

MATHEMATICS WITH LOVE

The Courtship Correspondence of Barnes Wallis,
Inventor of the Bouncing Bomb

MARY STOPES-ROE

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of the Bouncing Bomb

Mary Stopes-Roe

Macmillan

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This story celebrates the delights of sending and receiving letters. It is dedicated to the memory of my parents, Barnes and Molly, who wrote the letters printed here; and to all those over the centuries who have left us their stories in this way.

“And oft the pangs of absence to remove
By letters, soft interpreters of love”

Matthew Prior 1684–1721 *Henry and Emma*

“She’ll vish there was more, and that’s the great art o’
letter writin”

Charles Dickens 1812–1870. Sam Weller, *Pickwick Papers*

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I owe a debt to the Textbooks Colloquium who first helped me to view the mathematics lessons as an unusual text; and especially to the late John Fauvel of the Mathematics Department of the Open University, who assured me they were a correspondence course of serious teaching material.

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NOTES ON THE LETTERS

There are more than 250 letters in this correspondence, without including the 152 pages of mathematics lessons. Some of the letters are mere notes, while some are 12 pages long. All are written in beautifully clear writing: Barnes's an elegant italic hand, Molly's a rounded and still rather girlish script. Each letter is still in its own separate envelope; therefore the whereabouts of sender and receiver, and dates of writing and posting, are recorded for the personal letters. The mathematics lessons were despatched under separate covers which have not survived, and the exact dating of these is certain for only a few. Handling these documents is a privilege, a step into the lives, situations, pressures of time and emotion, of two private people. Each letter, after 80 years carefully folded, refuses to give up its creases.

As children we knew the story of the mathematics lessons, and how they were sent by our father to our mother as he was courting her; but we had no idea that they still existed. In 1979, as I cleared out our family home, I found them tightly packed in an old-fashioned dress-box at the top of a cupboard.

There are vagaries of spelling and punctuation, particularly on Barnes's part, which I have carefully kept. The volume of text is considerable and I have omitted much of the more descriptive and conversational exchanges, retaining the passages that more clearly show the personalities and emotions of the two. I have had to be brief with explanations of the characters in their family and social lives, trusting that sufficient details can be derived from what they themselves say in their letters.

All the manuscripts used here belong to Barnes and Molly's four children. My siblings have generously and kindly allowed me to delve into the letters, private though they are. Some of the characteristics which the writers describe in themselves are different from those appearing later in the well-known public figure and his supportive wife; I sincerely hope that I have done them justice. I have certainly written with increasing love and respect.

There is a considerable archive of Barnes Wallis material which is not held by the family. It is lodged in the Science Museum; Churchill College, Cambridge; the Barnes Wallis Memorial Trust at Elvington, York; the R.A.F. Museum, Hendon; and the Imperial War Museum. The family archive will finally be deposited in the British Library.

PROLOGUE

In the dog days of summer, 1962, a 74-year-old man lay in a London hospital bed. He was bored and in some discomfort after a prostate operation; but instead of trying to sleep, read or use his earphones, he amused himself by writing to his daughter:

Great-grandfather	died aged 72 years in about 1860–70
Grandfather	d. " 81 " " " 1906
Father	d. " 86 " " " 1945

Now it is not really possible to apply mathematical laws to an individual, but only to very large numbers of individuals as is done by insurance companies, etc., but it is amusing, if no more, to take advantage of the singular regularity of advance shown above, to see how old I should be, assuming that mathematical laws did apply to an individual. If we neglect end effects, as we must do, since historically they are buried in prehistoric times, and for the future are unpredictable for a variety of reasons, then we can treat the above sequence as a very small part of a curve that extends, virtually, to infinity in both directions.

