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978-1-107-02058-0 - Alan M. Turing: Centenary Edition
Sara Turing
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Alan M.

TURING

"an even-tempered, lovable character with an impish sense of humour and a modesty proof against all achievement."

"He thought so little of physical discomfort that he did not seem to apprehend in the least degree why we felt concerned about him, and refused all help."

"in a short life he accomplished much, and to the roll of great names in the history of his particular studies added his own."

So is described one of the greatest figures of the 20th century, yet someone who was barely known beyond mathematical corridors till the revelations in the 1970s. It was then that Alan Turing's critical contributions to the breaking of the German Enigma code and the development of computer science, along with the circumstances of his suicide at the height of his powers, became widely known.

From the rather odd, precocious, gauche boy through an adolescence in which his mathematical ability began to blossom, to the achievements of his maturity, the story of Turing's life fascinates. In the years since his suicide, Turing's reputation has only grown, as his contributions to logic, mathematics, computing, artificial intelligence and computational biology have become better appreciated.

To commemorate the centenary of Turing's birth, this republication of his mother's biography, unavailable for many years, is enriched by a new foreword by Martin Davis and a never-before-published memoir by Alan's older brother. The contrast between this memoir and the original biography reveals tensions and sheds new light on Turing's relationship with his family, and on the man himself.

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Sara TURING

with a foreword by
Martin Davis

with an Afterword by
John Turing

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FOREWORD TO THE CENTENARY EDITION

Sara Turing, a woman in her seventies mourning the death of Alan, her younger son, a man that she failed to understand on so many levels, wrote this remarkable biographical essay. She carefully pieced together his school reports, copies of his publications, and comments on his achievements by experts. But Alan Turing was a thoroughly unconventional man, whose method of dealing with life's situations was to think everything through from first principles, ignoring social expectations. And she was trying to fit him into a framework that reveals more about her and her social situation than it does about him. Alan's older brother John trying to fill in the gaps he saw in his mother's account, also ends up revealing a good deal about his own attitudes.In these few pages I will discuss some of the questions that may occur to readers of these documents.

Alan Turing's War

In 1940, after France had been defeated, Britain fought on mainly alone. The merchant shipping on which the island was dependent was being sunk by German submarines at a rate that threatened to force the UK to yield. The radio communications between the submarines and their base concerning their operational plans were being picked up in Britain. If these plans were known, attacks could be mounted against the submarines. Merchant ships could adjust their routes so as not to go where they would encounter enemy submarines. But of course the data was encrypted.

For the purpose of decrypting enemy communications, an assorted group of classics scholars, mathematicians, and hobbyists who were good at solving puzzles were brought together in an estate called Bletchley Park near the present-day town of Milton Keynes. For much military communication the Germans used an enhanced version of a commercial enciphering machine called Enigma. Some Polish mathematicians had worked out a technique for decrypting German military messages coded on their Enigma, and had passed their work on to the English. But by the time war broke out in 1939, the Germans had added additional complications and the Polish techniques were no longer of any use. Not only were there several disks on the machine whose rotational position could be altered, but there was also a plug-board into which cables could be plugged in various ways. In order to decrypt a message, these precise settings had to be known. Taking advantage of certain weaknesses in the design of the machines as well as carelessness on the part of German cipher clerks, the Bletchley park code-breakers could rule out a large number of possible settings. That still left a number of possibilities to be attacked by trial and error. Turing played a major role in developing these techniques, and in working out a method for automating them. He designed a machine that would systematically try various settings, rejecting those that contradicted what was already known. These machines, many of which were built, strangely called bombes, were highly effective. What is truly remarkable is that, constructed to Turing's specifications, they worked as intended without the need for any fine tuning. Although Turing's contributions, and indeed the entire project of decrypting German military communications, were kept secret long after the war, Turing was awarded an O.B.E. (Order of the British Empire) for his contributions to the war effort.

Alan Turing's Universal Computer

Mathematical proofs use logical reasoning to get from assertions already accepted as true to statements called theorems, which thus achieve acceptance as mathematical truths. The work of logicians in the nineteenth and twentieth centuries showed how, in principle, the individual steps in such "proofs" could be replaced by the mechanical manipulation of symbols. This situation gave rise to the problem of finding a mechanical process, an algorithm, for deciding in advance whether from some given statements accepted as true, another desired statement could be obtained by such a sequence of steps. The great mathematician David Hilbert declared that this problem, he called the *Entscheidungsproblem*, was the main problem of mathematical logic. (The long German word simply translates into "decision problem," but since many problems involve "decisions," it has been customary to use the German name.) The game of chess provides a useful analogy. The individual moves in a chess game, like the individual steps in a logical proof, are simple and mechanical. The *Entscheidungsproblem* is then like the problem of how to tell for a given initial position of the chess pieces, whether white can achieve a check-mate regardless of black's counter moves. As every chess player knows, this is very difficult if not impossible.

Alan Turing learned about the *Entscheidungsproblem* from lectures on the foundations of mathematics given by Max Newman at Cambridge University in 1935. People were not at all convinced that there could be an algorithm meeting Hilbert's requirements. The mathematician G.H. Hardy, a professor at Cambridge, said it forcefully:

> There is of course no such [algorithm], and this is very fortunate, since if there were we should have a mechanical set of rules for the solution of all mathematical problems, and our activities as mathematicians would come to an end.

Alan agreed, and considered how one could go about proving that no such algorithm exists. Apparently no one had ever provided a definition of "algorithm," and indeed there had hardly been a need for such a definition. As children, we all learned algorithms for adding and multiplying numbers. Later many of us will have learned algorithms for solving equations, and even the algorithms from the differential calculus for computing derivatives. None of this required that we be told what an algorithm is. We recognized that the rules we used were explicit and mechanical. Once we learned them, we could carry them out without any creative thought. That was good enough. But to prove that there is no algorithm to carry out some task, more was needed than the words "explicit" and "mechanical."

Thinking about what people do when they "compute," that is carry out algorithms, Turing saw that it all seemed to amount to taking note of particular symbols and then writing other symbols. Although the work is done on a two-dimensional surface like a sheet of paper or a blackboard, Turing could see that, in principle, it could all be done on a paper tape in which the symbols are written as a linear string. He realized that it was crucial that no limit be placed in advance on the amount of space needed. Speaking somewhat metaphorically, the tape should be infinitely long to be sure that it doesn't get all used up before the computation is complete. Next he saw that the behavior of the person doing the computation could be represented by a simple table that indicated the next step to be carried out, writing a symbol and moving left or right on the tape. Finally a machine could be constructed that does what the table instructs it to do. Such machines have come to be called Turing machines.

Now he was off and running. He asked whether one of his machines could be what we may call a *tester*. What a tester would be required to do would be to determine whether a given one of his machines will eventually write some particular symbol, say "0", when started with its tape empty. One imagines writing the table for the machine being tested on the tape of the "tester" and expecting it to eventually halt with "yes" written on its tape if the machine being tested would eventually write "0," and "no" written on its tape, otherwise. Turing proved that no such tester could exist. Finally, he showed how to use symbolic logic to represent the behavior of his machines in such a way that an algorithm to solve the *Entscheidungsproblem* could also be used as a tester. The conclusion: Since there are no testers, there also is no algorithm to solve the *Entscheidungsproblem*.

This work was enough for a very important research paper. Turing had given an explicit characterization of what is algorithmically computable, had provided a simple example of a problem that is not algorithmically solvable, and had used this to prove that the *Entscheidungsproblem* itself is unsolvable. Indeed, Turing's paper "On Computable Numbers with an Application to the Entscheidungsproblem" published in 1936 did all of that. But it did something more, something that was to apply not only to an abstract mathematical problem, but also to a matter of great practical importance: the possibility of making an all-purpose machine for computation, a machine that could crunch numbers to work out how to get to the moon, but could also play a game of chess, as well as carry out the many other tasks we have learned to entrust to what we now call "computers." Turing wrote out in detail the table for a machine *U* that he called "universal." What made it deserve this name is that if the table for one of his machines *M* is written on *U*'s tape, and *U* is then started, it will carry out the same calculation that *M* would do when started on a blank tape. So *U* can do anything that is computable. Of course due to limitations of space and time, no physical device can be fully universal. But what Turing's paper made clear is that given the capability to do a few simple things together with a very large memory, a physical machine could approximate universality.

It's important to emphasize that although the "machines" in Turing's 1936 paper existed, and were only intended to exist, on paper, nevertheless they represented a paradigm shift in the way people thought about computation. Computation was not only "number crunching," but was also the execution of algorithms dealing with any kind of data. Moreover, they showed that the distinction between what would come to be called hardware and software, as well as that between program and data were quite relative to circumstance and convenience. Turing's machines were conceived as machines, but their tables on the tape of the universal machine functioned as programs, and the universal machine treated them as data. When the question of how much functionality to build into the hardware of a computer became a practical one, these considerations dominated the discussion. John von Neumann, who wanted his machine to do number crunching in connection with the design of hydrogen bombs, chose to make basic arithmetic part of the hardware. Turing, who since his Bletchley Park days, had imagined a computer capable of playing decent chess, chose in his design to build only fundamental logical operations into the hardware, with arithmetic to be supplied by programming. Turing was dismissive of the "American tradition of solving one's difficulties by means of much equipment rather than by thought." Many years later, when the technology had advanced to the point that the universal computer was embedded on a chip of silicon and the huge memory was just more silicon, this issue was debated in terms of RISC (Reduced Instruction Set Computing) vs. CISC (Complete Instruction Set Computing) computer architecture.

Alan Turing's Homosexuality

Turing had been a practicing homosexual since his puberty, and apparently regarded his sexuality as simply part of who he was. It is not clear what his mother knew of this, but when his arrest for engaging in a liaison with a young man in Manchester made it a matter of public record, he did provide her with some explanation. In any case, her biography says nothing about any of this. His brother's essay does discuss it, and even offers an explanation of his brother's orientation. He blames it on Alan having been left to board with strangers in England at a very young age when the needs of the British Raj called his parents to India. Such psychological explanations of homosexuality, considered a "disorder," were very much the vogue at the time when John Turing was writing. Alan himself angrily suggested something similar on an occasion when one of his advances had been rebuffed.

Nowadays, it is accepted that the specific sexual proclivities of an individual are simply one aspect of that person and are unlikely to be altered by any intervention. There is apparently some evidence to connect male homosexuality to hormonal influences in the womb. But the truth is that, at this time, it is just not understood why certain people are homosexual. In any case, if it is reasonable to want to understand why a specific individual has turned out to be homosexual, it is just as reasonable to seek to understand why another is heterosexual. The powerful force of sexual attraction remains deeply mysterious.

The Engagement

Although Sara Turing doesn't mention it, Alan was engaged to a young woman, Joan Clarke, a co-worker at Bletchley Park, for several months. Joan was a very talented mathematics student who had been recruited to work as a cryptanalyst. Although Alan let her know from the beginning of his homosexual "tendencies," she remained willing to continue the engagement. It was after they spent a week together on a bicycling trip in Wales, that he decided that it wouldn't work, and broke off the engagement. They were, and remained, very fond of one another and it was all very difficult. Many years later, she decided not to see the play *Breaking the Code* which was about Turing, because she would have found it too painful.

Joan dealt with institutional obstacles and social prejudices that faced anyone who was both female and a mathematician at that time. At Bletchley Park she was listed as a "linguist" because the designation "cryptanalyst" was not available to women. She later married a man with a great interest in Scottish history. She became similarly interested and made a significant contribution to numismatics in that connection. She died in 1996.

John Turing dismissed Joan as "safe" (apparently meaning unattractive). In an earlier version of the document, he had referred to her "unwashed hair" and "problems of personal hygiene." This was in contrast with the "attractive and lively young women" that John had brought home for weekends who "cheered up" his father. Even allowing for the prejudices of the time, this denigration of a capable intelligent woman was truly appalling.

Turing in Princeton

Although Alan had no way of knowing this, he had not been the only one working on the problem of characterizing algorithmic computability. In Princeton Kurt Gödel visiting from Vienna as well as Alonzo Church and his students at Princeton University discussed the same problem. This came to light at Cambridge when a copy of a mathematical periodical arrived in the mail containing an article by Church with the title "An Unsolvable Problem of Elementary Number Theory." It turned out that, in addition, Church had also published a proof of the unsolvability of the *Entscheidungsproblem*. So, in a sense, Alan had been preempted. But his approach was so different and so fundamental that it was clearly still important enough to merit publication. Also the notion of universality, with its implied consequences for a new understanding of the nature of computation, was entirely Turing's. It was decided that Alan should spend some time at Princeton so Church and he could explore their common interests, and Max Newman wrote Church to see what could be worked out. Turing did spend two years at Princeton followed by a year back in Cambridge before the war broke out. There was something anomalous about Alan's situation at Princeton. At that time, in England, a doctorate was not ordinarily considered part of the preparation for an academic career. As a Fellow, Turing was on the lower rungs of a ladder that, if his research career proved successful, could eventually lead to a professorship. But the American system was different, and the simplest way for Turing to fit himself into it was as a candidate for the Ph.D. His dissertation was an important contribution to mathematical logic extending Gödel's work on undecidability.

Turing's ACE

After the war had ended, Alan was eager to help build a working Universal computer. He was offered a position at the National Physical Laboratory (NPL) to do just that. Full of enthusiasm, and harnessing the practical knowledge of electronics he had acquired from his war work, he wrote a detailed plan for a machine he called Automatic Computing Engine (ACE). This document and the machine it proposed anticipated a number of concepts that later were widely accepted. An address Turing delivered to the London Mathematical Society on the proposed ACE demonstrated Turing's expansive view of what came to be called computer science.

Unfortunately, the project ran into bureaucratic difficulties Turing had not expected, being used to the war-time atmosphere in which obstacles of that nature could be eliminated by a letter to Winston Churchill. In addition, engineers ignorant of the great success of Turing's "bombe" at Bletchley Park, wouldn't take seriously the pronouncements of this stuttering mathematician. He must have been terribly frustrated when computers did come to be built elsewhere, and their design moreover followed "the Americans" in solving problems by hardware rather than "thought." He left and accepted Max Newman's invitation to come to Manchester to work with the computer being built there. He did, but interacted with it not in pushing the kind of advanced software development he had outlined in his ACE report, but rather as a user to carry out computations related to the biological problems in which he had become interested.

Can Machines Think?

What led Turing to raise this question was that he saw in his ACE a first crude approximation to a human brain. He wrote a much-cited essay on the subject and even spoke about it on the radio. He sought an objective experimental test on the basis of which one could be justified in saying that a programmed computer was thinking, avoiding philosophical and religious objections that might be raised. The criterion he chose was the ability of such a machine to carry on a conversation that could not reasonably be distinguished from one by a person. He predicted that this would be achieved by the end of the twentieth century, but was far too optimistic about the task of programming computers to achieve a command of natural language equivalent to that of every normal person.

The Burglary

Alan foolishly went to the police when a few items had been stolen from his house. Alan's sex partner Arnold had mentioned Turing's posh house to someone named Harry, and Harry had gone to the house and helped himself. It turned out that Harry had been known to the police and had left his fingerprints behind after the theft. John Turing thought that Arnold himself was the thief and that there had been no burglary, but he was pretty clearly mistaken.

In any case, the police were more interested in what Alan and Arnold had been doing together than in the theft, and Turing found himself before a judge charged with "gross indecency." In order to spare Turing from a prison sentence, he was required to undergo a course of estrogen injections for a year, apparently in an effort to block his sex drive. What it did accomplish was to cause Alan to grow breasts.

Alan Turing's Death

Sara Turing would have it that it was her son's slovenly habits that led to his getting deadly cyanide on an apple he was eating. John

Turing was convinced that it was suicide. Alan Turing was a man who was privy to official secrets that, after his conviction, he was no longer entitled to have. Sex for him in England was evidently dangerous. In the Cold War atmosphere of the 1950s, he would surely have been warned about travel abroad. When a man he had met in Norway tried to visit Turing, the authorities saw to it that it wouldn't happen.

In any case, there is reason to believe that Alan did take his life, and that moreover he had staged his suicide in such a way that it would be clear to friends what he had done, while to his mother it would appear as a vindication of all her warnings about his slovenly habits. He had been much impressed by the Walt Disney film *Snow White and the Seven Dwarfs* and particularly the scene in which the wicked witch holds an apple in a steaming pot of poison chanting:

> Dip the apple in the brew
> Let the Sleeping Death seep through.

We are told that Alan enjoyed chanting those lines. Perhaps this was the very song he sang as he prepared the deadly concoction and took his bite.

Other Reading

First and foremost, there is Andrew Hodges's biographical masterpiece, *Alan Turing: The Enigma.* A much shorter and very worthwhile account is David Leavitt's *The Man Who Knew too Much: Alan Turing and the Invention of the Computer*. Finally I venture to mention my own *The Universal Computer: The Path from Leibniz to Turing* which tells the story of developments leading up to Turing's breakthrough, now available in an updated edition for the Turing Centenary.

Martin Davis

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PREFACE TO THE FIRST EDITION

The aim of this book is to trace from early days the development of a mathematician and scientist of great originality and to record details from which a selection may be made by a future biographer. Owing to the enforced silence regarding my son's activities in the Foreign Office during the Second World War, there is, except for some few anecdotes, a regrettable gap of six years in the narrative. The book is divided into two parts. The former and major part is mainly biographical but contains sufficient scientific material to indicate the scope and depth of my son's research. The second part affords more technical particulars which might prove wearisome to the general reader: but these barely touch the fringe of his work on Computing Machines and Morphogenesis. His writings on these and other subjects, together with a posthumous paper on Morphogenesis, prepared by Dr. N.E. Hoskin and Dr. B. Richards, can be studied in the volume of his collected works, which is to be published by the North-Holland Publishing Company, Amsterdam. I am indebted to many of my son's friends – too numerous to name – for their recollections. Here I take this opportunity to express my gratitude to various American mathematicians and scientists for their particularly courteous interest and co-operation. For their scrutiny of my typescript and valuable suggestions and advice, my special thanks go to Professor M.H.A. Newman, F.R.S., Mrs. Newman (Lyn Irvine), Mr. Geoffrey O'Hanlon and to Mr. Nowell Smith, who also read the proofs.

E.S.T.

FOREWORD TO THE FIRST EDITION

This book contains almost all the essential material for the biography of a very remarkable man, who died tragically in June, 1954, in the prime of his life and in the middle of research which may still prove to be even more original and important than the finished work which had brought him so much honour and fame. Alan Turing's mother, who has assembled and written this record of his childhood and his mature achievements, believes that his death was accidental. The explanation of suicide will never satisfy those who were in close touch with Alan during the last months and days of his life, however much the available evidence may point to it, and in the future the possibility of accident will be considered by those in a better position perhaps to decide the truth. But even if his death was not chosen by him, he was a very strange man, one who never fitted in anywhere quite successfully. His scattered efforts to appear at home in the upper middle class circles into which he was born stand out as particularly unsuccessful. He did adopt a few conventions, apparently at random, but he discarded the majority of their ways and ideas without hesitation or apology. Unfortunately the ways of the academic world which might have proved his refuge, puzzled and bored him; and in return that world sometimes accepted him wholeheartedly (I remember Shaun Wylie's saying "He was a lovely man: never a dull moment") but often felt puzzled by his remoteness. A letter from Sir Geoffrey Jefferson to Sara Turing describes this particularly well:

He was a wonderful chap in many ways. I remember how he came to my house late one evening to talk to Professor J.Z. Young and me after we had been to a meeting in the Philosophy Department here, arranged by Professor Emmet. I was worried about him because he had come hungry through the rain on his cycle with nothing but an inadequate cape and no hat. After midnight he went off to ride home some five miles or so through the same winter's rain. He thought so little of the physical discomfort that he did not seem to apprehend in the least degree why we felt concerned about him, and refused all help. It was as if he lived in a different and (I add diffidently, my impression) slightly inhuman world. Yet he had some warmth, I know – for you in particular, for he told me so in a revealing couple of hours that we had together not very long before he died. . . . Alan, as I saw him, made people want to help and protect him though he was rather insulated from human relations. Or perhaps because of that we wanted to break through. I personally did not find him easy to get close to.

We all marvelled at his indifference to creature comforts – for example, his staying at YMCA Hostels when he could easily afford a first class hotel. But was he so indifferent? He always appreciated finding himself warm and well-fed in a strange house during the difficult winters after the war. But he was at least half a Spartan and did not believe in expending much trouble and expense on physical comforts. He was Spartan rather than Bohemian. At Bletchley during the war when crockery was scarce and expensive, it was a nuisance if one's tea mug disappeared and Alan with characteristic thoroughness brought a padlock and chain and locked his mug to the radiator in his room. He was genuinely furious when some wag took the trouble to pick the lock and hide the mug.

Alan certainly had less of the eighteenth and nineteenth centuries in him than most of his contemporaries. One must go back three centuries (or *on* two perhaps) to place him; and yet of all the great minds most likely to understand and appreciate him, I should place Tolstoy first. A couple of years before he died I pushed first *Anna Karenina* and then *War and Peace* into his hands. I knew that he read Jane Austen and Trollope as sedatives, but he was totally uninterested in poetry and not particularly sensitive to literature or any of the arts, and therefore not at all an easy person to supply with reading matter. *War and Peace* proved to be in a very special way the masterpiece for him and he wrote to me expressing in moving terms his appreciation of Tolstoy's understanding and insight. Alan had recognized himself and his own problems in *War and Peace* and Tolstoy had gained a new reader of a moral stature and complexity and an originality of spirit equal to his own.

With ninety-nine people out of a hundred Alan protected himself by his off-hand manners and his long silences – silences finally torn up by the shrill stammer and the crowing laugh which told upon the nerves even of his friends. He had a strange way of not meeting the eye, of sidling out of the door with a brusque and off-hand word of thanks. His oddly-contoured head, handsome and even imposing, suddenly from another angle, or in a different mood, became unprepossessing. He never looked right in his clothes, neither in his Burberry, well-worn, dirty, and a size too small, nor when he took pains and wore a clean white shirt or his best blue tweed suit. An Alchemist's robe, or chain mail would have suited him, the first one fitting in with his abstracted manner, the second with that dark powerful head, with its chin like a ship's prow and its nose short and curved like the nose of an enquiring animal. The chain mail would have gone with his eyes too, blue to the brightness and richness of stained glass. They sometimes passed unnoticed at first; he had a way of keeping them to himself, and there was also so much that was curious and interesting about his appearance to distract the attention. But once he had looked directly and earnestly at his companion, in the confidence of friendly talk, his eyes could never again be missed. Such candour and comprehension looked from them, something so civilized that one hardly dared to breathe. Being so far beyond words and acts, that glance seemed also beyond humanity.

It was more than fortunate for Alan that his mother took such pains to select a public school to suit him. I find the account of his years at Sherborne fascinating. His mother and his housemaster, of one mind about him throughout, saved Alan from what threatened to be a career of scientific pranks. It was through Sara Turing's appreciation at a very early stage both of his brilliance and his difficulties, that he went to Sherborne and went in good heart, and there in a housemaster of unique perception and tact, he found someone able to carry on the difficult task of discouraging the misfit without discouraging the genius. It was at Sherborne, in his deep attachment to Christopher Morcom, the brilliant boy who died at eighteen, that Alan saw a vision of human relationships which sent him questing for the rest of his life.

To those who like myself came to know Alan only in the last ten years of his life, there is the answer to many questions in this short book. He carried so many odd suggestions of his past as well as his present about with him, almost like a pedlar's wares festooned about his person, although without any notion of showing them off. From his being in part still a child and an adolescent and an undergraduate, as well as a don and a Fellow of the Royal Society, arose the extraordinarily wide range of his friends. No one I have ever known proved compatible with so many people who would themselves have been incompatible with one another; partly through his divine tardiness to notice the faults of anyone who had won his regard, no matter by what trifling service. Yet it was characteristic of his honesty and detachment that he would listen to criticisms of his friends with the same humility as he accepted criticisms of himself – never apparently suspecting that people can find fault except honestly and from the best motives. He himself found the idea of deceiving others so distasteful that he supposed it equally so to almost everyone.

It is hard to remember a single instance of Alan's acting in imitation, even unconscious imitation, of another person. His originality was something quite by itself in its extent and depth. Sara

Turing quotes his writing to her as a little boy from his preparatory school saying: "I seem always to want to make things from the thing that is commonest in nature." This throughout was his ruling principle, and some of the ways that it guided and affected his research are described in this book. The specialist will be able to trace it in many of his more. important interests. To others it was particularly evident in his long-distance running. In that he achieved by mere legs and feet what most of us achieve only with the help of horses or wheels and the internal combustion engine. In the Easter holidays of 1949 Alan stayed with us[1] at Criccieth (the Pearsons having lent us their charming house in Marine Terrace). One afternoon of overcast skies and threatened rain, Alan changed into blue shorts and disappeared for a short time. When we asked him where he had been he pointed out a promontory of Cardigan Bay seven or eight miles north-west, inaccessible by road. We might have entertained the idea of walking there, but not without carrying a meal and macintoshes with us, scarcely without resting an hour or so on the way. For us it would have been a day's outing, but Alan did it between lunch and tea. From that day-although his normal walking gait was uninspired and almost shambling-we all felt awed, as if Mercury had joined our circle of acquaintances.

That sentence from his childish letter without other evidence would stamp him as a genius. He was not merely doing something extraordinary in a small boy but *recognizing it as extraordinary*, and it is the recognition of self that carries genius through to achievement. I recommend this record to anyone who has an interest in the nature of what we call genius. We are very ignorant still about its origin and character and it is hard to see how this ignorance can be readily mended, owing to the lack of material to study. There are very few men and women of genius in any century, and of these few some are certain to be overlooked in their own time and possibly in all time. Of those who are known the material for biography

[1] Professor and Mrs M.H.A. Newman.

is often thin and dull, and particularly with men of science much has to be made of little. Sir Isaac Newton remains a mystery to us after every recorded morsel has been displayed and examined. A new anecdote of his youth would be seized as a treasure by the entire learned world, no matter how slight and trivial an anecdote it might be, for it is particularly the child and the boy that excites most curiosity. We want to know where and how a nature and mind so unlike the normal first showed its divergence.

Sara Turing survives her son owing to the tragic earliness of his death, and with great courage and faith she has taken the opportunity that his death offered and made this source-book for a future biographer. For it does show unusual courage not to be ashamed of putting down the trifling memories, the details of childhood and family affairs, the little events that are almost insignificant and yet have just that faint signature in the corner, "A.M.T.," which made them so well worth preserving. Nothing that science can ever offer is more valuable than the knowledge of how a scientist develops.

Lyn Irvine.