmatrix} 2 & 6 \\ -1 & -3 \\ -1 & -1 \end{vmatrix} \quad \begin{vmatrix} 2 & 5 \\ -1 & -1 \end{vmatrix} \quad \begin{vmatrix} 2 & 4 \end{vmatrix} \quad \therefore -2v = 4 \quad \therefore v = -2$$

$$\begin{vmatrix} 3 & 0 \\ -1 & -2 \end{vmatrix} \quad \begin{vmatrix} 3 & 3 \end{vmatrix} \quad \therefore 3u = 3 \ \ldots\ldots \ \therefore u = 1$$

$$\begin{vmatrix} -3 & -3 & -3 & 3 & -6 \\ 3 & 3 & 3 & -1 & 2 \\ -5 & -3 & -1 & -5 & 8 \\ 3 & -5 & 1 & 1 & -4 \end{vmatrix} \quad \begin{vmatrix} 3 & 0 \\ -1 & 0 \\ -5 & -2 \end{vmatrix} \quad \begin{vmatrix} 6 & 6 \end{vmatrix} \quad \therefore -6z = 6 \ \ldots\ldots \ \therefore z = -1$$

$$\begin{vmatrix} 6 & 0 \\ 8 & -2 \end{vmatrix}$$

$$\begin{vmatrix} 0 & 0 & 6 & 0 \\ 6 & -6 & 8 & -2 \\ -17 & 8 & -4 & 6 \end{vmatrix} \quad \begin{vmatrix} 12 & 12 \end{vmatrix} \quad \therefore 12y = 12 \ \ldots\ldots \ \therefore y = 1$$

$$\begin{vmatrix} 0 & 12 & 12 \\ 18 & 40 & -8 \end{vmatrix}$$

$$\begin{vmatrix} 36 & -72 \end{vmatrix}$$

$$\because -36x = -72 \ \ldots\ldots \ \therefore x = 2$$

$$\begin{array}{cccc} - & + & - & + \end{array}$$

$$\begin{aligned}
5x + 2y - 3z + 3 &= 0 \\
3x - y - 2z + 7 &= 0 \\
2x + 3y + z - 12 &= 0
\end{aligned}$$

$$\begin{vmatrix} 5 & 2 & -3 & 3 \\ 3 & -1 & -2 & 7 \\ 2 & 3 & 1 & -12 \end{vmatrix} \quad \begin{vmatrix} -3 & 8 \\ -2 & 10 \end{vmatrix} \quad \begin{vmatrix} -3 & 12 \end{vmatrix} \quad \therefore 3z = 12 \ \ldots\ldots \ \therefore z = 4$$

$$\begin{vmatrix} -11 & -7 & -15 \\ 11 & 5 & 17 \end{vmatrix} \quad \begin{vmatrix} -7 & -14 \end{vmatrix} \quad \therefore -7y = -14 \ \ldots\ldots \ \therefore y = 2$$

$$\begin{vmatrix} -22 & 22 \end{vmatrix}$$

$$\therefore 22x = 22 \ \ldots\ldots \ \therefore x = 1$$

Dodgson's determinants

[*From the* Proceedings of the Royal Society, No. 84, 1866.]

CONDENSATION OF DETERMINANTS,

BEING A

NEW AND BRIEF METHOD

FOR

COMPUTING THEIR ARITHMETICAL VALUES.

BY THE

Rev. C. L. DODGSON, M.A.,

STUDENT OF CHRIST CHURCH, OXFORD.

IV. "Condensation of Determinants, being a new and brief Method for computing their arithmetical values." By the Rev. C. L. Dodgson, M.A., Student of Christ Church, Oxford. Communicated by the Rev. Bartholomew Price, M.A., F.R.S. Received May 15, 1866.

If it be proposed to solve a set of n simultaneous linear equations, not being all homogeneous, involving n unknowns, or to test their compatibility when all are homogeneous, by the method of determinants, in these, as well as in other cases of common occurrence, it is necessary to compute the arithmetical values of one or more determinants—such, for example, as

$$\begin{vmatrix} 1, & 3, & -2 \\ 2, & 1, & 4 \\ 3, & 5, & -1 \end{vmatrix}.$$

Now the only method, so far as I am aware, that has been hitherto employed for such a purpose, is that of multiplying each term of the first row or column by the determinant of its complemental minor, and affecting the products with the signs + and − alternately, the determinants required in the process being, in their turn, broken up in the same manner until determinants are finally arrived at sufficiently small for mental computation.

This process, in the above instance, would run thus:—

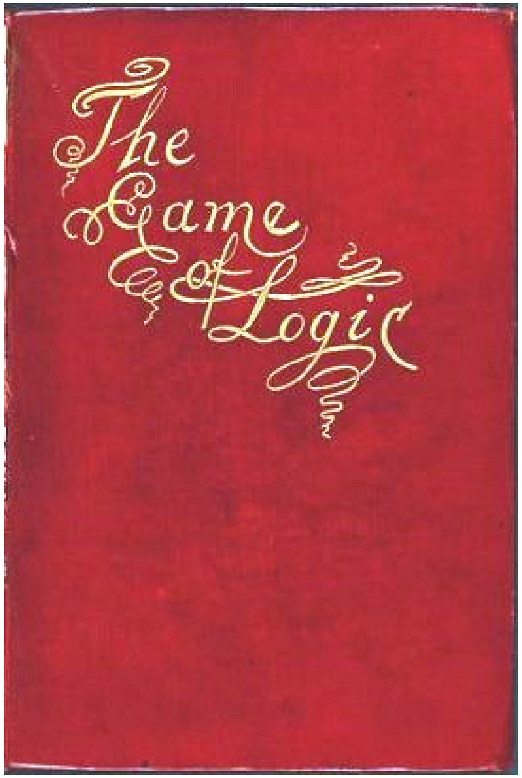
$$\begin{vmatrix} 1, & 3, & -2 \\ 2, & 1, & 4 \\ 3, & 5, & -1 \end{vmatrix} = 1 \times \begin{vmatrix} 1, & 4 \\ 5, & -1 \end{vmatrix} - 2 \times \begin{vmatrix} 3, & -2 \\ 5, & -1 \end{vmatrix} + 3 \times \begin{vmatrix} 3, & -2 \\ 1, & 4 \end{vmatrix}$$
$$= -21 - 14 + 42 = 7.$$