The simplest form is parabolic, and the curve that fits the 3 known points reasonably well is $N = 72x^{.166}$ where N is age at death, and x is the number of the generation.... On this basis I should have lived to just over 90, but now I have had an op. that I am assured will add 10 years to my natural term!! Estimated age at death = 100 years. What a dreadful thought. Of course its all nonsense anyway, because one cannot just deal in generations – but it has passed a tedious hour in hospital..”

Seventeen years later, at a memorial gathering soon after the patient’s death at 92 (not far off his original estimate), his eminent surgeon was one of the speakers. Very many patients, a large number of them notable people, had passed through his clinic in the meantime; but the description of symptoms by this particular one had stuck in the surgeon’s mind. The patient described his complaint in unusual terms: he could not pass water in the customary “beautiful parabolic arc”. Such ways of thinking, however, came naturally to this man.

The patient was Barnes Wallis, an engineer, designer and inventor of considerable note. He is most widely remembered as the inventor of the bomb which breached the dams of the Ruhr valley in Germany in the Second World War; but this was only one of his achievements and interests. These ranged over airships, heavier-than-air-craft (most notably the Wellington and the trophy-winning Wellesley), variable geometry (or swing-wing) aircraft, submarines, bridge design, telescope construction, medical callipers, racing skiffs, school buildings and furniture, household gadgets, and a technique for accurate wood carving. He was creative for three quarters of a century, and was always imparting knowledge and arousing appreciation for mathematics and good design. Whenever an interested listener was available he launched into explanations and illustrations, using paper napkins, menus, programmes, envelopes – whatever came to hand. He was a teacher who followed his own methods, and paid no heed to the rules. He held just one brief teaching post in his long life; but throughout this life he inspired insight and understanding in many people by the dedication, the enthusiasm, the delight which he brought to his explanations.

Chapter 1

BEGINNINGS

In the autumn of 1922 Barnes had been teaching for just two months when he wrote his first lesson in mathematics to his cousin Molly Bloxam. The two of them met for the first time in April of that year, when Molly was 17 and in her last year at school, and Barnes was 35. He had not only lived twice as long as Molly, but his years had been full of experience, more hard and turbulent than happy.

Barnes, having gained a Foundation Scholarship, boarded from the age of 12 at the ancient public school Christ's Hospital; but by his own wish and determination and in spite of discouragement from his family and teachers, in 1904 he left at the age of 16. From his childhood he had been inventive, and interested in mechanics and machines; but the public schools of the time did not prepare their boys for a career in engineering. Barnes was convinced that the most appropriate way to learn was on the job, and apprenticed himself to a shipbuilding firm on the Isle of Wight. He learnt the hard way, living in cheap lodgings and working his way up from the shop floor to the drawing board. In 1913 he was appointed one of the chief designers in the airship development programme of the great engineering company Vickers.

Barnes came from a close and loving family in which he was the second child, with an older and a younger brother and one sister. His father was a doctor in East London, dedicated to his work, loved and valued by his patients; but he had been crippled by poliomyelitis caught from one of them, dragging round a lame leg for the rest of his life. He found it hard to maintain his practice. The family was thus permanently impecunious. Barnes saw his mother struggle with ill health to cope with the heavy domestic chores of the time, maintaining the respectability necessary for a doctor's household. He understood her daily, heartfelt prayers and her dutiful shouldering of the burdens laid upon her. He was her favourite child, her close companion and emotional support. During his school years, and the following apprenticeship away from home, the two exchanged more than a thousand letters. His mother shared with him

every detail of her daily life. The adolescent Barnes was less communicative and her many questions were not always answered, but he never failed to write. He planned to relieve her burdens by earning a living as soon as possible, choosing a hard course out in the world; but her early death in 1911 ended his hope, and the failure haunted him. From now onwards he must go on alone; the constant, loving, anxious, intruding, advice was ended, and he withdrew into himself. His mother stood on a pedestal, and for years no other woman entered his heart. His emotional distress was eased only by the comradeship of colleagues at work, and in his sporadic experiences of military life. After eleven years he was pulled, without any expectation that this might happen, from such desolation. A second great love took over his life.

