

# CONTENTS

PREFACE *ix*

## *QUADRANT ONE*

### NUMBERS AND NUMBER RECKONING

- 1° Saint Jerome's commentary on a passage in Matthew, 3
- 2° The ring finger, 4
- 3° Finger counting in Rome, 4
- 4° A reversal, 5
- 5° Richer or poorer?, 5
- 6° Holding the bowstring, 5
- 7° Attitude for prayer, 5
- 8° Frederick II on falconry, 5
- 9° Fibonacci and finger counting, 6
- 10° The Pa-kua, 6
- 11° One way to put it, 7
- 12° A misplaced credit, 7
- 13° The origin of the printers' ellipsis, 7
- 14° Wise men versus fools, 8
- 15° An unintentional commentary, 8
- 16° An old order giving way, 8
- 17° The case for the abacists, 8
- 18° How Xerxes counted his army, 9
- 19° Popular immensities, 9
- 20° Overestimation, 10
- 21° Perfect numbers, 10
- 22° You can't fool the sergeant, 10
- 23° An application of the "least natural number principle," 10

## CONTENTS

- 24° Lehmer's table of primes, 11
- 25° Modern numerals, 11
- 26° Chalk one up for the human being, 12
- 27° Broadening the college language requirement, 13
- 28° A possible hope for the world, 13
- 29° A proud boast, 13

### MAGIC SQUARES

- 30° Some terminology and a celebrated unsolved problem, 14
- 31° The lo-shu, 15
- 32° The early Hebrews and the lo-shu, 16
- 33° Talismans and charms, 16
- 34° The earliest fourth-order magic square, 18
- 35° Albrecht Dürer's magic square, 18
- 36° A pandiagonal magic square on a torus, 20
- 37° A pandiagonal magic square on a plane, 20
- 38° A pandiagonal magic square on a hypercube, 21
- 39° A magic square in architectural decoration, 22
- 40° Magic squares of odd order, 22
- 41° Magic squares of doubly-even order, 23
- 42° Doubly-magic and trebly-magic squares, 25
- 43° Prime magic squares, 26
- 44° Fibonacci magic squares, 26
- 45° Magic cubes, 27
- 46° Brains versus machines, 28
- 47° Origin of Eulerian squares, 30

### MATHEMATICALLY MOTIVATED DESIGNS

- 48° Some artistic applications of the lo-shu, 31
- 49° Magic traces, 31
- 50° Re-entrant knight's path, 33
- 51° Half-board solutions, 35
- 52° Magic re-entrant half-board knight's paths, 36
- 53° Re-entrant strong-knight paths, 36
- 54° Magic re-entrant king's path, 37
- 55° A conversation piece, 37
- 56° A patio mosaic, 38
- 57° The octagon puzzle, 39
- 58° A toral tulip garden, 41
- 59° A flower garden on a projective plane, 41

## CONTENTS

- 60° Schlegel flower gardens, 41
- 61° Professor Tucker's flag, 43
- 62° More patio designs, 43
- 63° In the foyer of the mathematics building, 45
- 64° Room numbers, 45
- 65° Tying gift boxes, 46
- 66° A Pythagorean theorem design, 46
- 67° A maple-leaf tile, 47
- 68° Another maple-leaf tile, 48
- 69° Some other tiles, 48
- 70° A lamp base, 49
- 71° A quilt, 49
- 72° Some more quilts, 52

### GEOMETRY

- 73° An analogy, 56
- 74° Another analogy, 56
- 75° A science fiction possibility, 56
- 76° The truth of a theory, 56
- 77° Zeuxis and Apollodorus, 57
- 78° Maps, 58
- 79° An anthology of great poetry, 59
- 80° The method of dual languages, 59
- 81° Blind geometers, 59
- 82° The true meaning of the Delphian oracle, 60
- 83° The origin of geometry, 60
- 84° Geometers and analysts, 61
- 85° DIN, 61
- 86° An early love affair, 62
- 87° Albrecht Dürer's approximate constructions, 62
- 88° Two daffynitions, 64
- 89° The birthplace of topology, 64
- 90° Q. E. D., 66

## QUADRANT TWO

### FROM THE AMERICAN SCENE

- 91° Super-respectability, 69

## CONTENTS

- 92° Practical rambler, 69
- 93° Mountain climber, 70
- 94° Creator of suspense, 70
- 95° Epicurean, 70
- 96° Einstein and religion, 70
- 97° A sufficient reward, 70
- 98° Einstein and his check, 71
- 99° The prankster, 71
- 100° Identification, 71
- 101° How Norbert Wiener got his beard, 71
- 102° Wienerian wit, 72
- 103° The modern physicist, 72
- 104° Shop-talker, 72
- 105° Wienerian disease, 72
- 106° An incomplete story, 72
- 107° How a young mathematician saved himself by ingenuity, 72
- 108° Crackpots, 73
- 109° Benjamin Franklin Finkel, 73
- 110° Problemist extraordinaire, 74
- 111° Two prizes, 75
- 112° A student from Missouri, 75
- 113° Cupid's problem, 75

### AMONG THE ENGLISH

- 114° Blissard's sermon, 76
- 115° From Blissard's obituary, 77
- 116° Unattached, 77
- 117° A man of peculiarities, 78
- 118° Mrs. De Morgan, 78
- 119° Definite integrals, 79
- 120° No ear for music, 80
- 121° A legend, 80
- 122° Mathematical talent foreshadowed, 80
- 123° Kite flying, 80
- 124° Unlocking a puzzle, 81
- 125° A repeated tribute, 81
- 126° Eddington on the fourth dimension, 81
- 127° Student, 82
- 128° Preparing for an examination, 82
- 129° Littlewood and the Dedekind cut, 82

## CONTENTS

- 130° Littlewood and Hardy, 83
- 131° Littlewood and Veblen, 83
- 132° A comment by J. E. Littlewood, 83
- 133° Littlewood demonstrates mountain-climbing techniques, 83

### TWO IRISHMEN

- 134° Poetry and disappointment, 84
- 135° Hamilton and Wordsworth, 86
- 136° A rare compliment, 87
- 137° Hamilton's second love affair, 87
- 138° A bad choice, and alcohol, 88
- 139° A rare honor, 88
- 140° Hamilton's wish, 89
- 141° Modified Irish blarney, 89
- 142° On the turn of a penny, 89
- 143° His last act, 90

### TWO SCOTSMEN

- 144° Wiping away a stigma, 91
- 145° *T and T*, 91
- 146° Tait and Stevenson, 91
- 147° Holding back the crowd, 91
- 148° Keeping the demonstration desk clear, 91
- 149° Behind the times, 92
- 150° The Tait's compass, 92
- 151° The hare and the hounds, 93
- 152° An embarrassment, 93
- 153° An allegory, 93
- 154° Unpopular, 94
- 155° Taking roll, 94
- 156° Poor arithmetician, 94
- 157° The marble, 94

### THE LAST UNIVERSALIST

- 158° Poor motor coordination, 95
- 159° The artist, 95
- 160° Fame helps, 95
- 161° How does he do it?, 95
- 162° A misunderstanding, 96
- 163° Cousins, 96

## CONTENTS

- 164° Literary success, 96
- 165° A poor administrator, 97
- 166° A powerful and unusual memory, 97
- 167° Poincaré's manner of working and composing mathematics, 97
- 168° Rated an imbecile, 98
- 169° Two kinds of absentmindedness, 98
- 170° A lover of animals, 99
- 171° An act of heroism, 99
- 172° Sylvester meets Poincaré, 99
- 173° An unfinished symphony, 99

### CROUTONS FOR THE FRENCH SOUP

- 174° Deep insight, 100
- 175° Precision, 100
- 176° Jordan and notation, 100
- 177° A story of Hadamard's youth, 101
- 178° A story of Hadamard's older age, 101
- 179° Bourbaki's office, 101
- 180° Mathematicians are like Frenchmen, 102

## QUADRANT THREE

### TWO NORWEGIANS AND A RUSSIAN

- 181° A lost manuscript, 105
- 182° By studying the masters, 106
- 183° Spurred on because of a bully, 106
- 184° An unfortunate incident, 106
- 185° An almost unique event, 107
- 186° A most admirable trait, 107
- 187° An apt description, 108

### THE PRINCE OF MATHEMATICIANS

- 188° A student's lamp, 108
- 189° Lost fame, 108
- 190° Ribbentrop as an overnight guest, 109
- 191° Ribbentrop as an observatory guest, 109
- 192° Gauss's assistant, 110
- 193° Gauss's power of concentration, 110

## CONTENTS

- 194° Source of pleasure, *110*  
195° Maintaining a standard, *110*  
196° Some similarities between father and son, *111*  
197° Gauss and his grandson, *111*  
198° Gauss and the British Admiralty, *111*  
199° The Berlin Academy of Sciences, *112*  
200° Wrong order, *112*  
201° Theory and practice, *112*  
202° A sacrilege, *113*  
203° The hunt rather than the treasure, *113*  
204° Gauss and a student, *113*  
205° The onerous side of teaching, *113*  
206° Cayley on Gauss, *114*  
207° Absolute and relative properties of a surface, *114*  
208° The heliotrope, *114*  
209° The Hohenhagen Tower, *115*  
210° The Gauss-Weber monument, *115*  
211° Ravages of war, *115*
- THREE GREAT GÖTTINGEN PROFESSORS**
- 212° An interesting analogy. *116*  
213° Presents, *116*  
214° Rapid assimilation, *116*  
215° Contrast, *116*  
216° Riemann's Habilitationsschrift, *117*  
217° Genius and craftsmen, *117*  
218° Intellectual tonnage, *118*  
219° A prodigy, *118*  
220° At a department meeting, *119*  
221° A rare burst of arrogance, *119*  
222° Minkowski on Einstein, *119*  
223° Minkowski on Mrs. Hilbert, *119*  
224° Minkowski's death, *120*  
225° The spoiled child of mathematics, *120*  
226° A Landau game, *120*  
227° The two sides of the ledger, *121*  
228° Felix and Serge, *121*  
229° Fermat's last theorem, *121*  
230° Irrepressible, *121*  
231° Slightly incorrect, *122*

## CONTENTS

- 232° Landau leaves Göttingen, 122  
233° Mrs. Landau, about her husband, 122

### THE MASTER

- 234° Stimulation, 123  
235° Hilbert conducts business with the Minister of Culture, 124  
236° The Wolfskehl Prize, 124  
237° Inflation, 125  
238° Requirements for a good problem, 125  
239° Catching a fly on the moon, 125  
240° In defense of Galileo, 125  
241° Hilbert's "flames," 125  
242° Brutally direct, 126  
243° Hilbert's harshness, 127  
244° Geheimrat Hilbert, 127  
245° Poor memory and slow understanding, 127  
246° Hilbert's obtuseness, 128  
247° Hilbert's class lectures, 128  
248° Existence, 128  
249° Hilbert and the new quantum mechanics, 128  
250° Hilbert and the prime numbers, 129  
251° Student adulation, 129  
252° Hilbert and Ackermann, 130  
253° The Riemann hypothesis, 130  
254° Hilbert and Hilbert space, 130  
255° Taking credit, 131  
256° Franz Hilbert, 131  
257° Imagination, 132  
258° Point of view, 132  
259° The frog and mouse battle, 132  
260° Hilbert on the law of excluded middle, 133  
261° No roast goose, 133  
262° Memorial to Darboux, 134  
263° Declaration to the Cultural World, 134  
264° A medical success story, 134  
265° An anti-Semite, 135  
266° Bieberbach and the Second International Congress, 135  
267° Hilbert and the Second International Congress, 136  
268° Hilbert's hotel bill, 136  
269° Hilbert Strasse, 136



## CONTENTS

270° A comparison of two deaths, 136

### QUADRANT FOUR

#### FURTHER GÖTTINGEN MATHEMATICIANS

- 271° Ordinary and extraordinary, 141  
272° Felix the Great, 141  
273° A distant god, 141  
274° A faux pas, 141  
275° A syllogism, 141  
276° Runge as a calculator, 142  
277° Runge introduces skiing, 142  
278° A proof of an impossibility, 143  
279° Walzermelodie, 143  
280° No effort too great, 143  
281° Blumenthal's dissertation, 143  
282° Blumenthal's end, 143  
283° First member of the honors class, 144  
284° Emmy Noether as a lecturer, 144  
285° The Noether boys, 144  
286° Hilbert and Emmy Noether, 144  
287° Max Born's examination, 144  
288° Twice disappointed, 145  
289° The Bohr brothers, 145  
290° Harald Bohr's examination, 145  
291° Siegel goes to Göttingen, 145  
292° A poor prediction, 145  
293° A paper for the *Annalen*, 146  
294° Van der Waerden as a boy, 146  
295° How Jacob Grommer was led to mathematics, 147

#### MORE GERMAN MATHEMATICIANS

- 296° Reward for a discovery, 148  
297° Discouragement, 148  
298° A Kummer simile, 148  
299° Kummer unexpectedly wins a prize, 148  
300° Kummer's empathy, 149  
301° Kummer's last nine years, 149  
302° Lotus-eaters, 149

## CONTENTS

- 303° Hot from the forge, *149*
- 304° Blaschke's bad mark, *150*
- 305° Immortality, *150*

### OLLA-PODRIDA

- 306° A means of escape, *150*
- 307° Depressed mathematicians, *150*
- 308° The spirit of mathematical inquiry, *150*
- 309° The sure test, *151*
- 310° A truism, *151*
- 311° Pioneer work is clumsy, *152*
- 312° How to win a war, *152*
- 313° The Greeks versus the European Christians, *152*
- 314° The Greeks versus the Romans, *153*
- 315° Boxing the mathematical compass, *153*
- 316° Internationalism, *153*
- 317° The performers and the creators, *153*
- 318° Virtuosity versus depth, *154*
- 319° A lesson in freedom, *154*
- 320° A difference between mathematics and other arts, *154*
- 321° The grove of scholarship, *155*
- 322° A law of genetics, *155*
- 323° Cheating, *155*
- 324° Equivalence and identity, *155*
- 325° A proposal and its acceptance, *156*
- 326° On large numbers, *156*
- 327° Dependence, *156*
- 328° The Alfonsine Tables, *157*
- 329° Bad news, *157*
- 330° A consuming proof, *157*
- 331° What a sprouting acorn said, *158*
- 332° A revolutionary sputnik, *158*
- 333° The queen of the sciences, *158*
- 334° An accidental immortality, *158*
- 335° The Scopes trial, *158*
- 336° Hermannus Contractus, *159*

### PRINTERS AND BOOKS

- 337° The copy editor, *160*
- 338° A typist's error, *160*

## CONTENTS

- 339° A questionable practice, 160
- 340° Linguistic oddities, 160
- 341° Dash it all, 160
- 342° Proofreading, 161
- 343° The compositor, 161
- 344° A ghost-author, 161
- 345° An unkind textbook reference, 161
- 346° Another unkind textbook reference, 162
- 347° Weitzenböck's "Invariantentheorie," 162

### PSYCHOLOGY

- 348° Gauss's experience, 162
- 349° Hamilton's experience, 163
- 350° Poincaré's experience, 163
- 351° Hadamard's experience, 165
- 352° Loss of interest, 165
- 353° A mathematical dream, 165
- 354° The mathematics bump, 166
- 355° Servants, not masters, 166
- 356° At what age?, 167
- 357° Morning or evening?, 167
- 358° Preparation-incubation-illumination, 167
- 359° Two kinds of discovery, 167
- 360° The thought curve, 168

## ADDENDA

### ESTHETICS

- 1081° The esthetic appreciation of mathematics, 173
- 1082° Esthetic appreciation smothered, 174
- 1083° The practical versus the esthetical, 174
- 1084° Popular appeal of mathematics, 174
- 1085° The guide for the choice of research subjects, 175
- 1086° Judging a graduate research student, 175
- 1087° A case history, 176
- 1088° Another case history, 176
- 1089° = [(33)<sup>2</sup>]° Ten pertinent quotations, 176

INDEX, 179