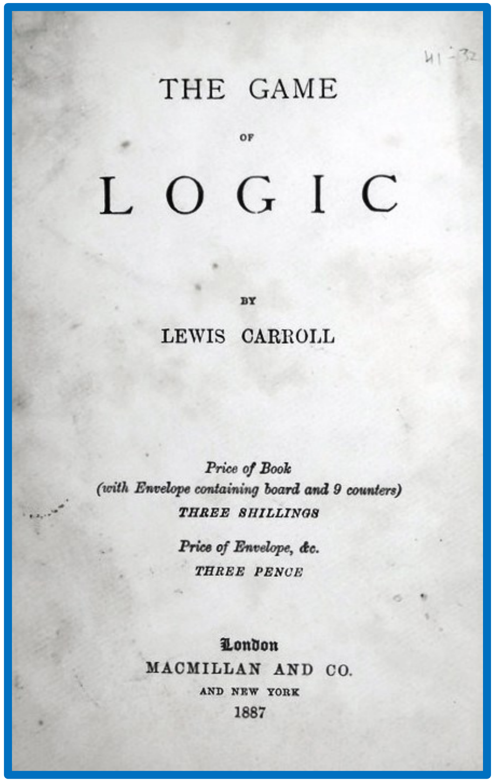
But such a process, when the block consists of 16, 25, or more terms, is so tedious that the old method of elimination is much to be preferred for solving simultaneous equations; so that the new method, excepting for equations containing 2 or 3 unknowns, is practically useless.

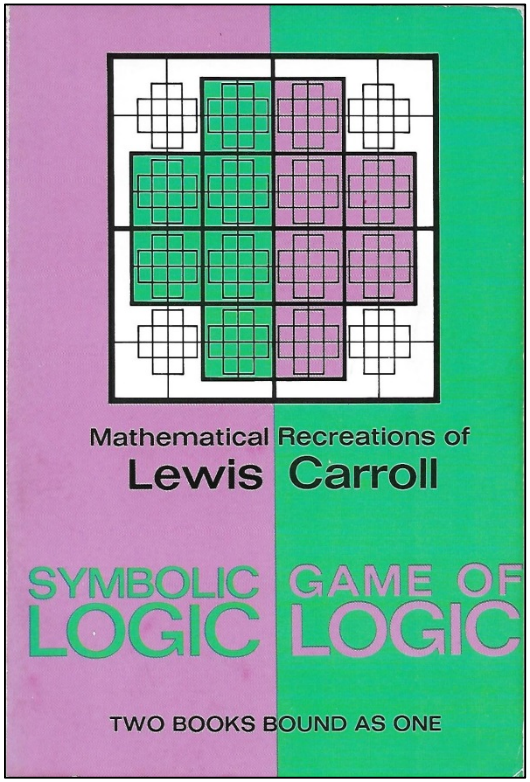
The new method of computation, which I now proceed to explain, and for which "Condensation" appears to be an appropriate name, will be found, I believe, to be far shorter and simpler than any hitherto employed.

Recently, Dodgson's condensation results have proved useful in combinatorics and for the 'alternating-sign conjecture'

The Game of Logic







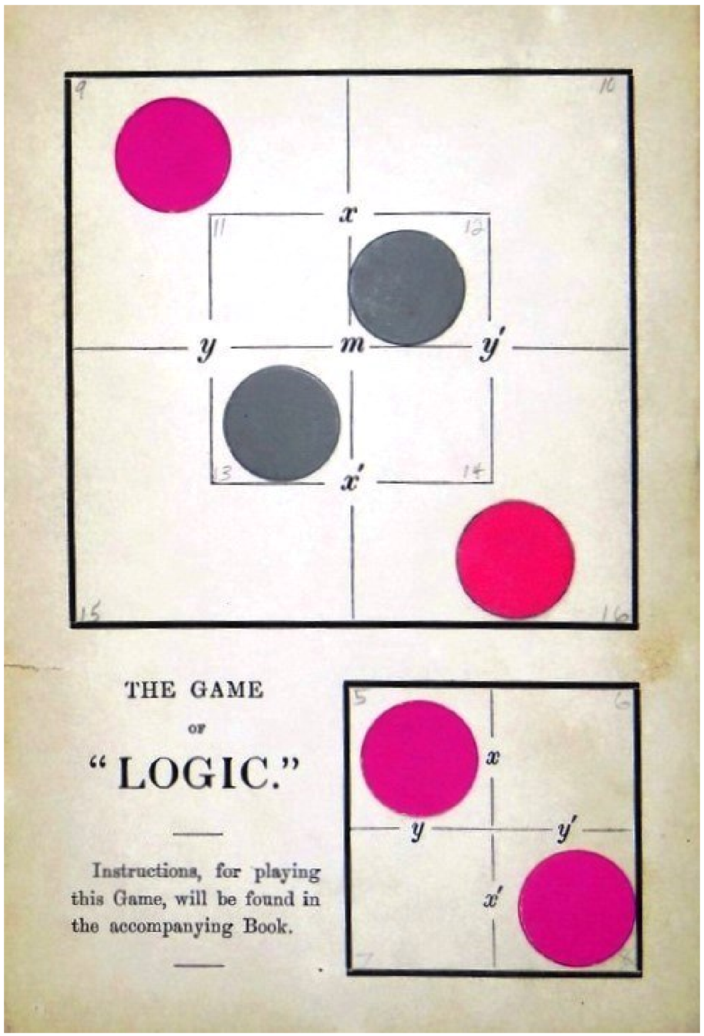
Aristotle: All men are mortal & Socrates is a man