Barnes's father Charles was also bereft by his wife's death. Five years later, in 1916, he married one of his late wife's girlhood friends, Fanny Bloxam. In 1922, with the war safely in the past, Fanny's brother Arthur Bloxam brought his family from the country back to London. His two eldest daughters Barbara – 'Baba' – and Molly were about to enter University College London. The two girls were glad to visit their Aunt Fanny, but apprehensive about meeting an unknown elderly male cousin. Would he be superior, fashionable, condescending? Neither had any experience whatever of male company other than their father's and the occasional visits of cousins. Like Barnes, Molly was the second child in a warm and loving family. Below her came Betty, Nancy, Pam and, nearly ten years younger than herself, George. Her family, so far, had been all to her, but it was also somewhat exclusive and smothering. The hub of this cheerful activity, security and comfort was her father to whom, as his favourite child, she was very close. Their mother Winifred Bloxam loved her children warmly. She was caring and dutiful, a gifted musician with no time, opportunity or encouragement to express her talents; but she was also eccentric and neurotic. A beloved nanny, Nan to two generations of the family, nurtured them with daily care and affection, and a structured nursery rule. Far from venturing out on to the troubled and uncharted waters of the world as Barnes had done, Molly had scarcely been allowed to dabble her fingers.

Thus in April 1922 the two met: Barnes with years of hard experience, and highly respected in his profession, but without any close female contact since his mother died; Molly half his age, and without any knowledge of work or male company or indeed of anything beyond the family fence, and more naive than was usual for a well-brought up girl. Her innocence

and straightforwardness appealed to Barnes; and the attention of one so mature and clever intrigued Molly.

When they met, Barnes was in fact out of work. The closing of airship production had made him redundant. He had turned this setback into advantage, and began working for a London External B.Sc. Molly was busy with the final school exams which would gain her entrance to University College London. In the six months since meeting in April, a sporadic correspondence had grown between the two. Then Barnes's circumstances suddenly changed. In some anxiety about work, he had applied to an agency for a teaching job, and was surprised to be offered one in a young gentlemen's academy in Chillon, Switzerland. He, who had left school 18 years earlier, and whose subsequent learning had all been self-motivated and by correspondence, took on the post and left for Chillon in September of 1922. He was one of the few of his generation still alive who had never been abroad, since his war years had been spent in a reserved occupation. In early August 1914, full of the zeal that swept the country, he had enlisted but was immediately called back to the drawing board on the airship development programme. Twice more he enlisted, and to his disappointment, was recalled. He was intensely patriotic, believing sincerely throughout his life in the rightness of the allied cause and in particular the preservation of the British ethos and way of life. His feelings as he crossed the Channel were a mixture of anticipation and apprehension coloured by homesickness and a deep regret that his burgeoning friendship with Molly would be disrupted.

Being brought up in a religious family still attached to Victorian manners and ideals, he was not affected by the loosening of codes of conduct of the 1920s. He had thus intended to get Arthur Bloxam's permission to continue to write to his daughter Molly. His stepmother Fanny had arranged that he and she would visit the Hampstead family for Barnes to say his farewells, but for some reason Fanny could not go. Barnes, longing to say a personal farewell to Molly, battled with his besetting diffidence and went on his own.

Barnes: 26th Sept. 1922. In the Dover train.

I did call, but rather late – my business took me rather longer than I had expected. I easily identified the house, tho' I walked past it the first time thinking it must be the Vicarage for St Lukes Church – "Vicars Moor" – the place where they moored the Vicar, a little unusual, but still quite explicit. Then I saw 25, followed by 23, so by mathematical induction

concluded that “Vicars Moor” was 27. So I went in a rang and knocked – and waited. Then my courage failed, no one came to the door, I had time to think that perhaps you were all busy and I should only be in the way so I simply bolted, and didnt stop till I got to Charing Cross, where I treated myself to a lonely and miserable cup of tea. I’m awfully sorry Molly. I did want to see you all so very much, but having to wait gave me complete cold feet. I dont suppose you will understand, but that is really and truly what happened.

- ◆ The haste of his unexpected departure left him no time to visit again, and he had to leave Fanny to intercede for him with her brother. Mr Bloxam conceded that Barnes could write as often as he wished, but Fanny’s remarks raised some doubts in his mind. There was to be no ‘nonsense’, only the chat and news which might safely be exchanged between two pen-friends, nothing that might pose a threat to Molly’s life at College and her open-minded contact with men her own age. Two weeks later having pondered the outcome, Fanny wrote to the hesitant suitor, whom she well knew to be diffident and lacking in self-confidence. There was no reason why he should not write in friendship to Molly, so that they could get better acquainted. Barnes was a lonely man, and in so far as one with a warm and dependent heart can endure loneliness, he was accustomed to endure it. But putting many miles of land and water between himself and Molly sharpened the fear of loss. Letters could blunt this and, encouraged by Fanny’s report, to letters he turned.

Barnes to Molly: 1st Oct. 1922. Chillan.

The Swiss train left Gare de Lyons at 9 pm Tuesday and I got here 9.10 am Wednesday. I spent the most appalling night Ive ever had in my life. By the way I had a jolly good crossing and made a hearty lunch on board, tho’ it was pretty roolly. I had a carriage with 2 fat French men and 2 fat French ladies, and they hermetically sealed the carriage and turned on the heat! I had no sleep whatever, and felt simply done up next day. I’m feeling fairly happy now, but was very miserable the first 3 days. Ive never been homesick since I first went away to school, when I was 12, and thought I was beyond such weakness, but I have been so wretched...

This is a most gorgeous place. There are no words. I am now (Sunday afternoon) sitting out on the balcony of our common room in blazing sunshine, dressed only in tennis flannels and perspiring freely, while towering all round are mountains covered with snow and above that the most

priceless blue sky.... My bedroom window looks out over Chillon Castle, about which Byron wrote a poem (which I have never read).

Right under my window is a vineyard! The whole mountain sides are stiff with vineyards. They have scare crows with old bits of tin plate hung on them and when the wind he blow, tin plate he go cling-cling. This goes on all night. Then every cow has a huge leather collar and a large and very mellow toned bell. So that:-

- 1) Tin plate he go cling cling
- 2) Cow he go clong clong (by the hundred)
- 3) Lake he go lap-lap
- 4) Trees they go rustle rustle
- 5) Mountain stream he go tinkle tinkle

All together, some cacophony. Still I manage to sleep

I like the Head immensely. He's the sort of man you fall down and worship at once. He was head of Dover Coll. and chucked it to go as Chaplain to the Guards at the beginning of the war, being subsequently invalidated out.

I suppose by the time you get this you will be just starting at London University. Do tell me all about it. Are you taking Science? and if so what subjects? I'm most awfully interested.

Molly: 8th Oct. 1922. Hampstead.

The first two or three days were horrid because I was continually getting lost. Its such an enormous place; but I like it awfully now. There was a "freshers" social on Friday, which was great fun. I actually had the temerity to try to dance a fox-trot, and as my partner was very good, we got on fairly well, but I always have to be warned if anything unusual is about to happen.

There are some awfully nice men and women in our classes. There are two funny little Japanese men, who always go about together; and there are three black men with very tight tiny curls. There's one most learned youth, who knows all about everything, with great big spectacles, and there's one who holds his pen in such a queer way that it quite fascinates me; and there's one who limps and is awfully decent. There is the prettiest girl I have ever seen in all my life. Don't you love looking at pretty people? I wish it wasn't rude to stare. In fact heaps of them are so pretty that I just love sitting and watching them.