Conclusion: Socrates is mortal

Carroll: No bald creature needs a hairbrush & No lizards have hair

Conclusion: No lizard needs a haircut

Symbolic Logic

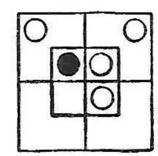


A Syllogism worked out.

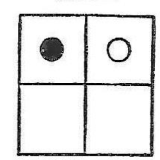
That story of yours, about your once meeting the sea-serpent, always sets me off yawning;
I never yawn, unless when I'm listening to something totally devoid of interest.

The Premisses, separately.

The Premisses, combined.



The Conclusion.



That story of yours, about your once meeting the sea-serpent, is totally devoid of interest.

Carroll's logic notation

Pairs of Premisses for Syllogisms. (*Answers only are supplied.*)

---

1. All pigs are fat;
   Nothing that is fed on barley-water is fat. $x_1 m_0' \dagger y m_0 \mathbb{P} x_1 y_0$
2. All rabbits, that are not greedy, are black;
   No old rabbits are free from greediness. $m_1' x_0' \dagger y m_0' \mathbb{P} x y_1'$
3. Some pictures are not first attempts;
   No first attempts are really good. $x m_1' \dagger m y_0'$ No Concl.
4. Toothache is never pleasant;
   Warmth is never unpleasant. $x_1 m_0 \dagger y_1 m_0' \mathbb{P} (x_1 y_0 \dagger y_1 x_0)$
5. I never neglect important business;
   Your business is unimportant. $m x_0 \dagger y_1 m_0$ No Con.
6. No pokers are soft;
   All pillows are soft. $x m_0 \dagger y_1 m_0' \mathbb{P} y_1 x_0$
7. Some lessons are difficult;
   What is difficult needs attention. $x m_1 \dagger m_1 y_0' \mathbb{P} x y_1$
8. All clever people are popular;
   All obliging people are popular. $x_1 m_0' \dagger y_1 m_0'$ No Con.
9. Thoughtless people do mischief;
   No thoughtful person forgets a promise. $m_1' x_0' \dagger m y_0 \mathbb{P} x' y_0$
10. Pigs cannot fly;
    Pigs are greedy. $m_1 x_0 \dagger m_1 y_0' \mathbb{P} x y_1'$

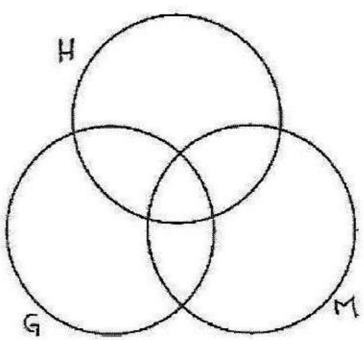
Larger examples (‘soriteses’)

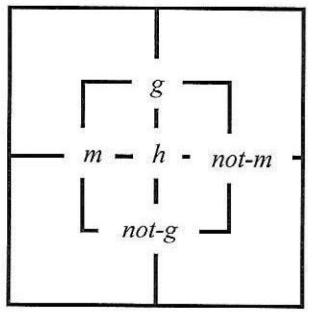
1. No kitten that loves fish is unteachable
2. No kitten without a tail will play with a gorilla
3. Kittens with whiskers always love fish
4. No teachable kitten has green eyes
5. No kittens have tails unless they have whiskers

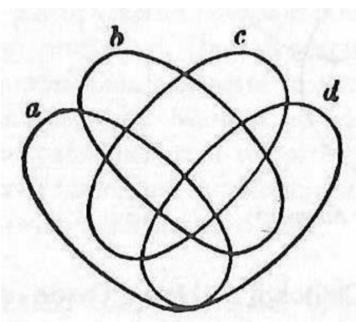
Conclusion:

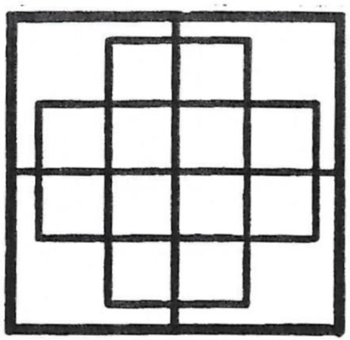
No kitten with green eyes will play with a gorilla

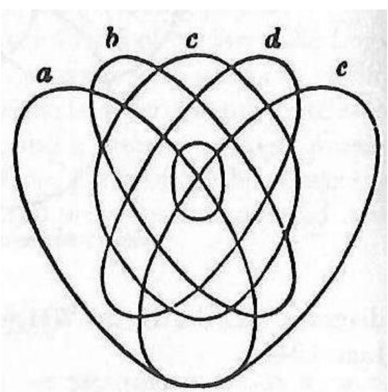
Venn / Carroll diagrams

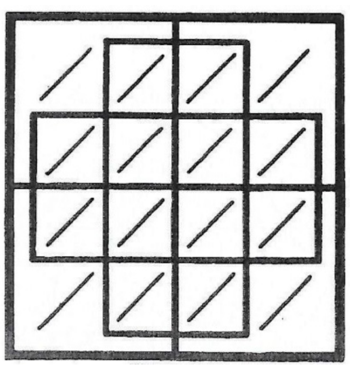


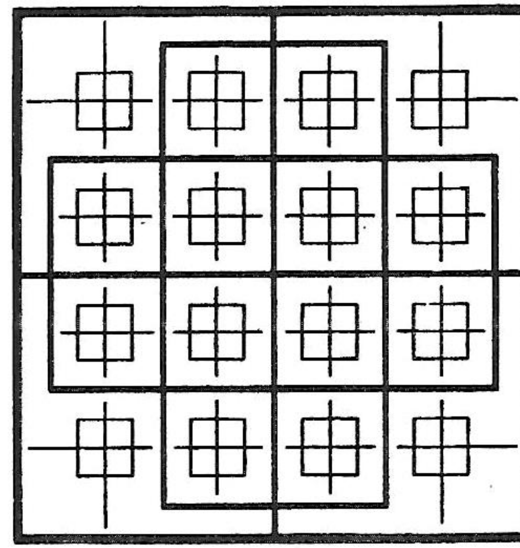


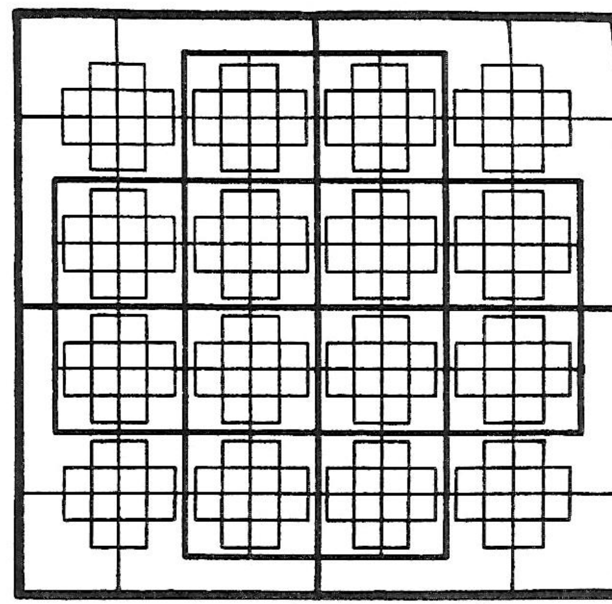












Voting patterns

On the failure of certain Methods of Procedure, in the case where an Election is necessary.

§ 1. *The Method of a Simple Majority.*

In this Method, each elector names the *one* candidate he prefers, and he who gets the greatest number of votes is taken as the winner. The extraordinary injustice of this Method may easily be demonstrated. Let us suppose that there are eleven electors, and four candidates, *a*, *b*, *c*, *d*; and that each elector has arranged in a column the names of the candidates, in the order of his preference; and that the eleven columns stand thus:—

CASE (*a*).

a	*a*	*a*	*b*	*b*	*b*	*b*	*c*	*c*	*c*	*d*
c	*c*	*c*	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*
d	*d*	*d*	*c*	*c*	*c*	*c*	*d*	*d*	*d*	*c*
b	*b*	*b*	*d*	*d*	*d*	*d*	*b*	*b*	*b*	*b*

Here *a* is considered best by *three* of the electors, and second by all the rest. It seems clear that he ought to be elected; and yet, by the above method, *b* would be the winner—a candidate who is considered *worst* by *seven* of the electors.

[*NOT YET PUBLISHED*]

2

A METHOD

OF

TAKING VOTES

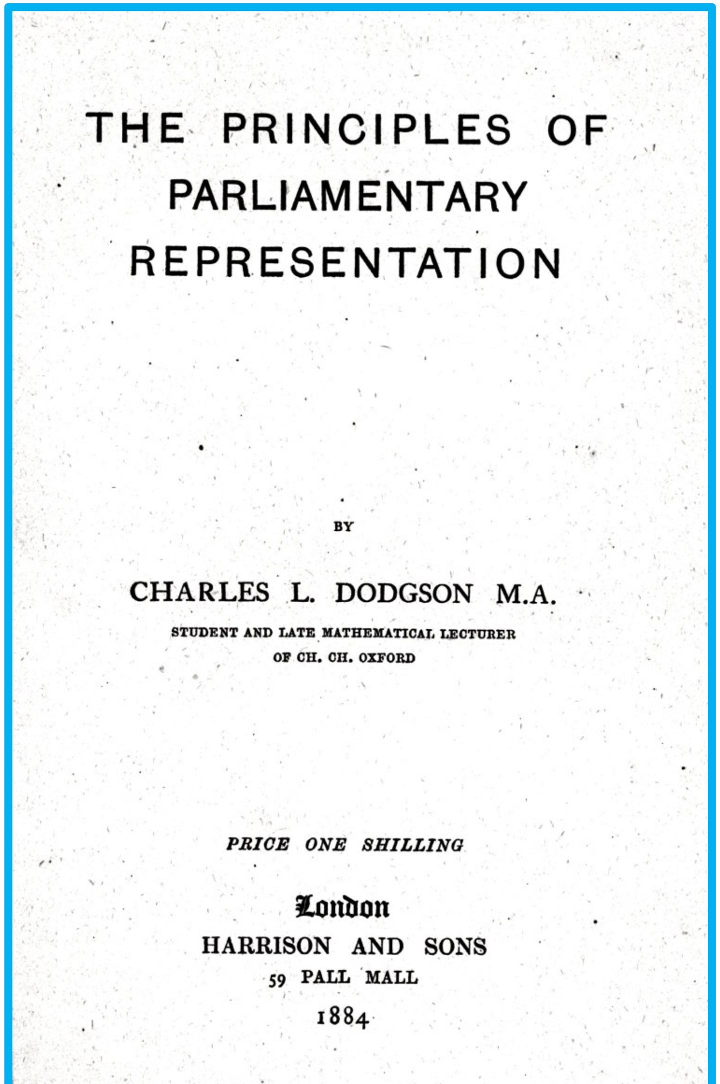
ON MORE THAN

TWO ISSUES

[*As I hope to investigate this subject further, and to publish a more complete pamphlet on the subject, I shall feel greatly obliged if you will enter in this copy any remarks that occur to you, and return it to me any time before*]

MARCH, 1876

Parliamentary representation



THE PRINCIPLES OF
PARLIAMENTARY
REPRESENTATION

BY

CHARLES L. DODGSON M.A.
STUDENT AND LATE MATHEMATICAL LECTURER
OF CH. CH. OXFORD

PRICE ONE SHILLING

London
HARRISON AND SONS
59 PALL MALL
1884

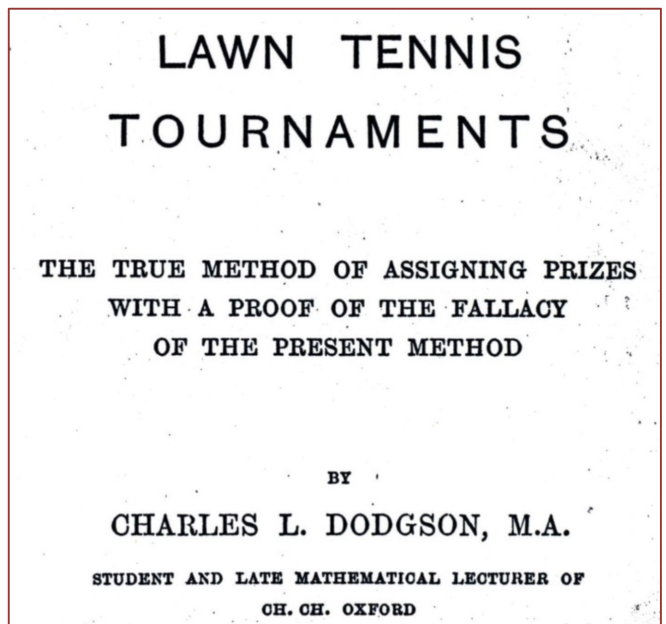
It is a matter of the deepest regret that Dodgson never completed the book that he planned to write on the subject.

Such were the lucidity of exposition and his mastery of the topic that it seems possible that, had he ever published it, the political theory of Britain would have been significantly different.

Michael Dummett

Lawn tennis tournaments

At a Lawn Tennis Tournament, where I chanced to be a spectator, the present method of assigning prizes was brought to my attention by the lamentations of one of the Players who had been beaten early in the contest, and who had the mortification of seeing the 2nd prize carried off by a Player whom he knew to be quite inferior to himself.



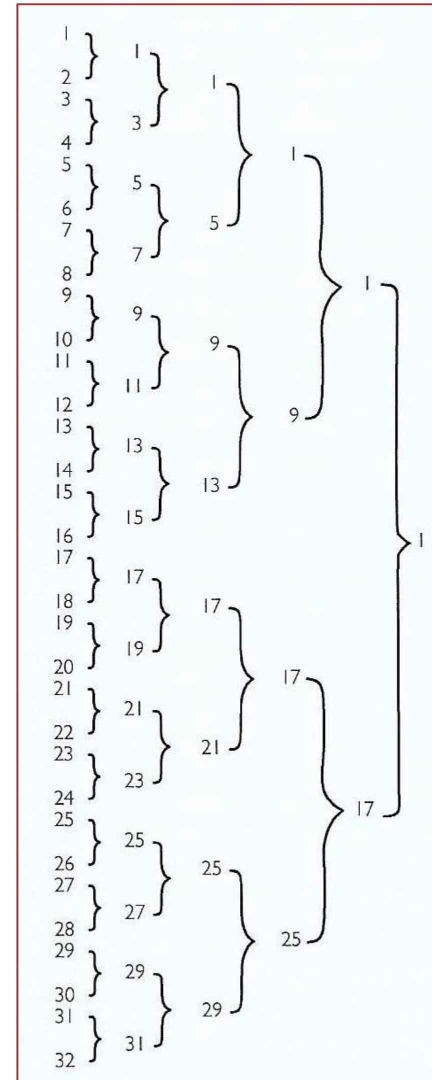
LAWN TENNIS TOURNAMENTS

THE TRUE METHOD OF ASSIGNING PRIZES
WITH A PROOF OF THE FALLACY
OF THE PRESENT METHOD

BY

CHARLES L. DODGSON, M.A.

STUDENT AND LATE MATHEMATICAL LECTURER OF
CH. CH. OXFORD



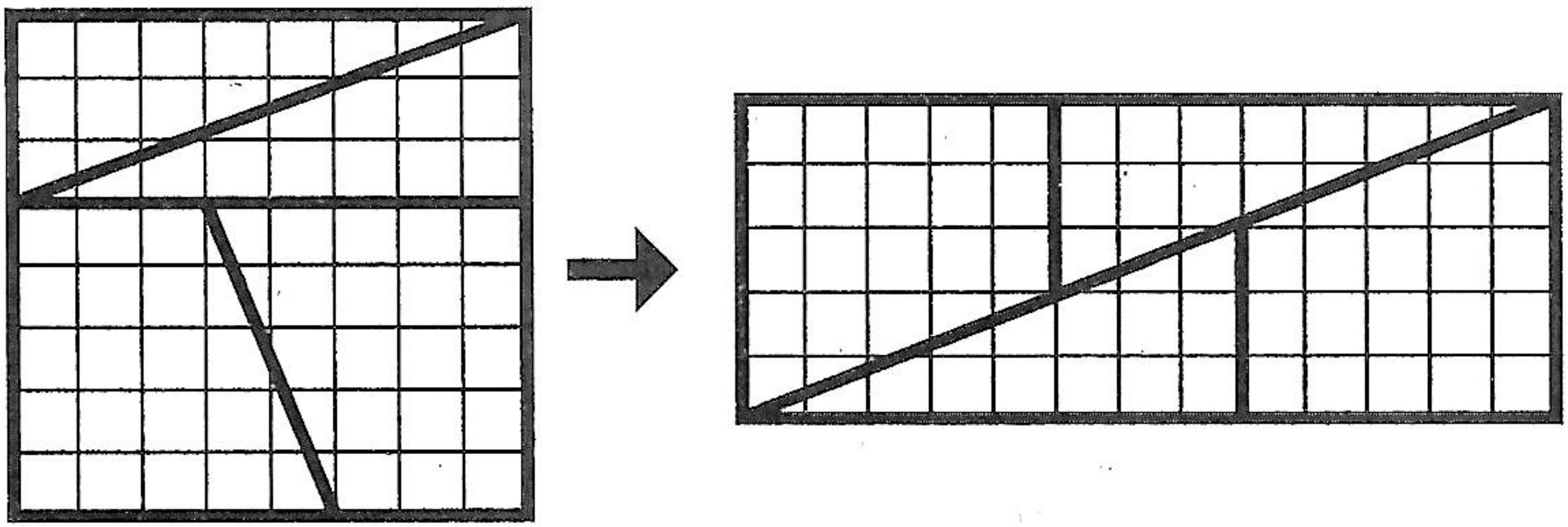
Two puzzles for St Aldate's School

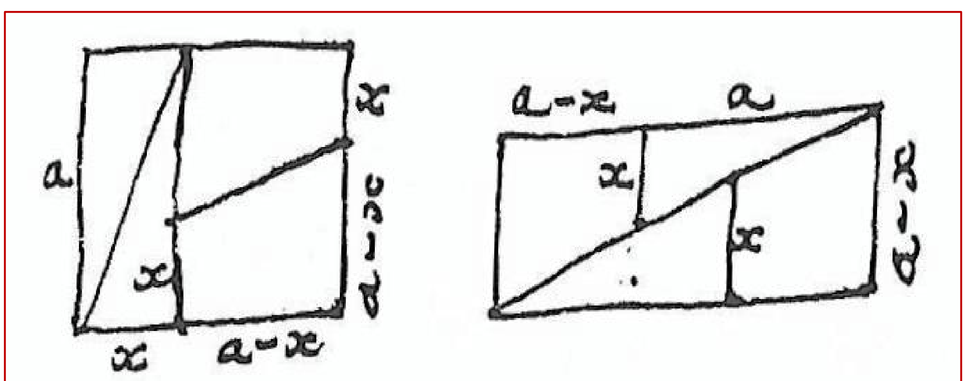
Using recreational puzzles to teach the children more serious mathematical ideas:

Start with the number 1.
Take it in turns to add a new number (up to 10).
The person that reaches 100 is the winner.
How can I ensure that I always win?

Choose any number, reverse it,
and subtract the smaller number from the larger.
Select any digit other than 0, remove it,
and tell me the sum of the remaining digits.
I'll then tell you which number you removed.

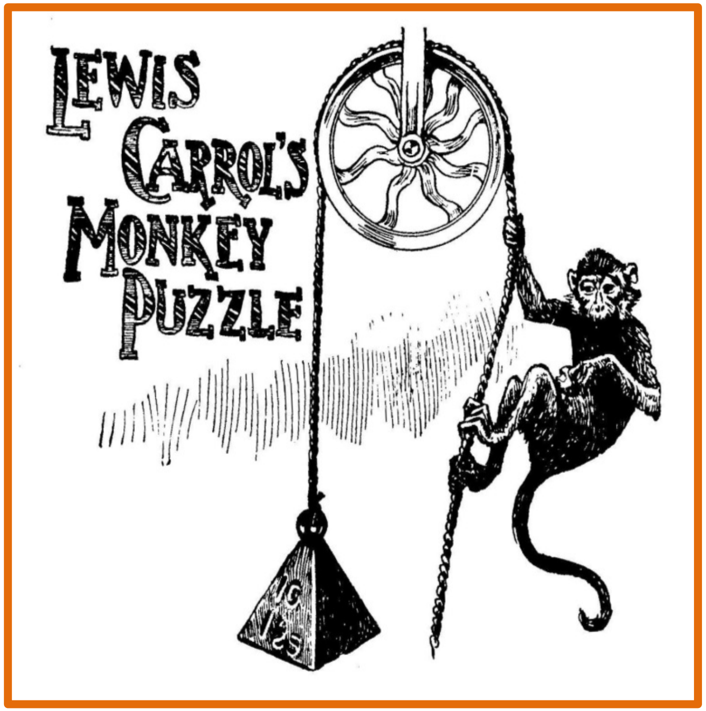
A geometrical paradox

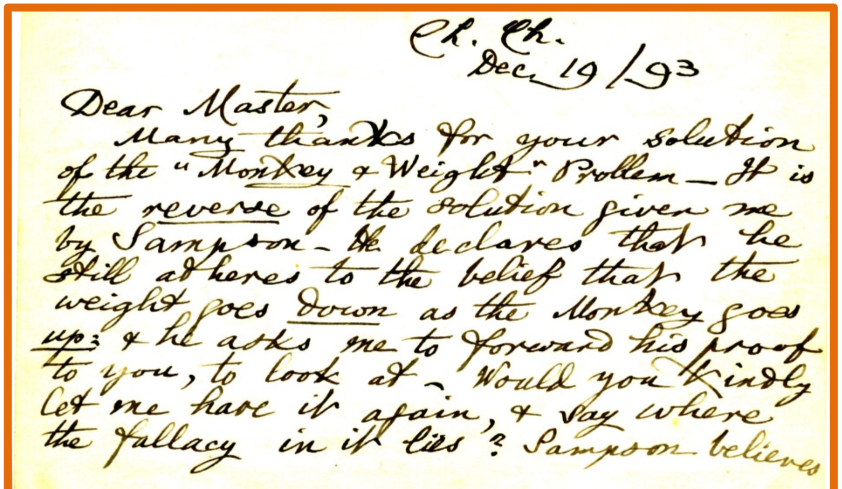




a	3	8	21	55	144	377	etc
x	1	3	8	21	55	144	etc

Monkey & weight problem





Ch. Ch.
Dec. 19/93

Dear Master,
Many thanks for your solution of the "Monkey & Weight" Problem – It is the reverse of the solution given me by Sampson – He declares that he still adheres to the belief that the weight goes down as the Monkey goes up: & he asks me to forward his proof to you, to look at – Would you kindly let me have it again, & say where the fallacy in it lies? Sampson believes

A weightless and perfectly flexible rope is hung over a weightless, frictionless pulley attached to the roof of a building. At one end of the rope is a weight which exactly counterbalances a monkey at the other end. If the monkey begins to climb, what will happen to the weight?

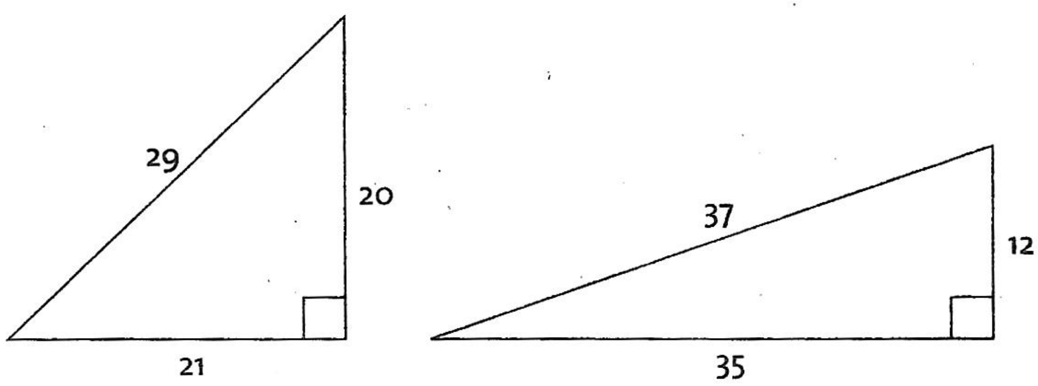
Number-guessing

Number-guessing 6/2/96

A. "Think of a number."
B. [thinks of 23]
A. "Multiply by 3. Is the result odd or even?"
B. [obtains 69] "It is odd."
A. "Add 5, or 9, whichever you like."
B. [adds 9, & obtains 78]
A. "Divide by 2, & add 1."
B. [obtains 40]
A. "Multiply by 3. Is the result odd or even?"
B. [obtains 120] "It is even".
A. "Subtract 2, or 6, whichever you like."
B. [subtracts 6, & obtains 114]
A. "Divide by 2, & add 29, or 38, or 47, whichever you like."
B. [adds 38, & obtains 95]
A. "Add 19 to the original number, & tack on any figure you like".
B. [tacks on 5, & obtains 425]
A. "Add the previous result."
B [obtains 520]
A. "Divide by 7, neglecting remainder".
B. [obtains 74]
A. "Again divide by 7. How often does it go?"
B. "Ten times".
A. "The number you thought of was 23".

Dodgson's last mathematics

19 December 1897: Sat up last night until 4 a.m., over a tempting problem, sent to me from New York, "to find three equal [in area] rational-sided right-angled triangles". I found *two,* whose sides are 20, 21, 29; 12, 35, 37: but could not find *three*.



area = 210

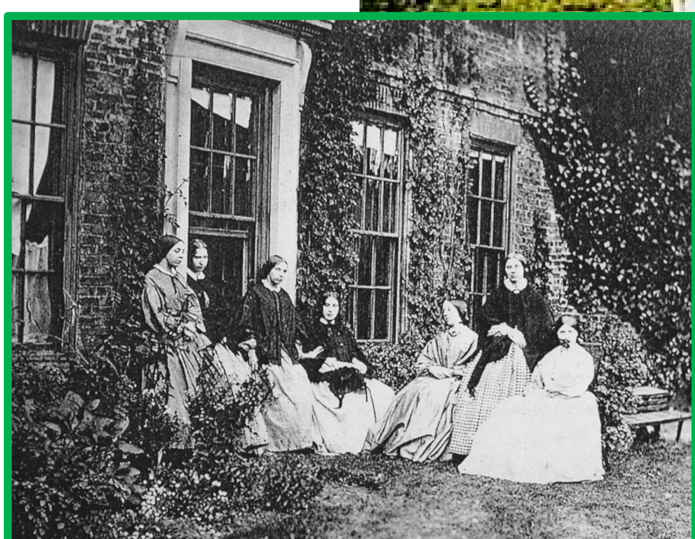
The smallest answer is

40, 42, 58; 24, 70, 74; 15, 112, 113 area = 840

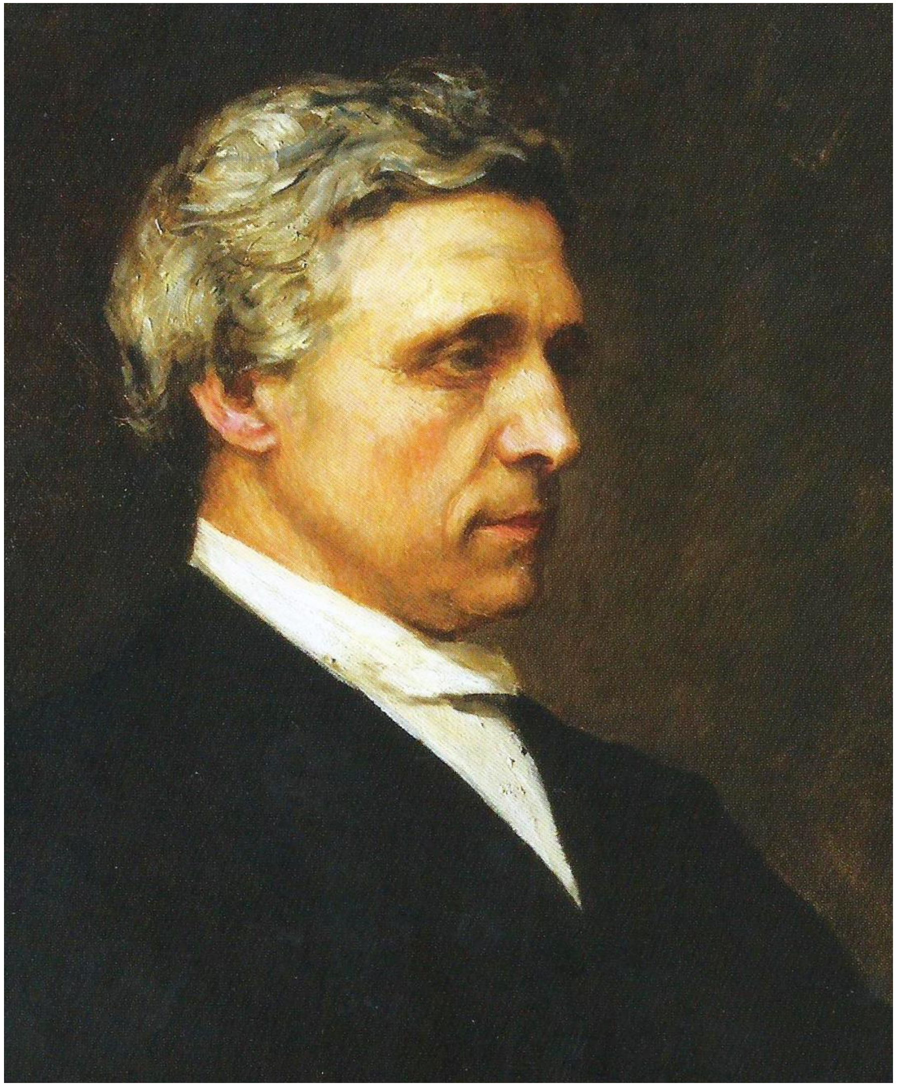
There are infinitely many solutions: another is

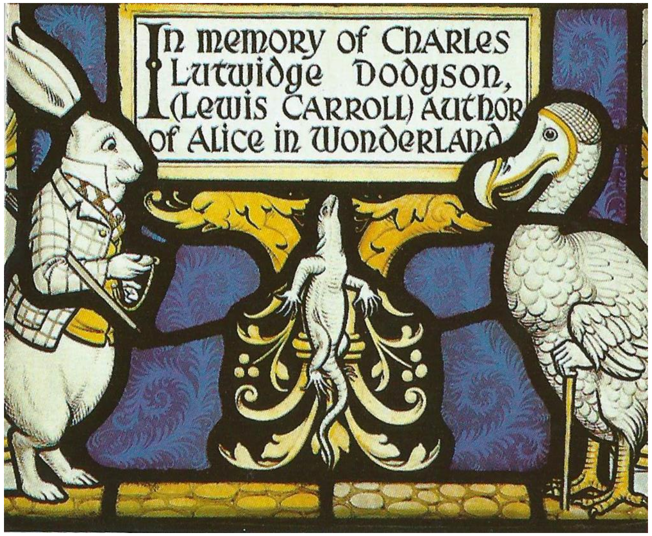
105, 208, 233; 120, 182, 218; 56, 390, 394 area is 10920

Christmas in Guildford



RIP Charles Dodgson (1832-98)





Lewis Carroll, RIP

Within the last few days Christ Church has lost much.

And though the work that bore the fame of Lewis Carroll far and wide stands in distant contrast with the Dean's, still it has no rival in its own wonderful and happy sphere;

and in a world where many of us laugh too seldom,
and many of us laugh amiss,
we all owe much to one whose brilliant
and incalculable humour found us fresh springs
of clear and wholesome and unfailing laughter.

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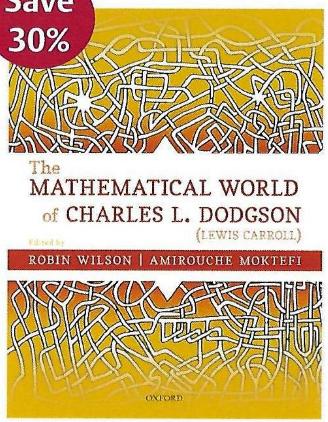

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