I am taking science – Botany, Chemistry, Zoology, and Physics. I can manage the first three fairly well, but physics is positively hopeless. The

old boy dashes along at such a rate that I can't possibly keep up with him, and the terms he uses are all so much Greek to me. I've never done any before, and when I read by myself, its dreadfully muddling, but I suppose it'll get better soon.

Barnes: 11th Oct. 1922. Chillon.

Thank you very much indeed for your perfectly ripping letter. You must have spent hours of your all too scarce leisure, and I have loved reading it, and have re-read it about 20 times. I will take you at your word, and go on writing, for the next best thing to getting a letter from you, is to write one to you. For somehow, out here, where one is sometimes somewhat lonely the mere fact of sitting down to write gives a feeling of company. It was very nice of you to be so understanding about that Monday [his abortive farewell visit]. Of course the family were in no way responsible, it was all my own fault for being so wretchedly shy. Do you remember how I funked you and Baba when you first came to New Cross?

I am most awfully interested in your science.... I cannot see how you can do physics and not maths. You cannot get really far in physics without a good groundwork of maths to help you.... I suppose it is silly of me to think that I might be of any help by writing to explain things to you? Would you let me try? You see I've had so much difficulty with things myself, as I have had to learn all I know without any tutor, that I can often see the hard parts better than other people.

I wonder what your lecturer has started on. I have had to start a physics class here from the beginning, and after a general explanation of the ground covered by physics, I had [the boys] up to units, fundamental and derived, and so to the idea of dimensional equations, which I think helps one to realise what one is measuring and observing. I find dimensional equations a terrific help myself. I mean this sort of thing:

$$V = [L^3][T^0][M^0]$$

where V stands for Volume, L for unit of length, T unit of time and M unit of mass. Then when you come to deal with forces and accelerations you can set them down like that, and see just what you are doing. Please let me try?

Chemistry I dont know much about, having never done any since I left school.

If you do think I could help just send a postcard and I will write by return.

I've been getting so cross with some of my people – I thumped a desk today. People seem so stupid over maths. I dont mind how much explaining

I do, or what pains I take to make them understand, but inattention and wilful stupidity I cannot tolerate.

Dont forget about the physics. If you would only send a card to say what you have difficulty on, I should so love to try to help.

Molly: 18th Oct. 1922. Hampstead. On a crowded postcard.

Thank you most awfully, Barnes, for offering to help me. I'm afraid the matter is that I am so terribly stupid. Our lecturer goes so fast that I simply can't follow him. He started by telling us what displacements, all the velocities and acceleration etc are. He uses so many letters and there are so many equations that I get hopelessly muddled. I am reading very slowly straight through our mechanics text book, at the rate of about 2 pages a day; and at present it is quite understandable, if I can only get it to stick in my head. I've never heard of fundamental and derived units, or of dimensional equations. If there is anything which is hopelessly muddling, I will let you know. Thank you very, very much.

I'm afraid you'd thump the desk pretty hard if I were in your class.

Molly: 22nd Oct. 1922. Hampstead.

Once again thank you ever so much for your offer of help. As I told you, I think at present anyhow, it is merely a matter of reading the book. The lectures are scarcely any use at all, except when he does experiments, because he goes so fast. I suppose when I can remember all the different formulae and how they are used, it will be all right. I wish they had taught us physics at school.

Yes I do remember how you funked me and Baba, and how you didn't come in till very late – after we'd gone to bed on Saturday. What did you think we'd be like? I know I funked you too – I was dreadfully afraid you'd be horrid and superior, and altogether hopelessly lazy and fashionable. Instead of which you turned out to be as decent as possible.

Barnes: 25th Oct. 1922. Chillon

About the physics – dont bother about fundamental and derived units and dimensional equations. Sorry I mentioned them if your prof. is not doing them. They help me personally – but it is not necessary to know them.

You will often find that in any one group of things there is a key formula from which all the others may be readily derived.

If only you knew the elements of Calculus, all these things become so simple. Take however as an example: