Ramanujan

Letters & Reminiscences

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MORIAL NUMBER

Volume-1

RAMANUJAN

LETTERS AND REMINISCENCES

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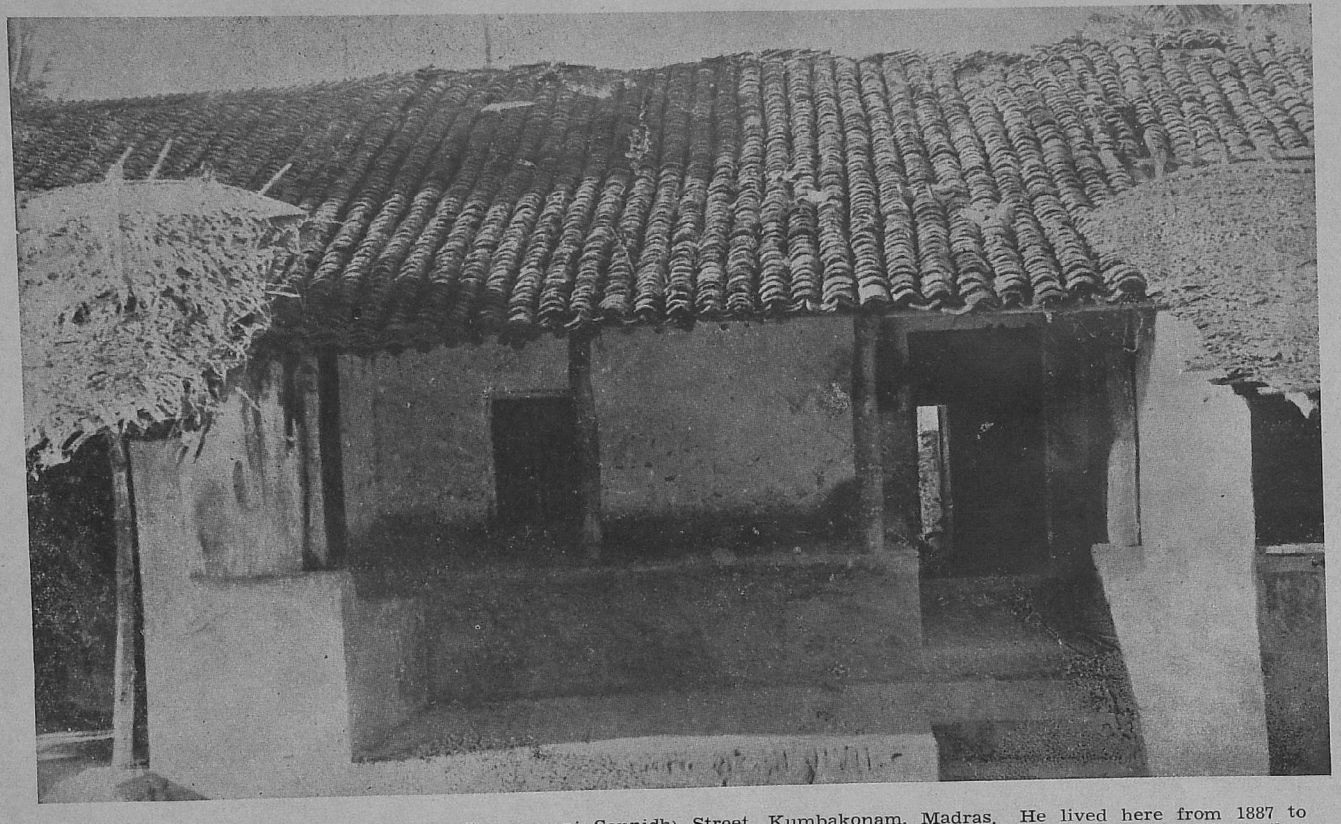
Editor:

P. K. SRINIVASAN, M.Ed.



The ancestral home of Ramanujan at Sarangapani Sannidhi Street, Kumbakonam, Madras. He lived here from 1887 to 1906 and then started moving to Madras. Seniors and juniors flocked here to get help from him in solving their mathematical problems. (Now the house is slightly remodelled.)

RAMANUJAN

LETTERS AND REMINISCENCES

RAMANUJAN MEMORIAL NUMBER

VOLUME ONE

THE MUTHIALPET HIGH SCHOOL
NUMBER FRIENDS SOCIETY
OLD BOYS' COMMITTEE
MADRAS-1

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To

The Fraternity of Good Men and Women

who muster courage

to break

man-made rules and conventions

in the discovery of

geniuses

and who, in all humility,

help them in all ways

to enrich and elevate

the humanity with their rare gifts.

PREFACE

With the indulgence of readers, I would like to commence with a brief narration of the story of this memorial compilation and publication.

Two decades before, I had the good fortune to read 'Indian Scientists' published by G. A. Natesan & Co., Madras. The life-sketch of Ramanujan given there moved me and created in me a strong desire to discover more of the man Ramanujan. As a mathematics teacher, I have been finding great satisfaction in encouraging pupils to know about his life and extraordinary achievements. His life carries the message that one can reach great heights of attainment irrespective of one's background if only one is true to oneself. The message has meant a lot to many of my pupils. With my support, pupils have been holding his birthday celebrations and memorial exhibitions under the auspices of the school mathematics club.

In 1954, a friend of mine took me to Srimathi Janaki Ammal and Sri S. Tirunarayanan, the wife and the brother respectively of Ramanujan. I was indeed excited to see and talk to them. Subsequently, I had occasion to meet Prof. K. Ananda Rao and learn, to my joy, that he was one of the contemporaries of Ramanujan in England.

In 1962 it was announced that a special commemoration stamp marking the 75th birthday of Ramanujan would be released on Dec. 22. Encouraged by the contacts with Ramanujan's close relatives and contemporaries and being in Madras, his home state, I began to wonder whether I could go about collecting letters and reminiscences to bring out a memorial number. To my knowledge, such an undertaking had not been made before.

I contacted my old boys and spoke to them about my urge. Of them, Sri S. Natarajan and Sri B. Seetharaman, in particular, deserve special credit for being the first in not only assuring but also giving me support in the venture. On the Vijayadasami day (8-10-1962), a committee was set up and it held its first meeting within the holy precincts of Mallikeswarar Temple in Linghi Chetty Street, Madras. The committee succeeded in convassing and enrolling more old boys as members on payment of subscription. With Sri S. Natarajan who was able to command leisure and serve as chairman of the committee, I set about searching for clues and contacting persons and institutions in India and England connected in any way with Ramanujan. How we succeeded in establishing contact with the persons whom we

searched for is itself a very big exciting story. We tracked down every clue by writing to numerous persons and knocking at all the houses in the suggested localities. We made appeals for materials through the newspapers, but that did not help us much. A few more letters and photos of Ramanujan, though promised, are yet to be obtained. Perhaps the second edition may include them.

By Dec. 1962, we had the good luck to secure a good collection of materials, hitherto not seen the light of day and so at the invitation of the Mathematics Department of the University of Madras, we arranged a display of the materials. Our contribution was openly acknowledged by Dr. A. Lakshmanaswamy Mudaliar, the great Vice-Chancellor of the Madras University, at the special function held on Dec. 22, 1962 in the University for the release of the Commemoration Stamp by the Governor of Madras. About three hundred pupils and teachers, past and present, of the Muthialpet High School went in a procession to the Philately Bureau of the Mount Road Post Office, carrying placards of homage to Mathematicians of India and bought the first day covers. The committee, as a result, became widely known, got more clues, made more contacts and secured more members and more materials.

Lack of time to do full-time job, paucity of funds and many clues still remaining to be tracked down stood in the way of early publication of the Memorial Number. Enthusiasm and earnestness alone being our main qualifications, we had to meet ticklish challenges. We prepared typed copies of the Number and went about showing them to people with means, hoping for liberal support. But, to our great disappointment, we had to postpone printing as the funds were quite inadequate. The advertisement revenue was also meagre. Donations were not forthcoming in ample measure. At this juncture, a miracle happened. With feelings of very deep gratitude and proud privilege, we make known the receipt of the first thousand rupees donation which Dr. K. Venkatachaliengar, the eminent Professor of Mathematics of the Mysore University, gave us unasked with his blessings, after being impressed with our work. This boosted our morale considerably and we took the solemn pledge to make the publication as perfect as possible to befit the memory of Ramanujan, the prince among the Indian Mathematicians, and the trust reposed in us by the contributors.

The second phase of engaging printers could be commenced only by '65. We decided to bring out a Souvenir and the Memorial Number in two volumes, the volume one to be of biographical interest and the volume two of mathematical interest. Volume

one comprises of original letters in photo-stat constituting the primary or the most authentic source and of reminiscences forming the secondary source. Most of them are published for the first time. The letters appear in two sections : 'Thus he wrote' and 'What they did and said'. They reveal not only the mind of Ramanujan but also the minds of those who had a difficult time with him. The letters have been arranged not on merely chronological basis but in bunches centring round recipients and senders. Most of the titles and paragraph headings have been supplied as part of editorial work.

Though it has taken nearly five years to finish our self-undertaken mission, we ardently hope that this memorial number will gladden all the contributors and supporters to whose commendable co-operation and patience we owe this publication and will inspire many a budding mathematician. The demand for the wealth of details is in direct proportion to the tallness of the stature of a person and so we have tried to make the volume as comprehensive as possible.

Some of the contributors, it is sad to note, are no more with us. The contributors were in their seventies and eighties and we could not help entering on this undertaking so late. We feel particularly forlorn with the passing away of Prof. K. Ananda Rao and Dr. A. Narasinga Rao, to whose blessings and help we are deeply indebted.

The story of the romantic rise of Ramanujan from obscurity to fame is, we believe, adequately delineated in the pages of this volume. He has had his own crop of difficulties and problems arising out of social conditions, absence of mathematical research and rigid practices of educational institutions. Everyone will wonder how he could not have been cared for better in spite of his moving so freely with so many persons. His faith that one day the world would recognise his Note books proved at last to be fully justified. He emerges from the pages as a giant with all lovable and understandable human characteristics.

The posterity owes a very deep debt of gratitude to Sri M. Anantaraman, Sri S. Tirunarayanan and Prof. K. Ananda Rao for preserving the letters and photos for over four decades and making them available to us for inclusion in the volume. Had it not been for the kind consent of Sri S. Tirunarayanan in whose custody still is the ancestral house where Ramanujan grew up and completed his matriculation, the Tamil letters of Ramanujan would not have seen the light of day. The editor had the privilege to open the almirah in the owner's room in the house at Sarangapani Sannidhi Street, Kumbakonam and unearth the two letters and the photo of the house as it was during Ramanujan's days.

Our special thanks go to revered Rajaji, Prof. J. E. Littlewood, Prof. T. Totadri Iyengar, Dr. S. R. Ranganathan, Prof. C. T. Rajagopal and Dr. M. Venkataraman for their fatherly guidance, help and blessings in our labour of love. Due acknowledgements with thanks have been separately made to the institutions, the associations and the publishing houses for their permission to include extracts and condensed versions from the already published material.

We are highly beholden to our revered Ex-President of India, Dr. S. Radhakrishnan for condescending to give his appreciation to this volume.

We are thankful to Sri N. Subbanarayanan of Port Trust Office, Madras, Sri K. Venkataraman, the Headmaster, Town High School, Kumbakonam and Sri Mir Shabeer Hussain, the Principal, Government College, Kumbakonam for their help in various ways.

A country that has learnt to cherish, keep alive and draw inspiration from the memory of its creative geniuses can always face its future with confidence and hope. As years roll by, a more and more favourable climate for mathematics is being ushered in. Seeing this welcome trend, the committee, while winding up following the fulfilment of its special programme, is giving place to Ramanujan Memorial Foundation with the object of setting up a permanent memorial to Ramanujan in the shape of a multi-storeyed building in Madras, housing a planetarium, mathematics exhibition wings, auditorium, library and showrooms displaying applications of mathematics in Industry. It will be a house of entertainment *par excellence* for the layman and it will strive to make mathematics almost as popular as dance and music. We solicit generous support and help from the readers and institutions all over the globe for translation of the dream into reality.

We will be failing in duty if we do not gratefully acknowledge the services rendered in various ways by other members of the committee, interested friends and relatives of the editor.

We thank all the donors for their support. To Jupiter Press we express our gratitude for their fine printing and get-up. To Sri M. X. Susairaj, an old boy of the editor, the colour pictures on the jackets are due and to Sri S. K. Vittal, a friend of the editor, some of the pictures in the book are due. We thank them for their services.

We welcome suggestions for improvement and correction of errors which might have escaped our notice, for bringing out a finer second edition after another critical evaluation.

Madras-33
1-1-1968

P. K. SRINIVASAN
Editor

AN APPRECIATION

BHARAT RATNA Dr. S. RADHAKRISHNAN
Ex-President of India

"Girija",
30 Edward Elliot Road,
Mylapore, Madras-4.
October 30, 1967.

It is a valuable publication reminding us of the great mathematical achievements of the late Ramanujam and the way in which from obscure beginnings he rose to world fame.

S. Radhakrishnan

(S. Radhakrishnan)

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REMINISCENCES

APPENDIX

LIST OF PLATES AND ILLUSTRATIONS

(Sources are given in italics within brackets)

ACKNOWLEDGEMENTS WITH THANKS

1. The Senior Bursar, Queen's College, Cambridge for permission to publish an extract from Prof. J. E. Littlewood's review of Collected Papers of Srinivasa Ramanujan appearing in the Mathematical Gazette Vol XIV. No. 200 (Apr. 1929) and use Prof. Neville's photo appearing in Vol. XIX No. 232 (Feb. '35) through letter EAM/JW dated Sep. 28, 1963.

2. The University of Madras for permission to publish letters to Dewsbury by Walker, Neville, Littlehailes, Barnes, Spring and Hardy and extracts from Ramanujan's Notebooks, through the Registrar's letter A 191 dated Jan. 11, 1965.

3. Curtis Brown Ltd., 13, King Street, Covent Garden, London, W.C. 2 for permission to publish extracts from Prof. C. P. Snow's Rectorial Address on Magnanimity through letter AT/LC dated Oct. 9, 1963.

4. Cambridge University Press, Bentley House, 200, Euston Road, London, N.W. 1 for permission to publish extracts from Hardy's Twelve Lectures and Collected Papers of Srinivasa Ramanujan through letter PLD/DG dated Oct. 4, 1963.

5. *Nature*, Editorial and Publishing Offices, Macmillan & Co. Ltd., St. Martin's Street, London, W.C. 2 for permission to publish extracts from Prof. E. H. Neville's article appearing in its issue *149*, 292 (1942) through letter LBJ/JB dated Oct. 2, 1963.

6. To Madras Port Trust for permission to publish Recommendation letter of Middlemast, and letters of Griffith, Bourne, Hill, Spring and Ramanujan through the Secretary's letter G/10232/63/S dated May 2, '63.

7. Trinity College Library, Cambridge, for permission to include the information about Ramanujan from the Trinity Admission Book through the Sub-librarian's letter dated May 23, '63.

8. The Principal, Government College, Kumbakonam, for permission to include an abridged version of N. Hari Rao's

biographical sketch of Ramanujan appearing in the College Centenary Souvenir.

9. The Indian Mathematical Society for permission to include Seshu Aiyar's biographical note on Ramanujan in Vol. XII No. 3 of the Journal of the Indian Mathematical Society of June 1920, extract from Lord Pentland's opening speech on 27-12-'16 at the First Conference of the I.M.S. held at the Presidency College, Madras.

RAMANUJAN IN ENGLAND

"Well. I have done one thing you could never have done, and that is to have collaborated with both Littlewood and Ramanujan on something like equal terms".

— HARDY in his '*A Mathematician's Apology*'.

THUS HE WROTE

1. Letters to Krishna Rao
2. Letters to Subramanian
3. Application to Port Trust, Madras
4. Letter to Narayana Iyer
5. Letters to parents
6. Letters to Hardy (excerpts)
7. Letter to the Registrar, University of Madras

Suez
30-5-14

Dear Mr. Krishna Rau,

Reached Suez this evening. The Steamer arrived on the 15th at Madras and I was very busy the next day (Sending my people to Kumbakonam after packing up things, going to Messrs Bennett to buy things, to the College, town, etc.) and so I couldn't go to you; but I told your brother to inform you of my starting on the 17th morning and thought I could see you at the Harbour.

For the first three days I was very uncomfatable and took very little food and after that I have been alright. The sea is very smooth and there is no fear of sea sickness. I do not know whether I have to go to Cambridge directly or stay at London and then go. I shall write to you after I reach England and everything is definately settled. My best compliments to your brother and respects to your uncle.

and warmest thanks

I am

Yours very sincerely

S. Ramanujan

1. LETTERS TO R. KRISHNA RAO

(Nephew of Dewan Bahadur R. Ramachandra Rao and the grandson of Sir T. Madhava Rao.)

'Krishna Rao's association with Ramanujan deserves to be better known.'

—*Prof. K. Ananda Rao.*

Letter 1

HALT AT SUEZ

Suez
30-3-14

Dear Mr. Krishna Row,

Reached Suez this evening. The steamer arrived on the 15th at Madras and I was very busy the next day (sending my people to Kumbakonam after packing up things, going to Wrenn Bennett to buy things, to the College, town, etc.) and so I couldn't go to you ; but I told your brother to inform you of my starting on the 17th morning and thought I could see you at the Harbour.

For the first three days I was very uncomfortable and took very little food and after that I have been alright. The sea is very smooth and there is no fear of sea sickness. I do not know whether I have to go to Cambridge directly or stay at London and then go. I shall write to you after I reach England and everything is definitely settled. My best compliments to your brother and respects and warmest thanks to your uncle.

I am
Yours very sincerely
S. Ramanujan

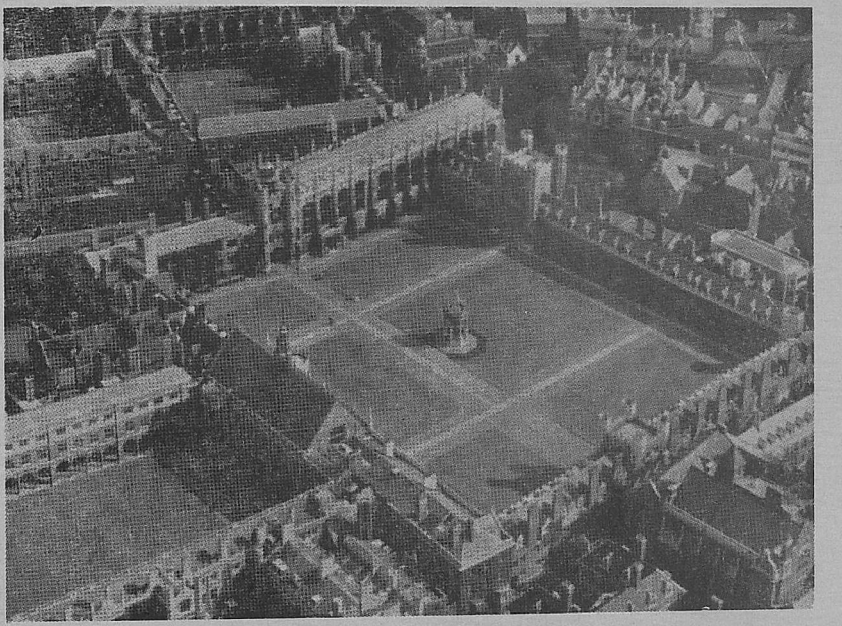
Replied on 9.7.14 / 9.7.14

Trinity College
11th June 1914.

My dear Krishna Row,

Please excuse me for the long delay in writing to you. Now I am somewhat accustomed to the living here. Till now I did not feel comfortable and I would often think why I had come here. It is due to the difficulty of getting proper food. Had it not been for the good milk and fruits here I would have suffered more. Now I have determined to cook one or two things myself and have written to my native place to send some necessary things for it.

After enjoying the pleasant voyage, except for two or three days when I was seasick, I reached London ~~of~~ on the 14th April when Mr Neville and his brother were kindly waiting at the docks and took to me to Cromwell road where I remained a few days. I came ~~to the College~~ Cambridge on the 18th evening and remained for some days in Mr Neville's house



Cambridge University Campus.

Ramanujan (in the centre) with other Fellows of the Trinity College.

LETTER 2

ARRIVAL IN LONDON ON 14-4-1914 AND SETTLING DOWN AT TRINITY COLLEGE

Trinity College,
11th June 1914.

My dear Krishna Row,

Please excuse me for the long delay in writing to you. Now I am somewhat accustomed to the living here. Till now I did not feel comfortable and I would often think why I had come here. It is due to the difficulty of getting proper food. Had it not been for the good milk and fruits here I would have suffered more. Now I have determined to cook one or two things myself and have written to my native place to send some necessary things for it.

After enjoying the pleasant voyage except for two or three days when I was sea-sick, I reached London on the 14th April when Mr. Neville and his brother were kindly waiting at the docks and took to me to Cromwell road where I remained a few days. I came to Cambridge on the 18th evening and remained for some days in Mr. Neville's house.

Now I am living in the college and going to stay here for the future also even though it is more costly than lodging houses, as it will be inconvenient for the professors and myself if I stay outside the college.

Mr. Hardy, Mr Neville and others here are very unassuming, kind and obliging. As soon as I came here Mr. Hardy paid £20 to the college for my entrance and other fees and made arrangements to give me a Scholarship of £40 a year. The remaining £20 may be given in due course or may be taken for the fees of the tutors.

I am attending lectures and have written two articles till now. Mr Hardy is going to London today to read a paper on one of my results before the London Math. Society.

I hope you have passed your examination. Is your brother coming here? my respects to your uncle and compliments to your brother.

Yours Sincerely
S. Ramanujan
c/o G. H. Hardy Esq.
Trinity College

Now I am living in the college and going to stay here for the future also even though it is more costly than lodging houses, as it will be inconvenient for the professors and myself if I stay outside the college.

Mr. Hardy, Mr. Neville and others here are very unassuming, kind and obliging. As soon as I came here, Mr. Hardy paid £ 20 to the college for my entrance and other fees and made arrangements to give me a scholarship of £ 40 a year. The remaining £ 20 may be given in due course or may be taken for the fees of the tutors.

I am attending lectures and have written two articles till now. Mr. Hardy is going to London today to read a paper on one of my results before the London Math. Society.

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Yours sincerely

S. Ramanujan

c/o G. H. Hardy Esq.,

Trinity College.

Trinity Colleg
7th Aug. 1884

My dear Krishna Row,

Received your kind letter of 7th July. Very glad to hear that you have passed your apprentice examination. Glad to hear also that Mr Ananda Row is coming here, and I am ready to help him in any sort of way I can be of use to him.

I came here at the end of the year for the climatic conditions as you know. The college was closed in the middle of June and it will be reopened in the middle of October. There is no body here except Prof. Hardy as the examinations are all over and all have gone outside I can write to you something interesting to you after the vacation is over. That is why I have nothing to write to you at present and you will excuse me for that.

LETTER 3

WRITING ORIGINAL PAPERS

Trinity College,
7th Aug., 1914.

My dear Krishna Row,

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I have written three papers till now. The proof sheets have come. I am writing three more papers. All will be published at the end of the vacation i.e in October.

It will be difficult for Mr Ananda Row to reach London through the channel and the Thames owing to the present war, and so it is better for him to get down at Plymouth or some other seaport.

Hoping your brother determined to go over here! Hoping all in your family are doing well and wishing a happy and successful career in life.

yours sincerely

S. Ramanujan
Trinity College
Cambridge.

P.S. I am living within the college premises and am cooking my food myself though it takes some of my time. I am getting things from a company at London selling Indian things as well as from my house.

yours sincerely
S. Ramanujan

I have written three papers till now. The proof sheets have come. I am writing three more papers. All will be published at the end of the vacation, i.e. in October.

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Yours sincerely
S. Ramanujan
Trinity College
Cambridge.

P.S.—I am living within the college premises and am cooking my food myself though it takes so much of my time. I am getting things from a company at London selling Indian things as well as from my house.

Yours sincerely
S. Ramanujan

(1)

Trinity College
13th Nov. 1914.

My dear Krishna Rao,

Ananda Rao has joined the King's College and settled quite comfortably. He is also coming to this college to attend some lectures.

I am attending some of only the University lectures. A few students from America and Japan have come here to attend these lectures.

I am very slowly publishing my results owing to the present war. A lecturer here from whom I know well and from whom I received some help to publish my results has gone to war. The other professors here whom I know have lost their interest in Matte-matics owing to the present war.

LETTER 4

OUTBREAK OF FIRST WORLD WAR

Trinity College,
13th Nov. 1914

My dear Krishna Rao,

Ananda Rao has joined the King's College and settled quite comfortably. He is also coming to this College to attend some lectures.

I am attending only some of the University lectures. A few students from America and Japan have come here to attend these lectures.

I am very slowly publishing my results owing to the present war. A lecturer here whom I know well and from whom I received some help to publish my results has gone to war. The other professors here whom I know have lost their interest in Mathematics owing to the present war.

(2)

One of the professors here, some days back, remarked that I have come to England in the most unfortunate time.

I have changed my plan of publishing my results I am not going to publish any of the old results in my note book till the war is over. After coming here I have learned some of their methods. I am trying to get new results by their methods so that I can easily publish these results without delay.

In a week or so I am going to send a long paper to the London Mathematical society. The results in this

One of the professors here, some days back, remarked that I have come to England in the most unfortunate time.

I have changed my plan of publishing my results. I am not going to publish any of the old results in my notebook till the war is over. After coming here I have learned some of their methods. I am trying to get new results by their methods so that I can easily publish these results without delay.

In a week or so I am going to send a long paper to the London Mathematical Society. The results in this

paper have nothing to do with those of my old results.

I have published only three short papers, two of which I have sent your uncle. For the mathematical side you may ask Mr Sechus Lyu or your uncle whenever you meet them.

I don't write anything about the war, so that the letter may reach you safely.

I was silent so long as I had nothing to write to you. Hereafter I may tell you something about my progress as the professors here are somewhat reviving their lost interest in mathematics

As for my food I have no other go but to cook myself.

paper have nothing to do with those of my old results.

I have published only three short papers, two of which I have sent your uncle. For the mathematical side you may ask Mr. Seshu Iyer or your uncle whenever you meet them.

I don't write anything about the war, so that the letter may reach you safely.

I was silent so long as I had nothing to write to you. Hereafter I may tell you something about my progress as the professors here are somewhat reviving their lost interest in Mathematics.

As for my food I have no other go but to cook myself.

There is no place very near the college where I can get vegetarian food and I can't go out of the College. I am getting some of the Indian things here. I will be very much obliged if you can send me some tamarind (seeds being removed) and good cocoanut oil by postal parcel through the cheapest route. Cocoanut oil is the best as it will be solid owing to cold and won't be spoiled. I can use lemons in stead of tamarind if they are sour, but unfortunately the lemons here are not sour like our lemons and moreover they are not proper-ly lemons at all but they are sweet [illegible]. I can receive the things only in proper order if you send me by postal parcel, otherwise it will be very difficult for me to go to London Docks to receive the things. I beg to be excused for the trouble

Yours sincerely
S. Ramanujan

There is no place very near this College where I can get vegetarian food and I can't go out of the College. I am getting some of the Indian things here. I will be very much obliged if you can send me some tamarind (seeds being removed) and good cocoanut oil by *postal parcel* through the cheapest route. Cocoanut oil is the best as it will be solid owing to cold and won't be spoiled. I can use lemons instead of tamarind if they are sour; but unfortunately the lemons here are not sour like our lemons and moreover they are not properly lemons at all but they are sweet *Narthāngaai.* I can receive the things only in proper order if you send me by postal parcel, otherwise it will be very difficult for me to go to London harbour to receive the things. I beg to be excused for the trouble.

Yours sincerely

S. Ramanujan

1/

Trinity college
7th Jan. 1915.

My dear Subbiramaniam,

It is very long since I heard from you. I am sorry I haven't received any reply to my letter up to this time. Are you keeping good health? How is your progress now? How long is your course? What department are you going to enter? Engineering or Archaeological? What about your B.E. degree? Do you know what Dasa-rajan and Govindarajan are doing?

I am doing my work very slowly. My note-book is sleeping in a corner for these four or five months. I am publishing only my present researches as I have not yet proved the results in my note-book rigorously. I am at present working in Arithmetical functions, such as the no. of divisors of N, the number of ways in which N can be expressed as the sum of 2 squares and so on, and trying to get Algebraic expressions for these Arithmetical functions. I have written a very long paper on these, which will be pub-

2. LETTERS TO S. M. SUBRAMANIAN

(a class mate of Ramanujan during school days.)

Letter 1

CONSTRUCTION OF A CURIOUS FUNCTION AND ENUMERATION OF ITS PROPERTIES

Trinity College,
7th Jan. 1915

My dear Subramanian,

It is very long since I heard from you. I am sorry I haven't received any reply to my letter up to this time. Are you keeping good health ? How is your progress now ? How long is your course ? What department are you going to enter ? Engineering or Archaelogical ? What about your B.E. degree ? Do you know what Durairajan and Govindarajan are doing ?

I am doing my work very slowly. My notebook is sleeping in a corner for these four or five months. I am publishing only my present researches as I have not yet proved the results in my notebook rigorously. I am at present working in Arithmetical functions, such as the no. of divisors of N, the number of ways in which N can be expressed as the sum of 2 Sqq. and so on, and trying to get Algebraic expressions for these Arithmetical functions. I have written a very long paper on these, which will be pub-

published within a few months. I have already published 3 pamphlets on Definite integrals and Elleptic functions. I shall now tell you a very curious function. Arrange all the rational numbers thus

$$\frac{1}{1}, \frac{1}{2}, \frac{2}{1}, \frac{1}{3}, \frac{3}{1}, \frac{2}{3}, \frac{3}{2}, \frac{1}{4}, \frac{4}{1}, \frac{2}{4}, \frac{4}{2}, \frac{3}{4}, \frac{4}{3}, \ldots$$

and construct the function $F(x) =$

$$\frac{\cos\left(\sec \frac{1}{\sqrt{1-x}}\right)}{2} + \frac{\cos\left(\sec \frac{1}{\sqrt{1-2x}}\right)}{2^2} + \frac{\cos\left(\sec \frac{1}{\sqrt{2-x}}\right)}{2^3} + \frac{\cos\left(\sec \frac{1}{\sqrt{1-3x}}\right)}{2^4} + \frac{\cos\left(\sec \frac{1}{\sqrt{3-x}}\right)}{2^5} + \ldots$$

The numerators are made up of the numerators and the denominators of the rational numbers. The denominators are the regular Geometric series $2, 2^2, 2^3, 2^4, \ldots$

Since the cosine is numerically not greater than 1, the series is absolutely convergent. If you give any rational value for x one term will be indefinite ($\cos(\sec \infty)$ is not definite). Hence $F(x)$ does not exist for all rational values of x. But $F(x)$ exists for all irrational values of x. Again there is another curiosity here. Take a rational point

lished within a few months. I have already published 3 pamphlets on Definite integrals and Elliptic functions. I shall now tell you a very curious function. Arrange all the rational numbers thus

$$1,\ \tfrac{1}{2}\ \tfrac{2}{1},\ \tfrac{1}{3}\ \tfrac{3}{1}\ \tfrac{2}{3}\ \tfrac{3}{2},\ \tfrac{1}{4}\ \tfrac{4}{1}\ \tfrac{2}{4}\ \tfrac{4}{4}\ \tfrac{3}{4}\ \tfrac{4}{3},$$

and construct the function

$$F(x) = \frac{\operatorname{Cos}\left(\sec\frac{1}{\sqrt{1-x}}\right)}{2} + \frac{\operatorname{Cos}\left(\sec\frac{1}{\sqrt{1-2x}}\right)}{2^2} + \frac{\operatorname{Cos}\left(\sec\frac{1}{\sqrt{2-x}}\right)}{2^3}$$

$$+ \frac{\operatorname{Cos}\left(\sec\frac{1}{\sqrt{1-3x}}\right)}{2^4} + \frac{\operatorname{Cos}\left(\sec\frac{1}{\sqrt{3-x}}\right)}{2^5} + \ldots$$

The numerators are made up of the numerators and the denominators of the rational numbers. The denominators are the regular Geometric series $2, 2^2, 2^3, 2^4, \ldots$

Since the Cosine is numerically not greater than 1, the series is absolutely convergent. If you give any rational value for x one term will be indefinite (cos (sec ∞) is not definite). Hence $F(x)$ does not exist for all rational values of x. But $F(x)$ exists for all irrational values of x. Again there is another curiosity here. Take a rational point

say $\frac{1}{2}$. If you approach from the left to this point $\frac{1}{2}$, then $\cos(\sec \frac{1}{\sqrt{1-2x}})$ approaches the form $\cos(\sec \frac{1}{\sqrt{+0}})$ which is indefinite. But if you approach the point $\frac{1}{2}$ from the right, then $\cos(\sec \frac{1}{\sqrt{1-2x}})$ approaches the form

$$\cos(\sec \frac{1}{\sqrt{-0}}) = \cos(\sec \frac{1}{\sqrt{+0}})$$
$$= \cos 0 = 1.$$

Similarly for every rational point. Hence $F(x)$ exists if you approach every rational point from the right-side but $F(x)$ is indeterminate when you approach the rational point from the left-side; and $F(x)$ is obviously finite and determinate for every irrational value of x. Just imagine this function remembering that

(i) between any 2 rational points there are an infinity of irrational points;

(ii) between any 2 irrational points there are an infinity of rational points.

(iii) every irrational point is the limiting point of some set of rational points as well as some set of irrational points;

(iv) every rational point is also the limiting point of some sets of rational points as

say $\frac{1}{2}$. If you approach from the left to this point $\frac{1}{2}$, then $\cos\left(\sec\frac{1}{\sqrt{1-2x}}\right)$ approaches the form $\cos\left(\sec\frac{1}{\sqrt{+0}}\right)$ which is indefinite. But if you approach the point $\frac{1}{2}$ from the right, then $\cos\left(\sec\frac{1}{\sqrt{1-2x}}\right)$ approaches the form

$$\text{Cos}\left(\sec\frac{1}{\sqrt{-0}}\right) = \text{Cos}\left(\text{sech}\frac{1}{\sqrt{+0}}\right) = \text{Cos } 0 = 1.$$

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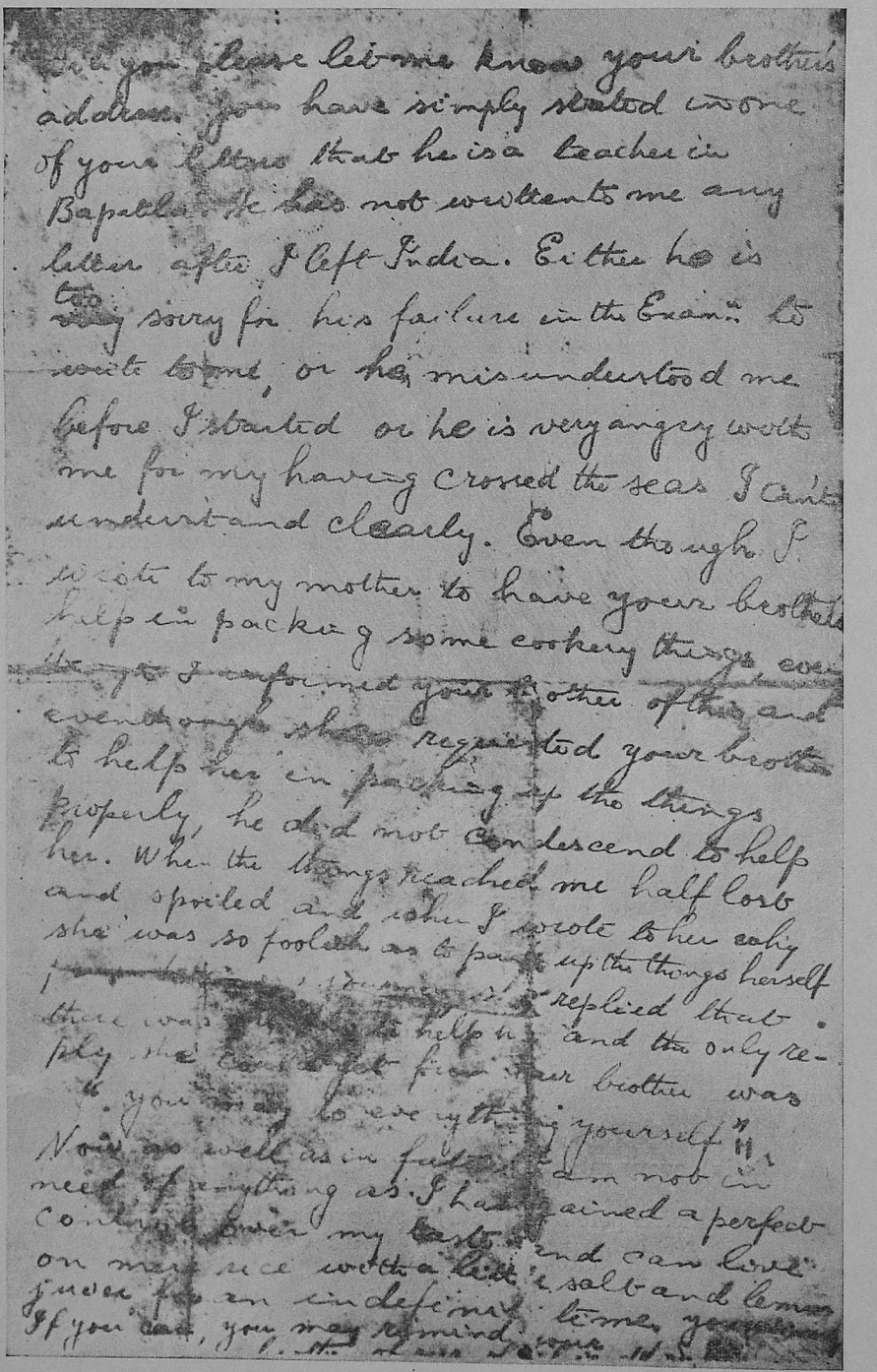
(i) between any 2 rational points there are an infinite no. of irrational points;

(ii) between any 2 irrational points there are an infinity of rational points:

(iii) every irrational point is the limiting point of some sets of rational points as well as some other sets of irrational points;

(iv) every rational point is also the limiting point of some sets of rational points as well as some other sets of irrational points.



Will you please let me know your brother's address. You have simply stated in one of your letters that he is a teacher in Bapatla. He has not written to me any letter after I left India. Either he is too very sorry for his failure in the Exam.ⁿ to write to me, or he misunderstood me before I started or he is very angry with me for my having crossed the seas I can't understand clearly. Even though I wrote to my mother to have your brother help in packing some cookery things, even though I informed your mother of this and even though she requested your brother to help her in packing up the things properly, he did not condescend to help her. When the things reached me half lost and spoiled and when I wrote to her why she was so foolish as to pack up the things herself [illegible] replied that there was [illegible] to help me and the only reply that I could get from your brother was "you must try to do everything yourself" Now as well as in future I do not in need of anything as I have attained a perfect control over my taste and can live on rice with a little salt and lemon juice for an indefinite time. You can, if you like, you may remind [illegible]

Will you please let me know your brother's address. You have simply stated in one of your letters that he is a teacher in Bapatla. He has not written to me any letter after I left India. Either he is too sorry for his failure in the Exam. to write to me, or he has misunderstood me before I started or he is very angry with me for my having crossed the seas. I can't understand clearly. Even though I wrote to my mother to have your brother's help in packing some cookery things, even though I informed your brother of this and even though she requested your brother to help her in packing up the things properly, he did not condescend to help her. When the things reached me half lost and spoiled and when I wrote to her why she was so foolish as to pack up the things herself for sending on a long journey she replied that there was nobody to help her and the only reply she could get from your brother was "You may do everything yourself". Now as well as in future I am not in need of anything as I have gained a perfect control over my taste and can live on mere rice with a little salt and lemon juice for an indefinite time.

If you can, you may remind your brother of our old friendship.

Yours sincerely

S. Ramanujan

LETTER 2

CONTEMPLATION OF A SHORT RETURN TO INDIA

Trinity College,

3rd June 1915

My dear Subramanian,

Received your letter of 23rd April and the Panchangam. Many thanks. Sorry to learn that you didn't receive my reply to your letter of 5th Feb. Will you please write to me definitely what books you want on architecture.

I may be conferred upon a "Research Degree" in a year but not an "Honorary Degree" as you expect. Honorary degrees are conferred upon those in a very high position in life (say Lords, dukes, maharajas etc.) here at present.

I am thinking of returning to India in a year and see you all again. I am sorry that I haven't got a photo of myself (up to this time) to send you. As for the pamphlets and dissertations of mine I shall send you some within a month. At present I do not know how many copies of my work should be sent to Vice-Chancellor, Referees, University library and a few other libraries to get my degree on any other footing. I have got only 10 or 11 copies of each in my possession. Two dozen copies are sent to me for my publication; of which 10 are distributed to the directors of studies here and 4 copies are sent to Madras.

You said in the beginning of your stay in Bombay that your work is not congenial to you owing to unpleasant surroundings. I hope you have overcome all those difficulties.

Where is your brother now at Bapatla or Kumbakonam? I am very sorry that I haven't received his letter. Is the post at Bapatla a permanent one?

Sorry to hear that your father is so ill. It is advisable that one of your brothers should remain in the house till he recovers. From your letter I understood that he was suffering from pain all over the body. I think he might have recovered in a short time.

Yours affectionately

S. Ramanujan

LETTER 3

UNUSUALLY SLOW IN WORK AND DESIRE TO STAY IN ENGLAND FOR TWO OR THREE YEARS

Trinity College,
1st July 1915

My dear Subramanian,

Received your letter of 29th May. I wonder why so many of my letters didn't reach you. I received all your letters except one. Three letters previous to this didn't reach you. I hope this will reach you very soon and safe owing to the overland mail.

I shall repeat briefly what I wrote to you in my previous letters.

Will you write to me definitely what kind of books on architecture you require ?

A few days back a friend of mine here one Krishnamachari came to me with his camera and took my photo when I was sitting near the fireplace in my room. He gave me a copy which I am now sending you with this letter. At that time there was only dim light in the room and the photo was taken for fun. You will see in the photo many books and papers in the table as a huge white mass.

As for my dissertations you have asked me I shall send you some in a fortnight after ascertaining how many copies I may be required to send the Vice-Chancellor and the Referees to take my degree.

I am going to take a Research degree at the end of one year (hence) and I am thinking of returning to India next year this month and of coming back to England if necessary.

I am unusually slow in my work and that is why I think it may be necessary to stay here a few years more as there is no help nor references in Madras for my work.

You told me in the beginning of your stay in Bombay that you had to move with uncultured and unpleasant persons. I hope you had overcome those difficulties.

I am very sorry to learn that your brother had to leave the school without any pay for the vacation. What is he doing at present ? I think it is better for him to be employed in metropolis like Madras and not in mofussils. In metropolis even if he is employed for a very short time in any department he can get a permanent job anywhere before he leaves another.

Hoping you are in good health.

Yours affectionately
S. Ramanujan

LETTER 4

B.A. DEGREE BY RESEARCH

Trinity College,

CAMBRIDGE

30th March 1916.

My dear Subramanyan,

Your letter duly to hand. I am very sorry to hear that your scholarship has not been extended. It would have been much better if you had ascertained what was happening about your case in Madras before the time for the extension of your scholarship. Haven't you seen yet the principal of the Engineering College? You needn't go for any subordinate service. Even if you can't get any post in Madras you can get something elsewhere in India. I am thinking of returning there in June (this year) for the long vacation. We shall talk over the matter and settle it as best as we can.

Did Ganapati appear for B.A.? Has Anantaraman finished his intermediate? I hope all in your family are doing well. My kind remembrances to Ganapathi.

Yours affly,

S. Ramanujan

P.S.—I took my degree some days ago as you know full well.

3. RAMANUJAN'S APPLICATION FOR EMPLOYMENT IN PORT TRUST, MADRAS

(He was serving then as an officiating clerk in Accountant-General's Office from 20-1-1912 to 21-2-1912 on Rs. 20 p.m. He was later appointed in Port Trust in the Accounts Section in class III, grade 4 on a salary of Rs. 30 p.m.)

LETTER

APPLICATION TO MADRAS PORT TRUST
FOR THE POST OF A CLERK

Triplicane,
9th February 1912.

From

S. Ramanujan,
7, Summer House,
Triplicane.

To

The Chief Accountant,
Madras Port Trust,
Madras.

Sir,

I understand there is a clerkship vacant in your office, and I beg to apply for the same. I have passed the Matriculation Examination and studied up to the F.A. but was prevented from pursuing my studies further owing to several untoward circumstances. I have, however, been devoting all my time to Mathematics and developing the subject. I can say I am quite confident I can do justice to my work if I am appointed to the post. I therefore beg to request that you will be good enough to confer the appointment on me.

I beg to remain,
Sir,
Your most obedient servant,

S. Ramanujan

4. LETTER TO NARAYANA IYER,

(Manager, Port Trust, Madras. He was formerly on the mathematics staff of St. Joseph's College, Tiruchi. He served as the treasurer of the Indian Mathematical Society in the early years.)

LETTER

GRATITUDE TO S. NARAYANA IYER AND SIR FRANCIS SPRING. FEELING THE NEED TO READ FRENCH AND GERMAN BOOKS AND JOURNALS

To Sri S. Narayana Iyer, M.A., L.T.

Trinity College,
Cambridge,

11th Nov. 1915.

My dear Sir,

Your kind letter duly to hand. Very glad to hear of the kind remembrances of Sir Francis Spring. Had it not been for his special recommendation to the Government of Madras, I would not have got the scholarship so easily and quickly from Madras University. He will be glad if he knows from you about my progress.

I am sending you one of my papers read before the London Math. Society in last November. It is wrongly printed in the paper that it was read in last June. The paper that was read in last June was about some of my results in my notebook. It will take some months for me to write that paper systematically and publish it.

As for your suggestion to publish more important and general results, I have first to read French and German works and journals and to become familiar with extremely rigorous proofs and then publish my results. Now I shall be going on to write something in my own way for 6 or 7 months to come. Unless I remain here for two years more I cannot do all I have to do. If I just consider the enormous losses to this College owing to this terrible war, I think I have no voice to ask the authorities of this College to do me anything if they cannot afford to retain me here of their own accord. There were about 700 students and even more than that sometimes before the war, but there are only about 150 this year. Perhaps there may be very few only next year if the war continues.

Mr. S. Narayana Iyer, M.A., L.T., the Manager of Port Trust who strove hard and succeeded in getting recognition for Ramanujan in the mathematical world.

KOMALATTAMMAL, mother of Ramanujan.

It appears that Madras University has asked this College about my work. I think the reports may reach Madras very soon after you receive this letter if they have not already reached there. If I could remain here for more than one year I should like to go over there for the coming long vacation so that I may not disappoint my people to whom I promised to return at the end of two years of my stay here.

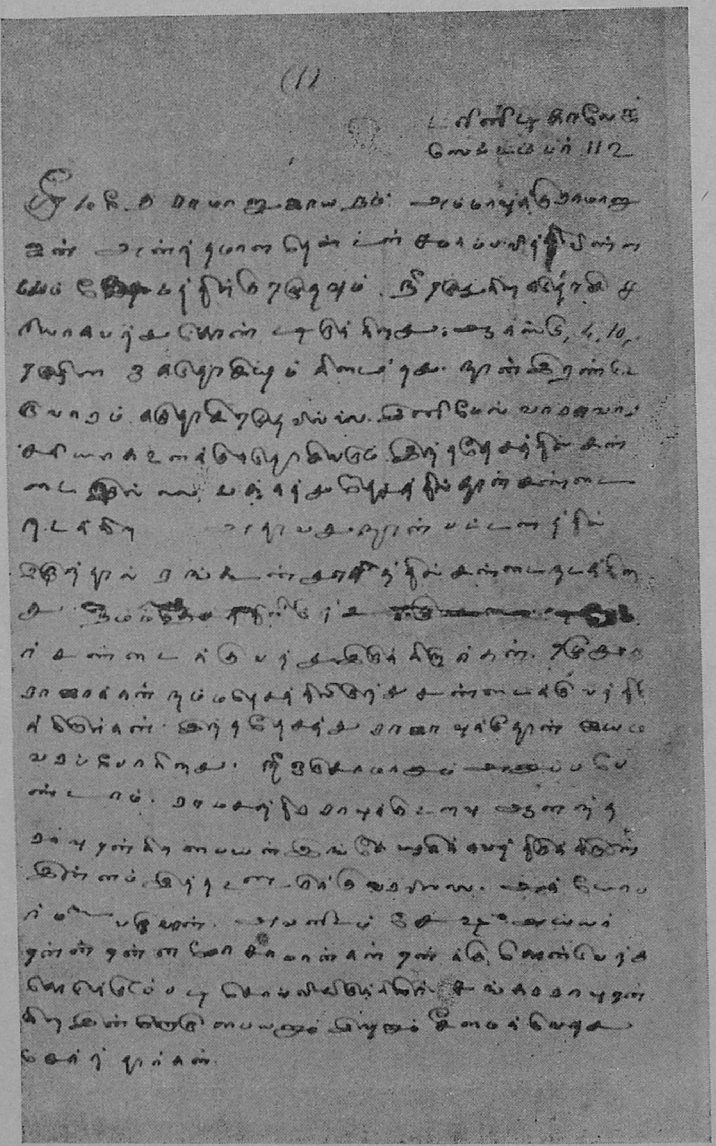
I shall be very much obliged to you if you take so much trouble as to let Sir Francis Spring know all I have written to you. He will make all the necessary arrangements for my further stay here as well as for my voyage to India.

I am ever indebted to you and Sir Francis Spring for your zealous interest in my case from the very beginning of acquaintance.

Yours sincerely

S. Ramanujan

P.S.—I am glad to tell you that I may be conferred upon the Research Degree next March.



5. LETTERS TO HIS PARENTS

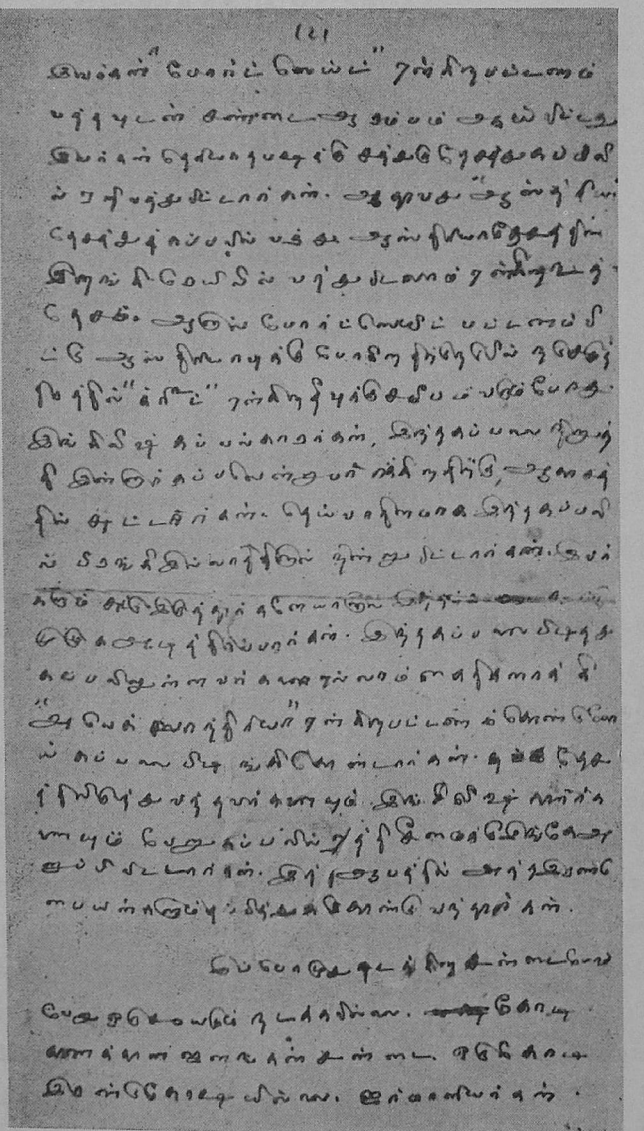
Letter 1

To his mother Komalattammal.

OUTBREAK OF WAR

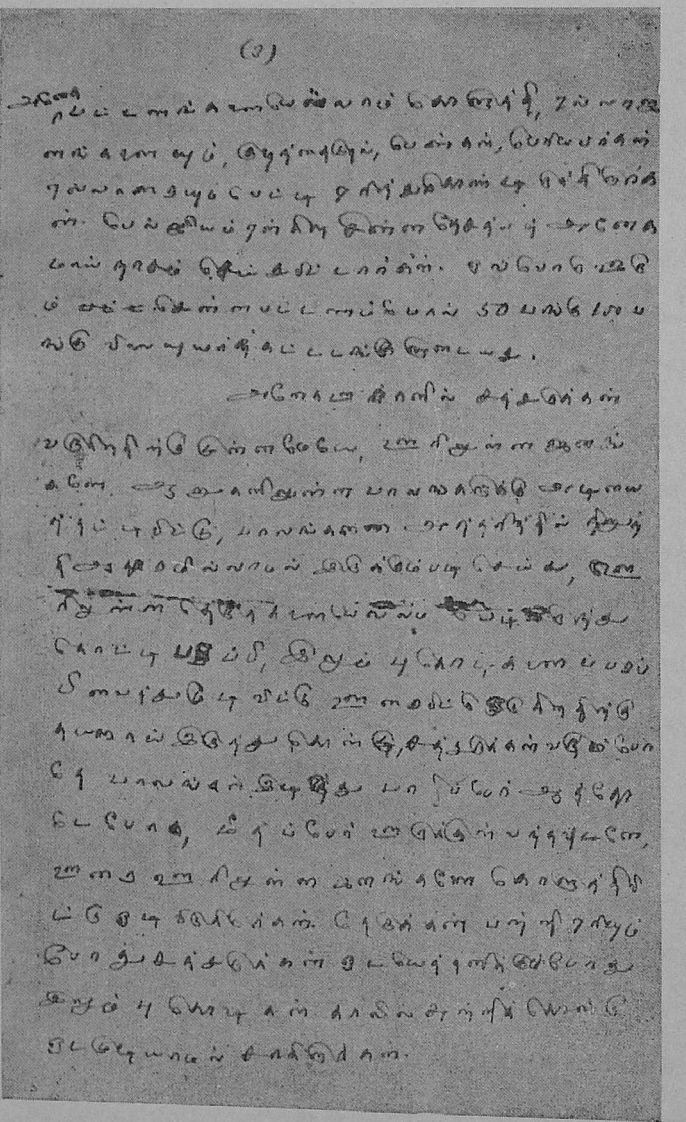
ட்ரினிடி காலேஜ்,
ஸெப்டம்பர் 11எ

ஸ்ரீமதே ராமானுஜாய நம: அம்மாவுக்கு ராமானுஜன் அனந்த மான தெண்டன் சமர்ப்பவித்த விண்ணப்பம். க்ஷேமத்திற்கு எழுதவும். நீ எழுதுகிற கடுதாசி சரியாக வந்துகொண்டிருக்கிறது. ஆகஸ்டு 4, 10, 11 எழுதின 3 கடுதாசியும் கிடைத்தது. நான் இரண்டொரு வாரம் கடுதாசி எழுதவில்லே. இனிமேல் வாராவாரம் சரியாக உனக்கு கடுதாசி வரும். இந்த தேசத்தில் சண்டை இல்லே. பக்கத்து தேசத்தில்தான் சண்டை நடக்கிறது. அதாவது நான் பட்டணத்தில் இருந்தால் ரங்கூன் தூரத்தில் சண்டை நடக்கிறது. நம்ம தேசத்திலிருந்து லக்ஷம் பேர் சண்டைக்கு வந்து இருக்கிறார்கள். எழுநூறு ராஜாக்கள் நம்ம தேசத்திலிருந்து சண்டைக்கு வந்திருக்கிறார்கள். இந்த தேசத்து ராஜாவுக்குதான் ஜயம் வரப்போகிறது. நீ ஒரு சாமானும் அனுப்ப வேண்டாம். ராமசந்திர ராவுக்கு உறவு ஆனந்த ராவு என்கிற பையன் இங்கே வாசிக்க வந்திருக்கிறன். இன்னம் இந்த ஊருக்கு வரவில்லே. அக்டோபர் மீ வருவான். அவனிடம் சேஷு அய்யர் என்ன என்னமோ சாமான்கள் எனக்கு கொண்டுவந்து கொடுக்கும்படி சொல்லியிருக் கிறார். சங்கர ராவு என்கிற இன்னொரு பையனும் இவனும் சீமைக்கு வந்து சேர்ந்தார்கள்.



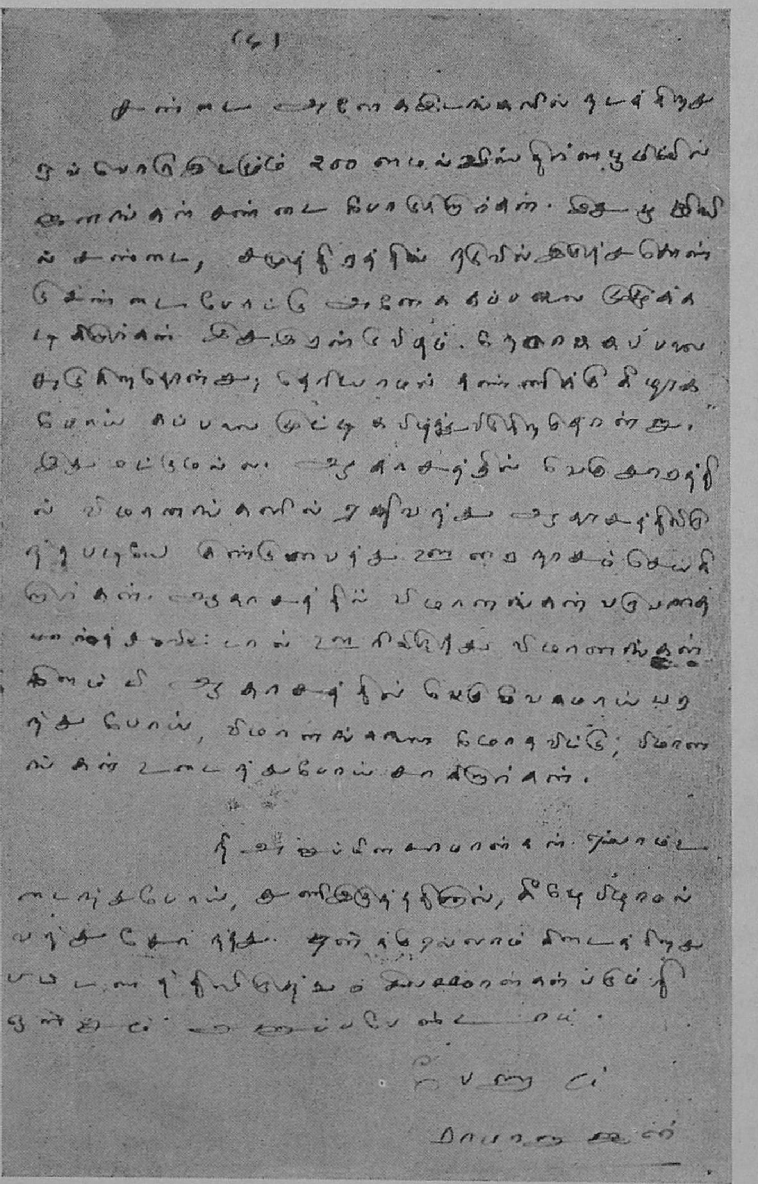
இவர்கள் "போர்ட் ஸெய்ட்" என்கிற பட்டணம் வந்தவுடன் சண்டை ஆரம்பம் ஆய்விட்டது. இவர்கள் தெரியாதபடிக்கு சத்துரு தேசத்து கப்பலில் ஏறி வந்துவிட்டார்கள். அதாவது "ஆஸ்த்ரியர் தேசத்துக் கப்பலில் வந்து ஆஸ்திரியா தேசத்தில் இறங்கி ரெயிலில் வந்துவிடலாம் என்கிற உத்தேசம். ஆனல் போர்ட் ஸெயிட் பட்டணம் விட்டு ஆஸ்திரியாவுக்குப் போகிறதிற்கு நடுவில் நடு சமுத்திரத்தில் "க்ரீட்" என்கிற தீவுக்கு சமீபம் வரும்போது இங்கிலீஷ் கப்பல் காரர்கள், இந்த கப்பலை நிறுத்தி இன்னர் கப்பலென்று பார்க்கிறதிற்கு ஆகாசத்தில் சுட்டார்கள். தெய்வாதீனமாக இந்த கப்பலில் பீரங்கி இல்லாதிதினல் நின்றுவிட்டார்கள். இவர்களும் சுட்டு இருந்தார்களே யானல் இந்தக் கப்பலைச் சுட்டு முழுக அடித்திருப்பார்கள். இந்த கப்பலை பிடித்து கப்பலிலுள்ளவர்களை எல்லாம் கைதிகளாக்கி "அலெக்ஸாந்திரியா" என்கிற பட்டணம் கொண்டுபோய் கப்பலைப் பிடிங்கி கொண்டார்கள். நம்ம தேசத்திலிருந்து வந்தவர்களையும், இங்கிலீஷ்காரர்களையும் வேறு கப்பலில் ஏத்தி சீமைக்கு இங்கே அனுப்பி விட்டார்கள். இந்த ஆபத்தில் அந்த இரண்டு பையன்களும் தப்பித்துக் கொண்டு வந்தார்கள்.

இப்பொழுது நடக்கிற சண்டைபோல் வேறு ஒரு சமயமும் நடக்கவில்லை. கோடிக்கணக்கான ஜனங்கள் சண்டை. ஒரு கோடி இரண்டு கோடியில்லை. ஜர்மானியர்கள்



அனேக பட்டணங்களை யெல்லாம் கொளுத்தி, எல்லா ஜனங்களையும் குழந்தை முதல், பெண்கள், பெரியவர்கள் எல்லாரையும் வெட்டி எரிந்துகொண்டிருக்கிறார்கள். பெல்ஜியம் என்கிற சின்ன தேசத்தை அனேகமாய் நாசம் செய்துவிட்டார்கள். ஒவ்வொரு ஊரும் சென்னை-பட்டணம்போல் 50 பங்கு 100 பங்கு விலை யுயர்ந்த கட்டடங்களுடையது.

அனேக ஊர்களில் சத்துருக்கள் வருகிறதிற்கு முன்னமேயே, ஊரிலுள்ள ஜனங்களே, ஆறுகளிலுள்ள பாலங்களுக்கு அடியைத் தட்டி விட்டு, பாலங்களை அந்தரித்தில் நிறுத்தி ஆதாரமில்லாமல் இருக்கும்படி செய்து, ஊரிலுள்ள தெருக்களை யெல்லம் வெடி மருந்து கொட்டி பரப்பி, இலும்பு கொடிகளைப் பரப்பிவைத்து மூடிவிட்டு ஊரைவிட்டு ஓடுகிறதிற்கு தயாராய் இருந்துகொண்டு சத்துருக்கள் வரும்போதே பாலங்கள் இடிந்து பாதிப்பேர் ஆத்தோடே போக, மீதிப்பேர் ஊருக்குள் வந்தவுடனே, ஊரை ஊரிலுள்ள ஜனங்களே கொளுத்திவிட்டு ஓடி விடுகிறார்கள். தெருக்கள் பற்றி எரியும்போது சத்துருக்கள் ஓட யெத்தனிக்கும்போது இலும்பு கொடிகள் காலில் சுற்றிக்கொண்டு ஓட முடியாமல் சாகிறார்கள்.



சண்டை அனேக இடங்களில் நடக்கிறது. ஒவ்வொரு இடமும் 200 மைல் விஸ்தீர்ண பூமியில் ஜனங்கள் சண்டை போடுகிறார்கள். இது பூமியில் சண்டை, சமுத்திரத்தில் நடுவில் இருந்துகொண்டு சண்டைபோட்டு அனேக கப்பலை முழுக்கடிகிறார்கள். இது இரண்டு விதம். நேராக கப்பலை சுடுகிறதொன்று; தெரியாமல் தண்ணிக்கு கீழாக போய் கப்பலை முட்டி கவிழ்த்து விடுகிறதொன்று. இது மட்டு மல்ல. ஆகாசத்தில் வெகு தூரத்தில் விமானங்களில் ஏறி வந்து ஆகாசத்திலிருந்தபடியே குண்டு வைத்து ஊரை நாசம் செய்கிறார்கள். ஆகாசத்தில் விமானங்கள் வருவதை பார்த்துவிட்டால் ஊரிலிருந்து விமானங்கள் கிளம்பி ஆகாசத்தில் வெகு வேகமாய் பரந்துபோய், விமானங்களை மோதவிட்டு, விமானங்கள் உடைந்துபோய் சாகிறார்கள்.

நீ அனுப்பின சாமான்கள் எல்லாம் உடைந்துபோய், துணி இருந்ததினால், கீழே விழாமல் வந்து சேர்ந்தது. எனக்கு எல்லாம் கிடைக்கிறது. பட்டணத்திலிருந்தும் சில சாமான்கள் வரும். நீ ஒன்றும் அனுப்பவேண்டாம்.

வேணும்

ராமானுஜன்.

Letter 2

To his father Srinivasa Ayyangar.

HOME TO BE KEPT ATTRACTIVE

ட்ரினிடி காலேஜ்,
17 - 11 - 14.

ஸ்ரீமதே ராமானுஜாய நம: அண்ணாவுக்கு ராமானுஜன் அனந்த மான தெண்டன் சமர்ப்பவித்த விண்ணப்பம். க்ஷேமம் க்ஷேமத்திற்கு எழுதவும். நீ எழுதின கடுதாசி வந்து சேர்ந்தது. அதிற்குமுன் திருநாராயணன் எழுதின கடுதாசியும் வந்து சேர்ந்தது. எனக்கு எல்லா ஊருகாயும் இருக்கிறது. எனக்கு பட்டணத்திலிருந்து புளி முதலானது எல்லாம் வருகிறது. நீ ஒன்றும் அனுப்பவேண்டாம். இப்பொழுது நீ அனுப்பி இருக்கிற கூழுவிடாத்தை தவிற வேறு ஒன்றும் அனுப்பவேண்டாம். எனக்கு காலேஜ் சாத்திவிட்டார்கள் போன வாரம்; ஜனவரி மீ நடுவில் திறக்கிறார்கள். நான் சௌக்கியமா யிருக்கிறேன். ஆத்தை பார்வைக்கு நன்றாக இருக்கும்படி வைத்துக் கொள். சாக்கடை முதலானதை எப்போதும் போல் வைத்துக் கொள்ளாதே. கல் தலவரிசை போட்டு சரியாக வைத்துக்கொள். நான் சௌக்கியமாயிருக்கிறேன். நம்ம பக்கத்திலிருந்து வந்த பிள்ளைகள் பக்கத்து காலேஜியில் இங்கே சேர்ந்திருக்கிறார்கள்.

வேணும்

ராமானுஜன்.

6. LETTERS TO PROF. G. H. HARDY

(EXCERPTS)

(1)

To Hardy dated 16-1-'13.

TO HAVE HIS THEOREMS PUBLISHED

. . . . I had no University education but I have undergone the ordinary school course. After leaving school I have been employing the spare time at my disposal to work at Mathematics. . . . . I have made a special investigation of divergent series. . . Very recently I came across a tract published by you, styled *Orders of Infinity,* in page 36 of which I find a statement that no definite expression has been as yet found for the number of prime numbers less than any given number. I have found an expression which very nearly approximates to the real result, the error being negligible. Being poor, if you are convinced that there is anything of value, I would like to have my theorems published. I have not given the actual investigations nor the expressions that I get ; but I have indicated the lines on which I proceed. Being inexperienced, I would very highly value any advice you give me. . . . .

(2)

To Hardy dated 27-2-'13.

TO GET A SCHOLARSHIP

. . . . I have found a friend in you who views my labours sympathetically. This is already some encouragement to me to proceed. . . . To preserve my brains, I want food and this is now my first consideration. Any sympathetic letter from you will be helpful to me here to get a scholarship either from the University or from the Government. . . .

I find in many a place in your letter rigorous proofs are required and you ask me to communicate the methods of proof. . . . . I told him that the sum of an infinite number of terms of the series $1+2+3+4+\ldots = -\frac{1}{12}$ under my theory. If I

tell you this you will at once point out to me the lunatic asylum as goal. . . . . What I tell you is this. Verify the results I give and if they agree with your results you should at least grant that there may be some truths in my fundamental basis. . . . .

(3)

To Hardy dated 17-4-'13.

NONE TO APPRECIATE MY METHOD

(Read Hardy's letter to Ramanujan on p. 56)

. . . . I am a little pained to see what you have written. . . . . I am not in the least apprehensive of my method being utilized by others. On the contrary my method has been in my possession for the last eight years and I have not found anyone to appreciate the method. As I wrote in my last letter I have found a sympathetic friend in you and I am willing to place unreservedly in your hands what little I have. It was on account of the novelty of the method I have used that I am a little diffident even now to communicate my own way of arriving at the expressions I have already given. . . .

I am glad to inform you that the local University has been pleased to grant me a scholarship of £ 60 per annum for two years and this was at the instance of Dr. Walker, F.R.S., Head of the Meteorological Department in India, to whom my thanks are due. . . . . I request you to convey my thanks also to Mr. Littlewood, Dr. Barnes, Mr. Berry and others who take interest in me. . . . .

(4)

To Hardy, dated 12-1-'20.

DISCOVERY BEFORE DEATH

. . . . I am extremely sorry for not writing you a single letter up to now. . . . . I have discovered very interesting functions recently which I call 'Mock theta-functions". Unlike the False theta-functions (studied partially by Prof. Rogers in his interesting paper) they enter into mathematics as beautifully as the ordinary theta-functions. . . . . .

7. A LETTER TO THE REGISTRAR, UNIVERSITY OF MADRAS

(An excerpt)

Dated 11-1-'19.

DESIRE TO HELP POOR BOYS

. . . . . I feel, however, that, after my return to India, which I expect to happen as soon as arrangements can be made, the total amount of money to which I shall be entitled will be much more than I shall require. I should hope that, after my expenses in England have been paid, £ 50 a year will be paid to my parents and that the surplus, after my necessary expenses are met, should be used for some educational purpose, such in particular as the reduction of school-fees for poor boys and orphans and provision of books in schools. No doubt it will be possible to make an arrangement about this after my return.

I feel very sorry that, as I have not been well, I have not been able to do so much mathematics during the last two years as before. I hope that I shall soon be able to do more and will certainly do my best to deserve the help that has been given me.

WHAT THEY DID AND SAID

1. E. W. Middlemast
2. Griffith to Francis Spring
3. Bourne to Francis Spring
4. Graham to Griffith
5. Hill to Griffith
6. Walker to Dewsbury
7. Hardy to Ramanujan
8. Neville to Dewsbury
9. Littlehailes to Dewsbury
10. Francis Spring to Cotterell
11. Barnes to Dewsbury
12. Francis Spring to Dewsbury
13. Hardy to Subramanian
14. Hardy to Dewsbury

1. E. W. MIDDLEMAST

A RECOMMENDATION LETTER TO RAMANUJAN

I can strongly recommend the applicant. He is a young man of quite exceptional capacity in Mathematics and especially in work relating to numbers. He has a natural aptitude for computation and is very quick at figure work. Though he has had no experience of statistical work, I am confident that he can pick up the details in a very short time.

E. W. Middlemast,

Ag. Principal & Prof. of Maths.,
Presidency College.

Madras
21-9-1911.

2. GRIFFITH TO SIR FARNCIS SPRING

TO KEEP RAMANUJAN HAPPILY EMPLOYED

GOVT. OF MADRAS

College of Engineering,
Madras,
12-11-1912.

Dear Sir Francis,

You have in your office as an Accountant on Rs. 25, a young man named S. Ramanujan who is a most remarkable mathematician. He may be a very poor Accountant, but I hope you will see that he is kept happily employed until something can be done to make use of his extraordinary gifts. I am writing to one of the leading mathematics professors at home about him and sending copies of some of Ramanujan's papers and results.

Our Math. Professor here says that very few people could follow or criticise the work. It is of course far beyond my scope, but I happen to know who is at work in the same line at home, and I hope to get instructions as to what this fellow ought to do.

If there is any real genius in him, he will have to be provided with money for books and with leisure, but until I hear from home, I don't feel sure that it is worthwhile spending much time or money on him.

Yours sincerely,

C. L. T. Griffith.

3. A. G. BOURNE TO SIR FRANCIS SPRING

TO SEND RAMANUJAN TO MIDDLEMAST OR GRAHAM

DIRECTOR OF PUBLIC INSTRUCTION, MADRAS

The Old College,
Nungambakkam,
14th Nov., 1912.

My dear Spring,

I never heard of Ramanujan — Littlehailes is now away on the west coast — Middlemast is at the Presidency College and Graham at the Fort. I should certainly send him to see one or both of these. I don't like the suggestion that access to a library would ruin any genius; it favours of the middle ages and if his genius is so elusive or mysterious that good mathematicians possessed besides of much common sense cannot recognise and appreciate it even if it carries them beyond their scope, I should doubt its existence.

Yours sincerely,

A. G. Bourne.

4. W. GRAHAM TO C. L. T. GRIFFITH

A CALCULATING BOY

ACCOUNTANT GENERAL, MADRAS

Fort St. George,
27-11-1912.

Dear Griffith,

Ramanujan came to see me today. He seems to have done a great deal of work in one particular branch of Calculus and from the way he has done it he must have considerable mathematical aptitude. He has read no mathematics at all except Calculus apparently and it is possible his brains are akin to those of the calculating boy.

I should say however, that if he had had the training, mathematics of a certain kind — Algebra, Differential Equations, Hydrodynamics and Calculus, i.e. pure theory and development of Algebraic functions — juggling with symbols it has been called — would have become very easy to him.

Whether he has the stuff of great mathematicians or not I do not know. He gave me the impression of having brains.

His original work is an interesting development of work already done — but interesting only to the purist.

However I am not the best qualified to judge.

Middlemast's opinions would be of value.

Yours sincerely,
W. Graham.

5. M. J. M. HILL TO C. L. T. GRIFFITH

FALLEN INTO PITFALLS

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE

Telephone No.
3979 Central

Gower Street, London, W.C.,
3-12-1912.

Dear Professor Griffith,

Your letter of the 12th Nov. reached me a day or two ago, and I write now in order not to miss the mail.

I am sorry that the twenty years, which have passed since you were with me, prevent me from remembering anything about you but your name.

As soon as I can get more time I will look into Mr. Ramanujan's paper about the Bernoulli's Numbers, but I cannot do this during term time.

One thing however is clear.

Mr. Ramanujan has fallen into the pitfalls of the very difficult subject of Divergent series.

Otherwise he could not have got the erroneous results you send me

$$1 + 2 + 3 + \&c = -\tfrac{1}{12}$$
$$1^2 + 2^2 + 3^2 + \&c = 0$$
$$1^3 + 2^3 + 3^3 + \&c = \tfrac{1}{240}$$

All the 3 series have infinity for their sums. The book which will be most useful to him is Bromwich's Theory of Infinite Series, published by the Cambridge University Press (or Macmillan).

Next as to the publication of papers, if Mr. Ramanujan will write out his ideas carefully and clearly on some one subject and send them to the Secretary of the London Mathematical Society, London W., his paper will be referred to a Mathematician, who is an expert in the particular department of Mathematics with which his paper deals. If it is found to be new and worthy of publication, it will be printed in the Proceedings of the Society at the expense of the Society and 25 free copies will be sent to the author.

But he should be very careful with his Mss. It should be very clearly written, and should be free from errors; and he should not use symbols which he does not explain (e.g. in his printed paper he should have explained on page what the symbols C_1, C_2, C_3 &c .. mean; § 12 to which he refers on p. 5 does not apparently exist. He passes from § 11 to § 13.

What you say about him personally is very interesting and I hope something may come of his work.

I will write later when I have had more time to look into his paper.

I remain,

With kind regards.

Yours sincerely,

M. J. M. Hill.

6. GILBERT T. WALKER TO FRANCIS DEWSBURY

COMPARABLE TO A MATHEMATICS FELLOW OF CAMBRIDGE

Madras,
26th Feb., 1913.

To

The Registrar of the
University of Madras.

Sir,

I have the honour to draw your attention to the case of S. Ramanujan, a clerk in the Accounts Department of the Madras Port Trust. I have not seen him, but was yesterday shown some of his work in the presence of Sir Francis Spring. He is, I am told, 22 years of age and the character of the work that I saw impressed me as comparable in originality with that of a Mathematics fellow in a Cambridge College; it appears to lack, however, as might be expected in the circumstances the completeness and precision necessary before the universal validity of the results could be accepted. I have not specialised in the branches of pure mathematics at which he has worked, and could not therefore form a reliable estimate of his abilities, which might be of an order to bring him a European reputation. But it was perfectly clear to me that the University would be justified in enabling S. Ramanujan for a few years at least to spend the whole of his time on mathematics without any anxiety as to his livelihood, and I would suggest that they should communicate with Mr. G. H. Hardy, Fellow of Trinity College, Cambridge with whom he is already in correspondence and assure Mr. Hardy of their interest in him.

I have the honour to be
Sir
Your most obedient servant
Gilbert T. Walker,
Director General of Observatories.

7. HARDY TO RAMANUJAN

(EXCERPTS)

VERY REMARKABLE WORK DONE

Trinity College
Cambridge
26 March 1913

Dear Mr. Ramanujan,

Since I wrote to you last I have heard from Mr. Littlewood to whom I sent your last letter to me, and I have considered further some of your results.

* * * *

The theory of divergent series leads, as a rule, to correct results. The important exceptions to the general rule lie in the theory of prime numbers, the most difficult of all branches of pure mathematics. If, as seems to me probable, it has led you here into mistakes, my view that what you have done is very remarkable would not in any way be shaken : the results you give concerning continued fractions and Elliptic functions are enough in themselves to show it (assuming as I am quite willing to do, that they are correct).

Mr. Littlewood suggested to me also that your unwillingness to give proofs was probably due to apprehensions as to the use I might make of your results. Let me put the matter quite plainly to you. You have in your possession now 3 long letters of mine, in which I speak quite plainly about what you have proved or claim to be able to prove. I have shown your letters to Mr. Littlewood, Dr. Barnes, Mr. Berry, and other mathematicians. Surely it is obvious that, if I were to attempt to make any illegitimate use of your results, nothing would be easier for you than to expose me. You will, I am sure, excuse my stating the case with such bluntness. I should not do so if I were not genuinely anxious to see what can be done to give you a better chance of making the best use of your obvious mathematical gifts.

What I should like above all is a definite proof of some of your results concerning continued fractions . . . . and I am quite sure that the wisest thing you can do, in your own interests, is to let me have one as soon as possible.

I am
Yours very sincerely
G. H. Hardy.

8. HARDY TO RAMANUJAN

(EXCERPTS)

MAKE THE ACQUAINTANCE OF NEVILLE

Dear Mr. Ramanujan,

. . . . your outline of the proof is too incomplete for me to pronounce a confident opinion, but it has all the appearance of being right, and it looks to me a very remarkable piece of work.

If you will send me your proof *written out completely* (so that it is easy to follow), I will (assuming that I agree with it — of which I have very little doubt) try to get it published for you in England. Write it in the form of a paper . . . . giving a full proof of the principal and most remarkable theorem, ...

* * * *

All this is correct. You infer (correctly) . . . . You give no proof : but the result is true.

You then infer that . . . . There is no theorem I know of which warrants such a conclusion : and I do not believe it to be a correct inference (though I cannot offhand construct an example to the contrary).

* * * *

Perhaps you have proved this : anyhow I am prepared to believe it.

So I can make nothing of this step . . . Mr. Littlewood and I have proved *this* . . . . But even here the proof is exceedingly difficult. I can see how your result is *suggested* : but to get a rigid proof is quite a different matter.

You will see that, with all these gaps in the proof, it is no wonder that the result is wrong.

The truth is that the theory of primes is full of pitfalls, to surmount which requires the fullest of trainings in modern

rigorous methods. This you are naturally without. I hope you will not be discouraged by my criticisms. I think your argument a very remarkable and ingenious one. To have proved what you claimed to have proved would have been about the most remarkable mathematical feat in the whole history of mathematics.

As regards your work on continued fractions and elliptic functions — here the difficulties to be surmounted are of an entirely different kind, and I have no reason at all to suppose that your results are not perfectly correct. I hope you will adopt the suggestions I made at the beginning.

Try to make the acquaintance of Mr E H Neville, who is now in Madras lecturing. He comes from my college and you might find his advice as to reading and study invaluable.

Well, you will see from the length of this letter that answering yours is not entirely trifling business and that I have some excuse if I have delayed.

Believe me

Yours very sincerely

G. H. Hardy.

9. E. H. NEVILLE TO DEWSBURY:

THE DISCOVERY OF THE GENIUS OF RAMANUJAN

Madras,
28-1-1914.

Dear Mr. Dewsbury,

The discovery of the genius of S. Ramanujan of Madras promises to be the most interesting event of our time in the mathematical world. From the first results which he communicated, the mathematicians of Cambridge at once believed that he had uncommon ability, and the effect of personal acquaintance with the man and conversation as to his methods has been in my own case to replace that belief by certainty. At the same time the importance of securing to Ramanujan a training in the refinements of modern methods and a contact with men who know what range of ideas have been explored and what have not cannot be over estimated.

Unassisted by knowledge of contemporary achievements in Europe, Ramanujan has among other things developed two of the most fruitful and subversive theories which have been studied there during the last ten or fifteen years, theories which still are to be found only in contributions to the various scientific journals and are not admitted to current text books and treatises. Who can say, had his power not been employed in the invention of these tools, what other machinery he might by now have built

or what uses unnoticed by the others he might have observed for the processes themselves ? Inspiration is not confined to the making of a single discovery, and it is always a loss to science when two men do the same work.

On the other hand, we have learnt in Europe what Ramanujan has not yet discovered, that the more powerful a method may be the more carefully it must be used. It is often thought that mathematical genius includes an instinct for the avoidance of fallacies, but it is not true to say more than that genius includes a potential faculty of detecting danger. A trained mathematician is often aware intuitively when special care is necessary, but that this intuition, which no English analyst would trust his reputation, may be developed in a man of genius, the fact that Ramanujan himself has sent to Cambridge a number of demonstrably false results proves conclusively. At present all his results must necessarily be regarded with some suspicion till they have been independently obtained, a state of affairs which must not continue.

I see no reason to doubt that Ramanujan himself will respond fully to the stimulus which contact with Western mathematicians of the highest class will afford him. In that case his name will become one of the greatest in the history of mathematics, and the University and City of Madras will be proud to have assisted in his passage from obscurity to fame.

Yours sincerely,

E. H. Neville.

10. LITTLEHAILES TO DEWSBURY

FIRST RESEARCH STUDENT IN MATHEMATICS

The Observatory,
Nungambakkam,
Madras,
29 1-1914.

My dear Dewsbury,

I venture to request that you will be so good as to place before the Syndicate of this University a request that I have to make regarding Ramanujan, at present research student in Mathematics.

It is that he be granted by this University a scholarship of about £ 250 (sterling) together with a grant of about £ 100 in order to enable him to proceed to Cambridge.

Ramanujan is a man of most remarkable mathematical ability, amounting I might say to genius, whose light is metaphorically hidden under a bushel in Madras.

He has, I understand, passed the Matriculation Examination from the High School, Kumbakonam, but after beginning his Intermediate College course, he fell ill and did nothing for a couple of years. Subsequently he obtained an appointment as a clerk in the Office of the Madras Port Trust and was last year granted a Research Studentship in Mathematics.

He is now 26 years of age and has for the last 10 years made the study of Mathematics his special hobby, though he has had access to no memoirs or modern mathematical treatises until comparatively recently when he came to Madras. He has, nevertheless, developed his subject to such a remarkable degree as to leave no trace of doubt that he has most exceptional mathematical genius and for this reason it is considered most desirable that he should be granted the financial means which will enable him to proceed to Cambridge where he will have ready access to modern

mathematical literature, advice and criticism which is not to be obtained in this country and the privilege of absorbing and in turn reacting upon the mathematical atmosphere for which Cambridge is so renowned. He has already formulated theorems of a most comprehensive character dealing with some of these patterns of mathematics that are on the boundaries of our present day development and treatment of the subject and it is greatly to be desired that he be given the opportunity of discussing his methods and results with some of the leading mathematicians of Europe and of having them published in the leading mathematical periodicals. I have little or indeed no hesitation in stating my opinion that if he continued in the future to develop as he has done in the past and subjects his work and methods to the test of modern mathematical criticism, then it will be only a matter of a delay of two or three years before he will be called upon to fill a chair of Mathematics at some university.

It was formally suggested that Ramanujan should go to Cambridge but he was unwilling to leave India, and it is only within the last fortnight that he has been persuaded to agree to leave India. He has been in correspondence with certain Cambridge Mathematicians of late, and Mr. Hardy, one of the finest of the modern Cambridge school has only recently expressed his keen disappointment at Ramanujan's refusal to leave India for Cambridge. But now that he has been persuaded to put aside his prejudices against travel, the University of Madras is afforded a unique opportunity for the promotion of research by granting — if they can and will — such financial aid as will enable Ramanujan to proceed to Cambridge.

It is probably necessary to mention that he is not overburdened with this world's goods being but passing rich on Rs. 50 per mensem.

Mr. Neville tells me that he has already forwarded to you a memo dealing with Ramanujan; so it is unnecessary to state more than I have done. But in this case there is any question likely to arise regarding his treatment at Cambridge, I should say that we have it on Mr. Neville's authority that Trinity College will do everything in their power to aid Ramanujan and it is even possible — though we cannot at present reckon on it — that they will subsequently give him some financial assistance.

I therefore recommend that this University grant Ramanujan a scholarship of the value of £ 250 per annum for one year, to

be possibly extended in whole or in part for a second year on receipt of a report from the authorities of Trinity College, Cambridge, and in addition give him a sum of £ 100 which will be necessary for his passage to England and initial outfit.

Mr. Neville, who leaves India on March 14th, would be willing to take him to Cambridge provided a passage can be obtained in the same boat as that in which he is travelling ; but if that is not possible then he would like Ramanujan to leave at the earliest possible date so that he may reach England before the end of the May term.

I trust that the Syndicate will be able to grant this scholarship which promises to bring credit on this University as being one of the foremost in the promotion of research and advancement of knowledge.

I am,

Yours sincerely,

Littlehailes.

11. SIR FRANCIS SPRING TO C. B. COTTERELL

RECOMMENDATION TO LORD PENTLAND, GOVERNOR OF MADRAS

Madras,
5th Feb., 1914.

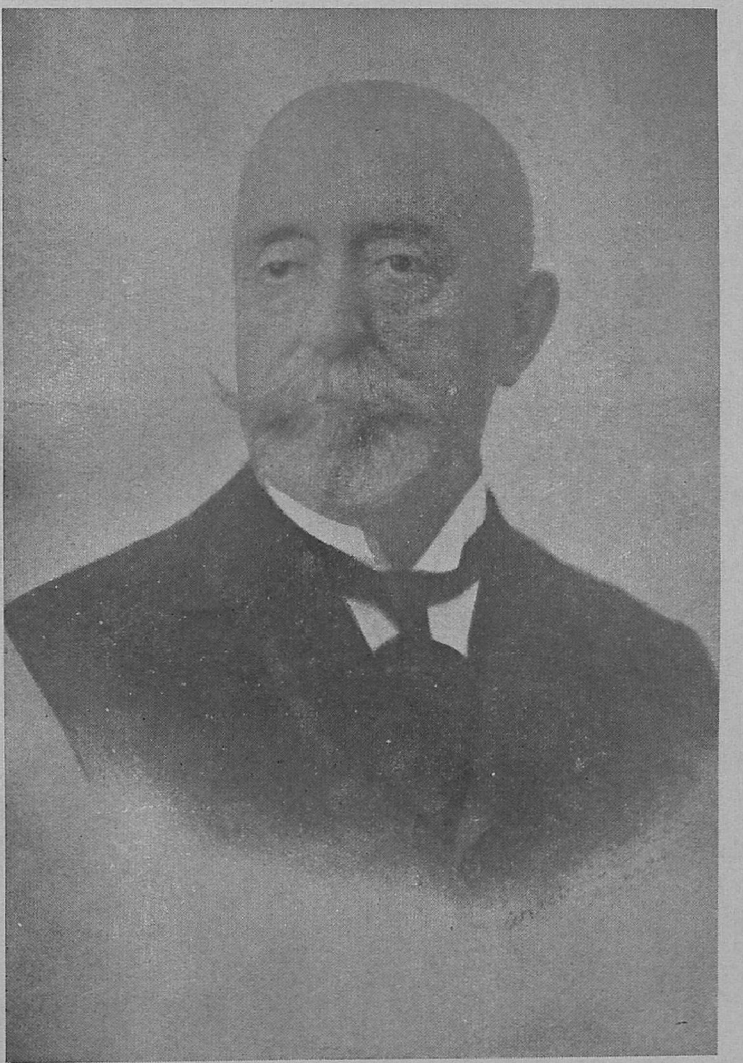
My dear Cotterell,

If I understand right, His Excellency * has the Educational portfolio. So I am anxious to interest him in a matter which I presume will come before him within the next few days — a matter which under the circumstances is, I believe, very urgent. It relates to the affairs of a clerk of my office named S. Ramanujan, who, as I think His Excellency has already heard from me, is pronounced by very high mathematical authorities to be a Mathematician of a new and high, if not transcendental, order of genius.

A few months ago the Madras University gave S. Ramanujan a scholarship to enable him to fill certain gaps in his education which operated to prevent his conveying his conceptions to the outside world. Meanwhile during the last 8 or 9 months various Mathematicians in the first rank in Cambridge, Simla and Madras have had before them selections from his work and have pronounced upon them in terms of the very highest eulogy.

Just now, as probably His Excellency is aware, a Mr. Neville, who, I think, is a Senior Wrangler and a Fellow of Trinity, Cambridge, has been in Madras giving a series of lectures on certain phases of the Higher Mathematics to Honours students and others interested. Under a mandate from Cambridge, he has interested himself greatly in Ramanujan and there is every reason to hope that he may be persuaded to go to Cambridge for a year or two so that under expert guidance not

* Lord Pentland.



SIR FRANCIS SPRING, Chairman, Madras Port Trust, who did his best to get Ramanujan a place deserving his mathematical gifts.

The Port Trust Office, Madras where Ramanujan worked as a clerk
(Now it has moved to its new premises near Fort St. George)

only may the fruits of his genius be given to the world but also we may hope, his own fame, future usefulness and personal prosperity may be secured — matters probably quite impossible if he remained in a backwater like Madras for the rest of his life.

I now come to the point where His Excellency may perhaps be able to interfere with advantage. Last evening I learnt from Mr. Littlehailes and others that the University Syndicate had decided, subject to sanction of Government, to set aside a sum of Rs. 10,000 in order to secure Ramanujan's visit to England for a couple of years. Messrs. Littlehailes and Neville begged me to intercede with His Excellency with a view to the speedy confirmation of this action of the University Syndicate. But I wish to make it quite clear that I write under no mandate from the Syndicate but merely as a private individual interested in my own employee, Ramanujan, as well as in Mathematics.

Mr. Arthur Davies will doubtless arrange for the voyage to England and that Ramanujan's orthodoxy may be maintained unimpaired. Mr. Neville assures me that he will meet him on his arrival in London and conduct him personally to Cambridge and that when there he will interest himself personally in his welfare, generally and in all matters of Brahman orthodoxy, so that he may return to India without any loss of the esteem of his caste men.

I myself am very far from being Mathematician enough to express adequately what has been said to me by several who are fully qualified to express an opinion on the subject of the potential value of the science of the new line of thought in which Ramanujan's investigations lie. I am assured however by those who ought to know what I am talking about that they may conceivably be epoch-making and as such well worthy of financial support at the hands of the Madras University.

Needless to say Prof. Hardy and other high Mathematicians may be trusted to give Ramanujan the fullest credit in the scientific world for his work. My reason for saying anything so obvious as this is that I am told that certain of his Indian friends have been suggesting to him that the scientists' of England desire is to steal his ideas — obviously an utterly impossible suggestion with men of their class.

Yours sincerely,

Francis J. E. Spring.

12. E. W. BARNES TO DEWSBURY

HOPES JUSTIFIED

Trinity College,
Cambridge,

Nov. 8, 1915.

Dear Sir,

The work and progress of Mr. S. Ramanujan is excellent. He is entirely justifying the hopes entertained when he came here. There can be no doubt at all that his scholarship should be extended until, as I confidently expect he is elected to a Fellowship at the College. Such an Election I should expect in Oct. 1917.

Yours faithfully,

E. W. Barnes,
Fellow and Tutor of Trinity College.

13. SIR FRANCIS SPRING TO DEWSBURY

UNINTERRUPTED CONTINUANCE OF STUDIES

Madras Port Trust,
Chairman's Office,
15th Dec., 1915.

The Registrar,
Madras University,
Senate House,
Madras.

Dear Sir,

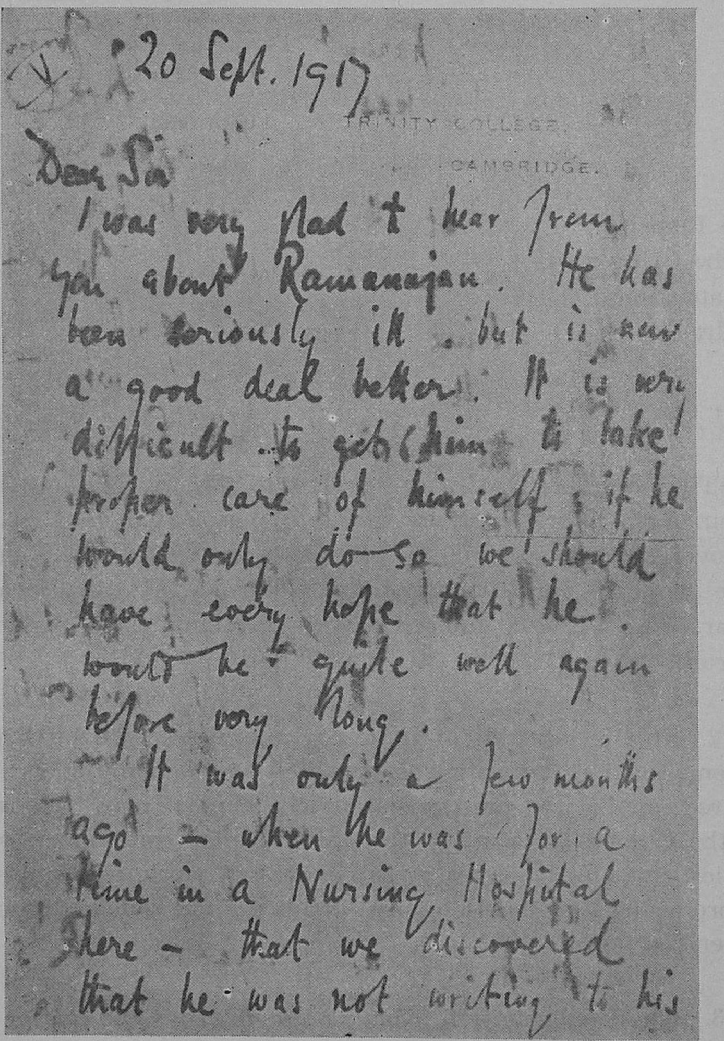
The accompanying papers refer to Mr. S. Ramanujan, in whom I am interested if for no other reason than that he was discovered while working as a clerk in my office. The papers have reached me from my office Manager Mr. S. Narayana Aiyar, M.A., L.T., who himself a good mathematician, was chiefly instrumental in bringing Mr. Ramanujan into notice.

2. In the interests of India's reputation, as the birth place of some good mathematicians of which Mr. Ramanujan is, I am assured, one of the most remarkable I hope it may be possible for the University to insure the uninterrupted continuance of his studies, but chiefly of his original research work, at Cambridge, by promising him the enjoyment of his present scholarship up to the end of March 1918.

3. The syndicate will, I have no doubt, give the matter best consideration.

Yours faithfully,

Francis Spring.



20 Sept. 1917

TRINITY COLLEGE,
CAMBRIDGE.

Dear Sir

I was very glad to hear from you about Ramanujan. He has been seriously ill, but is now a good deal better. It is very difficult to get him to take proper care of himself; if he would only do so we should have every hope that he would be quite well again before very long.

It was only a few months ago – when he was for a time in a Nursing Hospital there – that we discovered that he was not writing to his

14. HARDY TO SUBRAMANIAN

RAMANUJAN NOT WRITING TO HIS PEOPLE

20th Sept. 1917

Trinity College,
Cambridge.

Dear Sir,

I was very glad to hear from you about Ramanujan. He has been seriously ill but is now a good deal better. It is very difficult to get him to take proper care of himself; if he would only do so we should have every hope that he would be quite well again before very long.

It was only a few months ago — when he was for a time in a Nursing Hospital here — that we discovered that he was not writing to his

people nor, apparently, hearing from them. He was very reticent about it, and it appeared to us that there must have been some quarrel. As at that time he was really very ill indeed I wrote (on the advice of Mr Sundaram of Merton College, Oxford) to Mr R Ramachandra Rau, Collector, Madras. It would be a good thing if you could communicate with him. But it is important to let him know that the prospects as regards R's

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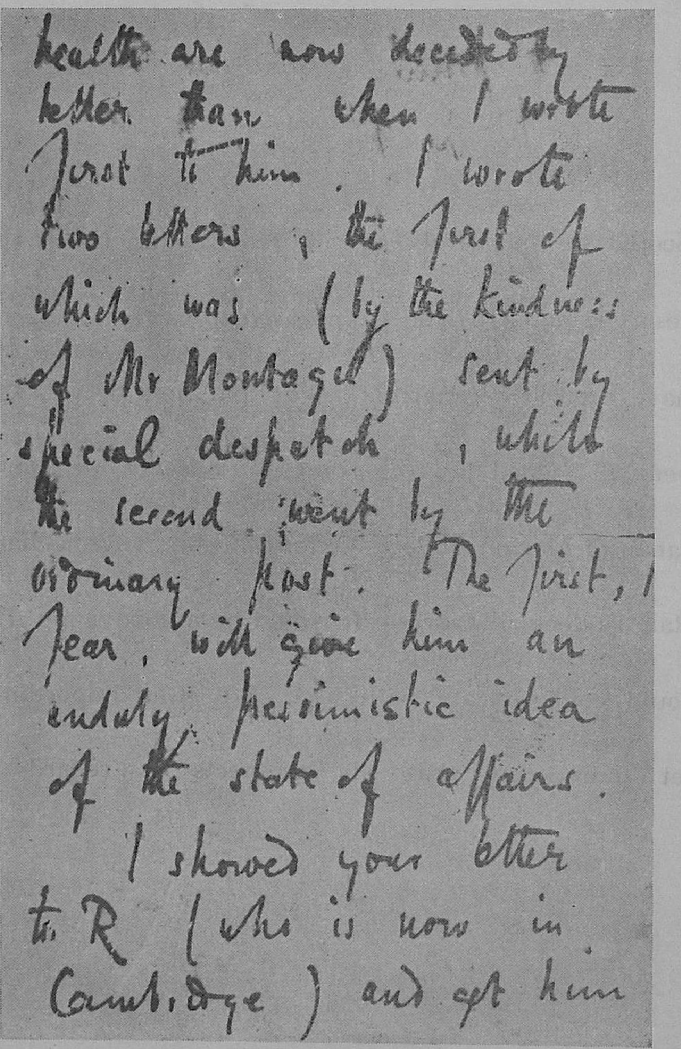

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better than when I wrote
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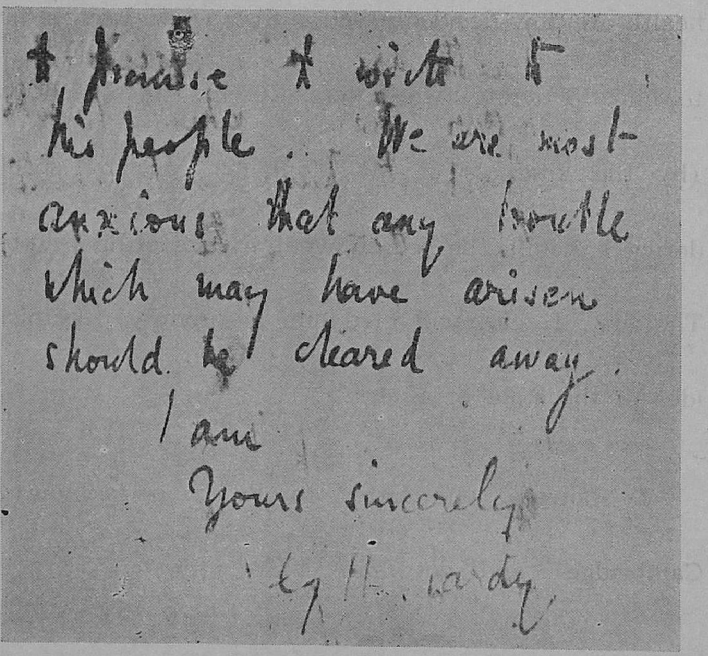


† Francis † write † his people. We are most anxious that any trouble which may have arisen should be cleared away.

I am

Yours sincerely

E. H. Hardy

to promise to write to his people. We are most anxious that any trouble which may have arisen should be cleared away.

I am

Yours sincerely,

G. H. Hardy.

15. HARDY TO DEWSBURY

RAMANUJAN'S RETURN WITH A SCIENTIFIC STANDING AND REPUTATION

Trinity College,

Cambridge,

26-11-1918.

Dear Sir,

I have been meaning for some days to write to you again about Ramanujan but have been prevented by stress of work. I think it is now time that the question of his temporary return to India and of his future, generally, should be reconsidered.

There is at last, I am profoundly glad to say, a quite definite change for the better. I think we may now hope that he has turned the corner, and is on the road to a real recovery. His temperature has ceased to be irregular, and he has gained nearly a stone in weight. The consensus of medical opinion is that he has been suffering from some obscure and only partially diagonised source of blood poisoning, which has now dried up : and that it is reasonable to expect him to recover his health completely and if all goes well fairly rapidly. He would even now be almost fit to make the journey if accompanied by a careful friend. Moreover, the other reasons which made his continuous stay in England, desirable (his candidature for the Royal Society for a Fellowship) have now ceased to have importance.

At various times we have felt considerable anxiety about his mental state. I do not think there is really anything seriously amiss with it. But the long illness, and spells of comparative solitude have undeniably had an effect and he has been subject to fits of depression and been difficult to manage. This (with a man of his rather nervous temperament and abnormal quickness of mind) is only natural and almost inevitable. But I think that (assuming his physical condition to have been improving as it has lately) a return for a while to his own country would be a very good thing. His tenure of his fellowship is in no way affected. It involves no duties nor any obligations to residence.

He has apparently been approached (with a view to return) directly by several friends. It is possible, I think that the suggestion has not been made in the most tactful way possible at any rate it seems to have turned him rather against the idea of going. My own view is that the suggestion would best be made more or less officially and by letter simultaneously to him and to me. His Fellowship, of course, makes him financially independent (when once he gets well enough to live by himself). But, if I were assured officially (as I have been unofficially) that it is the intention of Madras to make permanent provision for him, in a way which will leave him free to do research and to visit England from time to time, I would support the proposal for his return, and no doubt he would be willing to go.

There has never been any sign of any diminution in his extraordinary Mathematical talents. He has produced less, naturally during his illness but the quality has been the same.

Possibly you would be kind enough to communicate this letter or the substance of it to Mr. Ramachandra Rao, with whom I have corresponded previously about Ramanujan, and who has taken great interest in his welfare. He is, I believe, a Collector in the Government of Madras, unfortunately I cannot lay my hands on one of his letters or any note of his address, at the moment.

His Fellowship is worth £ 250 a year for 6 years. The first payment does not come till Xmas 1919, but it is possible to anticipate some of it. Until Aug. 1918, i.e. through the first 15 months or so of his illness, his Madras Scholarship, Trinity Exhibition and some 80-90 that was raised for him, enabled him to pay his way in spite of hospital medical expenses. During the last few months, he has been in London, he has seen several specialists and his expenses must have been heavy. On the other hand he has, I fancy, a substantial reserve of his own in the bank — his tastes are frugal and he saved a good deal of money during his first few years here.

He will return to India with a scientific standing and reputation such as no Indian has enjoyed before, and I am confident that India will regard him as the treasure he is. His natural simplicity and modesty has never been affected in the least by success — indeed all that is wanted is to get him to realize that he really is a success.

Yours very truly,

G. H. Hardy.

16. HARDY TO DEWSBURY

UNIVERSAL REGRET AMONG EUROPEAN MATHEMATICIANS

New College,

Oxford,

26th May '20.

Dear Sir,

It was a great shock and surprise to me to hear of Mr. Ramanujan's death. When he left England the general opinion was that, while still very ill, he had turned the corner towards recovery; he had even gained over a stone in weight (at one period he had wasted away almost to nothing). And the last letter I had from him (about 2 months ago) was quite cheerful and full of mathematics.

There is a substantial balance in his account at Cambridge (some £ 343, if I remember right), you may remember that there were a few unpaid debts (some £ 30 odd). He sent me, not a cheque, but a form transferring his whole account to me; and I arranged with the Bank to settle the debts and place the balance back to his credit on deposit. (He had no doubt forgotten that there would be substantial payments from Trinity — apart from these the balance would only barely have sufficed to settle the bills — so this action was not so absurd as it seems). In any case I understand that his death invalidates the whole transaction.

In any case there will be a substantial sum for his heirs, about which the bank will write to you — it will presumably be increased by the portion of a year's Fellowship up to his death.

However, these are rather sordid details. There will of course be universal regret among European mathematicians at such a tragedy — his work was just beginning to be known abroad, especially in Germany. Prof. Landau of Gottingen, Prof. Cohus of Berlin were both interested and impressed by it.

Is it possible that Madras would consider the question of publishing the papers in a collected form ? There should be some permanent memorial of so remarkable a genius : and this memorial would certainly be the most appropriate form. It might be possible to get some financial assistance in Cambridge.

For my part, it is difficult for me to say what I owe to Ramanujan — his originality has been a constant source of suggestion to me ever since I knew him, and his death is one of the worst blows I have ever had. There was nothing perhaps more remarkable in him than his persistent modesty. Few Indians would not have had their heads a little bit turned by the praise he had received, but he was too big a man.

I have two letters from relatives which I will forward to you shortly.

I am,

Yours very faithfully,

G. H. Hardy.

REMINISCENCES

C. V. Rajagopalachari, K. S. Viswanatha Sastri, M. Anantharaman,
S. Balakrishna Iyer, N. Govindaraja Iyengar,
K. Sarangapani Iyengar, K. Narasimha Iyengar,
N. Subbanarayanan, C. R. Krishnaswamy Iyer.

M. Patanjali Sastri, T. Srinivasacharya, N. Hari Rao, P. V. Seshu Iyer,
R. Ramachandra Rao, V. Ramaswamy Iyer,
Lord Pentland, M. T. Narayana Iyengar.

K. B. Madhava, R. Gopala Iyer, S. R. Ranganathan,
C. S. Rama Rao Sahib, S. V. Iyer.

E. H. Neville,
K. Ananda Rao.

P. C. Mahalanobis, G. H. Hardy, J. E. Littlewood,
C. P. Snow.

Janaki Ramanujan, S. Tirunarayanan,
R. Srinivasa Iyengar, R. Srinivasan,
T. K. Rajagopalan

"It should be borne in mind that he had access to only one book of Carr's, the mathematical knowledge of which may be said to be of the 1860's. Yet he arrived in England abreast, and often ahead, of contemporary mathematical knowledge. Thus, in a lone mighty sweep, he had succeeded in recreating in his field, through his own unaided powers, a rich half century of European Mathematics. One may doubt that so prodigious a feat had ever before been accomplished in the history of thought."

— *Newman.*

MY ASSOCIATION WITH RAMANUJAN

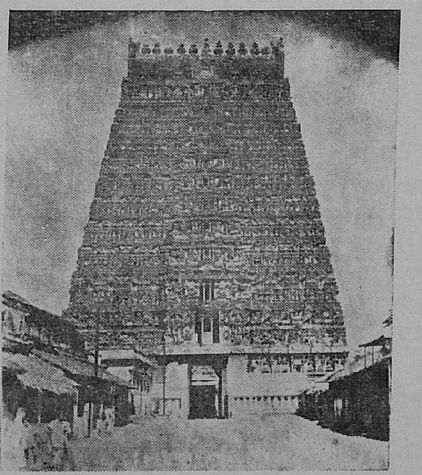
C. V. RAJAGOPALACHARI

Sri C. V. Rajagopalachari, an advocate at Mylapore and son-in-law of Sir K. Srinivasa Iyengar was senior to Ramanujan at school. He gives an absorbing account of the steps he took in co-operation with R. Krishna Rao in securing recognition for Ramanujan's genius.

ANSWER IN HALF A MINUTE

I was born in Kumbakonam in July 1887 and Ramanujan in Erode in December 1887. So we were nearly of the same age. He grew up in Sarangapani Sannidhi Street and I in Periatheru, Kumbakonam, two furlongs away from his house. We were both pupils of the Town High School. In 1902 I was reading in the V form and Ramanujan in the IV form of that school.

In 1902 I began to hear of young Ramanujan's astonishing proficiency in all branches of mathematics, Arithmetic, Algebra, Geometry and Trigonometry and even Hydrostatics. In fact he was very famous for his great mastery of mathematics among the students in the upper forms of the High School. I was not proficient in mathematics either in the school or in the college. But



Sarangapani Temple, Kumbakonam

I as a youngster in my teens was a frequenter of the Sree Sarangapani Temple at Kumbakonam. I came to know Ramanujan personally — not intimately — as another devotee in the same

temple. I became an admirer of Ramanujan because of his fame of having acquired an astonishing knowledge in mathematics. In the Town High School one day in 1902 between 1 and 2 (the recess hour) I said to T. K. Rajagopalan — then reading in the sixth form and known as the most brilliant student in the class — that Ramanujan was a very great mathematician. Rajagopalan gave me a question in a sheet of paper and asked me to give it to Ramanujan to work it out. The question was $\sqrt{x} + y = 7$; $\sqrt{y} + x = 11$; this question could not obviously be tackled by a student in the IV form. I gave the paper to Ramanujan and asked him to work it out. To my astonishment, Ramanujan worked it out in half a minute and arrived at the answer by two steps — and gave the answer as $x = 9$ and $y = 4$. I ran to Rajagopalan and gave the answer. He said that was indeed a marvellous achievement for a IV form student. I became thereafter more closely acquainted with Ramanujan.

INITIATION BY COLLEGE STUDENTS

I remember asking him how he had acquired the great knowledge. He said that he had always an aptitude for it, and that he was initiated in the several branches of the science by two Brahmin B.A. students of Tirunelveli and Trichinopoly districts who were living in his house as paying boarders each paying Rs. 10 per month. They noticed Ramanujan's extraordinary aptitude for mathematics and gave him, when he was between 10 and 12 years of age, elementary introduction in all branches of the science they had specialised in. They soon found that his progress in the subject was rapid, and that in a few months he had mastered the mathematical texts. He was pressing them to get him more advanced texts in the subject from the Kumbakonam College Library, where there was a very unique collection of books in mathematical science. They went on helping him and on his becoming more and more learned in the science they eventually became his pupils and he their coach.

COLLEGE SCHOLARSHIP

From 1900 to 1905, he was progressing steadily in his scholarship and he was making discoveries.

In about 1905 he became a student of the F.A. class in the Kumbakonam College. He sat for the competitive examination for getting the Subramaniam Scholarship. He got about full marks in mathematics but failed in the English composition paper.

University of Madras

CERTIFICATE REQUIRED UNDER SECTION XII. OF THE ACT OF INCORPORATION.

FIRST EXAMINATION IN ARTS.

I hereby certify that Ramanujam S

attended the Junior First Arts Class of the Kumbakonam

College for three-fourths of the number of working days of the first term of 1905

and that his progress and conduct have been satisfactory.

4th July 1905.

Principal.

So he was not given the scholarship. His distressed mother who had a crude exalted notion of her son's having an extraordinary and unrivalled genius in mathematical science went to the Principal C. Nagoji Rao — and strongly but unsuccessfully pleaded that her son was unjustly refused the scholarship and that nobody equalled him in the knowledge of mathematics. The Principal refused firmly but politely that the rules were against the awarding of the scholarship to him because he had miserably failed in the English composition paper. In great financial difficulty Ramanujan continued his studies in the Kumbakonam College for two years but failed in the F.A. Examination. All the lecturers of the College had become aware of his persistent studies and tremendous achievements in the science of mathematics — for there was no mathematical book in the College Library which he had not studied and mastered and utilised in building up his discoveries. But the reaction in their minds was one of sad sympathy at his tragically wasting his time in mathematics — no lecturer ever asked him to explain his theories.

FAMILY INCOME

For some years Ramanujan and I had not intimate contacts. He went to the Pachaiyappa's College at Madras — where also he failed a second time in ihe F.A. Examination. In all these years from 1905 to 1910 his family's chief financial support was from his father's earnings of Rs. 20 per month as a *gumastha** in a

* Clerk.

Sourashtra firm and his mother's income from the leaving of expenses in giving boarding and lodging to two or three student boys in her house at Rs. 10 a student p.m. A number of Brahmana and high caste ladies led by a very pious Brahmana lady Venku Ammal would conduct Bhajana songs in praise of the deity, Sree Sarangapany Swamy. Their Bhajana party would get an income of some Rs. 60 to Rs. 100 per mensem. The leader Smt. Venku Ammal would give some 5 to 10 rupees per mensem to Ramanujan's mother who was a member of the party. Two co-students in the college K. Sarangapani and K. Narasimhan, sons of the great lawyer N. Krishnaswamy Iyengar would help him in his expenses for clothing and for travel and also as their guest. The financial difficulties were very great.

HIS DESPONDENCY

In about the year 1909 or 1910 I met Ramanujan again somewhere — I can't remember where — in the city of Madras. He told me in conversation that he had failed in the examinations, that he had no future and that most unfortunately — his real merit in his scholarship and his researches in mathematics were not appreciated at all. He was most despondent. He told me that he had written to the Mathematical Society and Professor Saldhana of Bombay a great mathematician but he had not got any appreciation. He had his discoveries in his note books. He had the correspondence with eminent mathematicians, but he had to return to Kumbakonam the same night as his friend Sarangan was going to that place and he would buy him a ticket. Then I told him that I would get him personally introduced to Sri R. Ramachandra Rao, the Secretary of the Mathematical Society in a week. When he said that he had no money for his stay in Madras, I offered to give him the expenses and made him stay in Madras.

TURNING POINT IN HIS LIFE

Then I applied myself in a very serious manner to get him introduced to Sri R. Ramachandra Rao. I spoke to his nephew R. Krishna Rao, the grandson of the late Sir T. Madhava Rao who had become my friend in the F.L. class. He agreed to take Ramanujan and me to Sri R. Ramachandra Rao, then the District Collector of Nellore on leave. He gave a patient hearing and kept the papers of Ramanujan for a few days. We went a second time. Sri Ramachandra Rao said that the whole lore in the notebooks was unknown to scholars in mathematics, that there were a large number of theorems worked page after page but that he could make nothing out of all that. He asked us not

to worry him and left us in a hurry. Ramanujan became more frustrated. I persuaded him to stay another day and allow me to try again. A third time I went to Sri Ramachandra Rao and the latter said that Ramanujan might not be a moral fraud but he felt that he was an intellectual fraud. He could not help him in the context. When we left Ramachandra Rao, Ramanujam told me that he had in his possession the communication from Professor Saldhana — in which the latter had appreciated the genuineness of his work. Then I became determined to bring to the notice of Sri Ramachandra Rao, Saldhana's appreciation — and after I read it, Ramanujan and I went to Sri Ramachandra Rao a fourth time. He was at first angry that we went to him but a few minutes later, he asked me how we went to him a fourth time when he was not at all able to appreciate the achievements of Ramanujan whatever they might be. I produced the paper previously sent to Prof. Saldhana — a few examples of Ramanujan's work on the two sides of a half foolscap sheet. The Professor had written in margin that the theorems were all wonderful, that the results were not got step by step but were arrived at quickly from the questions written and that he had no familiarity with the new discoveries. He sympthetically deplored that he was not able to appreciate the work of Ramanujan and help him. When Ramachandra Rao had read this 'new' paper, he came to the view that Ramanujan's work must be examined deeply by other highly eminent mathematicians. He yielded to my pertinacity and told Ramanujan and me that he would help him and that Ramanujan might go to him and see him a few days later on. Thereafter Ramanujan became step by step an intimate friend of Sri R. Ramachandra Rao who helped him with money and with all other forms of tangible help. Sri Ramachandra Rao got Ramanujan introduced to Sir Francis Spring as a very great mathematician — Sir Francis Spring was then the Chairman of the Madras Port Trust and Sri Ramachandra Rao induced the latter to give him a sinecure post of a clerk in the Port Trust Office. Before he had his tuft cut and his head cropped, he came to me to take leave of me in his orthodox costume. He expressed his gratitude to me for my helping him to get introduced to Sri Ramachandra Rao. I gave him a cocoanut and *thamboolam** as a friend and I wished him safe voyage and a successful career. On that day my association with living and speaking Ramanujan ceased.

After he went to England, he wrote to me two or three letters which are not now with me. He rose from eminence to eminence as a very great mathematician and became a Fellow of the Royal Society at the very young age of 31.

---

* betel leaves

HIS FUNERAL

He was in Madras lodged as an invalid. The best medical attention did not improve his condition. A few days before he died I went to see him. I think he recognized me but I did not talk to him. He died in April 1920 in one of Raja T. Namberumal Chettiar's bungalows. As soon as he died the landlord Raja T. Namberumal Chettiar went to Ramachandra Rao's bungalow, next to mine, and intimated the sad event to them and requested the latter's wife and his sons-in-law to arrange for Ramanujan's cremation in a decent way. Sri Rama Rao Sahib, Ramachandra Rao's son-in-law now living and I arranged for funeral rites being done in a fitting manner at about 1 p.m. that day. Sri Raja Namberumal Chettiar, ourselves, five brahmins, his mother and his wife and his brother were there.

HIS PORTRAIT IN THE UNIVERSITY

After he died, in 1920, the University had his portrait unveiled in the Senate House by Sri K. Srinivasa Iyengar, my father-in-law, the then Vice-Chancellor.

This article will not have fully described his great personality, if I do not write a few lines about his great piety, his godliness, his freedom from ambition and avarice, his truthfulness, his humility, his great love for his wife and his unparalleled filial piety. He ever worshipped God Sriman Narayana and his parents most devotedly and with equal devotion. His great desire in his life was to earn the appreciation of mathematicians for his achievements and to lead good, humble, simple Hindu orthodox life. He had no wish to amass great wealth.

His faith in the truth of his grand achievements was absolute and unshakable, when for long years they could not be and were not appreciated.

REMINISCENCES OF MY ESTEEMED TUTOR

K. S. VISWANATHA SASTRI

Sri K. S. Viswanatha Sastri, a lawyer gives among his reminiscenses the interesting experience he had when he took private tuition in Mathematics from Ramanujan.

QUITE ORDINARY IN ENGLISH

It was in the year 1908, when I was in the Kumbakonam College in the Junior F.A. class, I came into contact with S. Ramanujan. Having passed out of the Town High School, Kumbakonam, he joined the Kumbakonam College but soon had to leave it owing to financial troubles. It was then he sought my father late Rao Sahib Sivakumara Sastriar's help when the latter was Assistant Professor of Philosophy, taking English composition classes for the F.A. class. Though highly proficient in mathematics and was highly appreciated by professors like K. S. Patrachariar, and thus mentioned to my father by him, my father to his regret found Ramanujan quite ordinary in his English composition classes. This, Ramanujan had told me, was due to his lack of interest in English. He would clear off mathematics question papers very quickly in a surprisingly small number of pages to the amazement of the examiner.

MY TUTOR

My father, however, was kind enough to put Ramanujan on to my tuition in mathematics for about Rs. 7 a month. He used to go to my residence at Solaiappa Mudali Street every morning from his house in Sri Sarangapani Swami Sannidhi Street and teach me Algebra, Geometry and Trigonometry. He was not like an ordinary tutor guiding one step by step but being precocious, he would carry me off to the regions of Calculus and show me the dizzy heights to which his mind flew. One peculiar feature with him was his utter originality in solving problems so that when I forgot the solution of anyone, once solved by him, and asked for his assistance he used to give me an easier method different from what he gave me first. It was thus his mind was original in the attack of problems. That way he was amazing to me. His association was ever inspiring to me. I had the good fortune of having his tutorship for about two years after which I came to the Presidency College, Madras, taking residence in the Victoria Hostel.

MUCH SOUGHT AFTER IN EXAMINATION TIME

During his tutorship at Kumbakonam, his marriage took place and he was very jubilant over it. He was a man of good girth, very healthy, and of good complexion. He was a man of few words, rather shy. He never wore a shirt but covered his body with a fairly big cloth. He was well known among the student population, was ever resorted to by them during the examination period. He would be instructing the students on the sands of the Cauvery in solving problems likely to appear in the examination.

WHY HE WAS SOMETIMES MISJUDGED

Mr. Ganapathy Subba Aiyar, the well known Mathematics teacher in the Town High School, Kumbakonam, was his admirer and Ramanujan was greatly attached to him. Mr. Satyapuri Rao, the great gymnastic instructor of the Town High School, was his particular friend and it was a familiar sight to see Ramanujan standing as Mr. Satyapuri Rao's solitary friend, when Satyapuri was delivering his frenzied address after the Cauvery bath, standing in the hot sun. To many, this conduct of Ramanujan was utterly strange, and even led people to misjudge him. To my queries to Ramanujan as to how he stood Satyapuri's torrential eloquence, which to us was a mad man's frenzy, Ramanujan used to tell me that in such frenzies, there were many flashes which he only could discern. This association of Ramanujan with Mr. Satyapuri Rao led to a misunderstanding as to Ramanujan's brain-power. But, Ramanujan said he never cared for what people thought about this. This way Ramanujan suffered a good deal in general public estimation but those who knew Ramanujan never thought ill of this. But such were few. And this led to a tardy recognition of Ramanujan's powers by the public at large.

IN SEARCH OF TUITIONS

I moved to Madras in the beginning of 1910 to join the Presidency College, and took my lodging in the Victoria Hostel. Very soon after, Ramanujan himself, came to Madras in search of employment. He went over to me straight and stayed with me as my mate. His purpose was to get employed as a tutor in Mathematics to students and thus eke out his livelihood. His shyness stood in the way of his going about and seeing people for the purpose, but luckily for him there were many Kumbakonians here who were his friends ready to help him. He went about every morning to see friends and get tutorship. But he was not quite successful.

For many days, he was my guest in the hostel. During nights, he used to bemoan his wretched condition in life and when I encouraged him by saying that being endowed with a valuable gift he need not be sorry but only had to wait for recognition, he would reply that many a great man like Galileo died in inquisition and his lot would be to die in poverty. But I continued to encourage him by telling him that God, who is great, would surely help him and he ought not to give way to sorrow.

SINGARAVELU MUDALIAR'S ADVICE

For sometime he took up lodging at Summer House in Swamy Pillai Street, in Triplicane and was messing in a hotel. During this period, he paid his respects to Sri Singaravelu Mudaliar, Professor of Mathematics, Pachiappa's College, Madras, his old professor and admirer. Many a time Mr. Mudaliar impressed upon him the futility of seeking recognition of his Mathematical work in this part of the country and advised him to communicate himself directly to professors at Cambridge where he would receive great help. Such was also the advice given to him by Sri Bhavaniswami Rao, his intimate professor at Kumbakonam College, who was later Principal, Madras-I-Azam. He wrote out his theories clearly at Summer House to be sent to Cambridge. Meanwhile, he got a clerical job in the Madras Port Trust with the help of Sri Narayana Iyer.

When Ramanujan was granted a research scholarship of Rs. 75 a month by the University of Madras, he took up lodging at Thope Venkatachala Mudali Street, Triplicane and brought his mother and others there to live with him.

SEND OFF AT THE MADRAS HARBOUR

Every arrangement for Ramanujan's going to England was attended to and looked after by Mr. Arthur Davies and Mr. Littlehailes. His passage to England was booked by steamer '*Nevasa*', which then came to Madras. Everything was got ready for his voyage. Ramanujan looked trim in his newly cropped up head and his close fitting trousers and coat. Many came to see him off in the harbour. The Director of Public Instruction, Mr. J. H. Stone came to see him and wished him all success and told Ramanujan that he had written to his friends in England, Mr. Berryman and others who would take care of him. The captain of the ship came down to cheer up Ramanujan and told him that he would take every care of him in the voyage provided he did not pester him with his mathematics. Ramanujan was in tears, throughout, being quite new to the trip. A salvation army

gentleman, travelling with him, cheered him up and said he would take care of him during the journey as he was himself going as far as Southampton. I was myself present in the steamer. The steamer left Madras at about 10 a.m. and everybody wished him success. I got a letter from Ramanujan from Port Said, the stamp on the envelope bearing the figure of the pyramids.

RETURN TO MADRAS BY BOMBAY MAIL

On his return to India, Sri Ramachandra Rao, myself and others received him at the Madras Central Station where he arrived by the Bombay Mail, his mother and brother arriving with him from Bombay where they had gone to escort him. Ramanujan was almost a wreck in health. He was taken to Edward Elliots Road for halt in a bungalow belonging to Sri Adinarayana Chetty, a barrister, from the station in a *jutka*, myself following behind on my cycle. When I saw him there, he was just taking his meal with curds and *sambhar**. Taking a few morsels, he exclaimed to me, " If I had had this in England, I would not have had any illness ". My father, too, visited him at this place.

HIS PURSUIT OF MATHEMATICS

The one notable feature about Ramanujan was that his pursuit of mathematics was a pursuit after God. He very often used to say that in Mathematics alone, one can have a concrete realisation of God. " $\frac{0}{0}$ ", he used to ask, " what is its value ? " His answer was 'It may be anything. The zero of the numerator may be several times the zero of the denominator and vice versa. The value cannot be determined. In the same way, 2^n-1 will denote the primordial God and several divinities. When n is zero the expression denotes zero, there is nothing ; when n is 1, the expression denotes unity, the Infinite God. When n is 2, the expression denotes Trinity ; when n is 3, the expression denotes 7, the Saptha Rishis and so on. Another peculiarity with him was that he was extremely supple and quick in the multiplication of figures. In multiplying two long-digited numbers, he will shortly write down the result and remove two or three figures and insert fresh ones instead instinctively and then declare the result. When asked how he could so quickly do it, he could not give any reply but would simply ask us to verify its correctness which was always true. The verification never failed. Figures and numbers stood out in life before him and this was a peculiarity. When asked about the fourth dimension, he would at once say the admission of the fourth

* spiced vegetable soup

would lead to the admission of the nth dimension. Another peculiarity with him was that in talking about the height of a wall of so many feet, he used to observe that the measurement was not absolute but only relative. No body knows how high it appears to an ant or a buffalo. In the *Illustrated Weekly of India*, there appeared a peculiarly coloured upholstered hall as it appeared to a dog's eye. The dog itself was represented sitting in the hall and viewing it. Ramanujan used to ask my father how the world was when first created with no living being. My father at once replied that his question was fallacious as it meant that some living being was alive prying to see how the beginning was. Ramanujan used to jocularly ask us this question, "Suppose we prepare a belt round the equator of the earth, the belt being 2π feet longer, and if we put the belt round the earth, how high will it stand?" and reply, to our surprise "the belt will stand 1 foot high, a substantial height."

INTERPRETATION OF DREAMS

Ramanujan had a peculiar gift of foretelling. Whenever we asked him about the possibility of a thing coming about, he would patiently hear our narration and say the answer the next day or so. He could tell us as to what would happen after dreaming of it and interpreting the dream. His interpretations mostly, proved true.

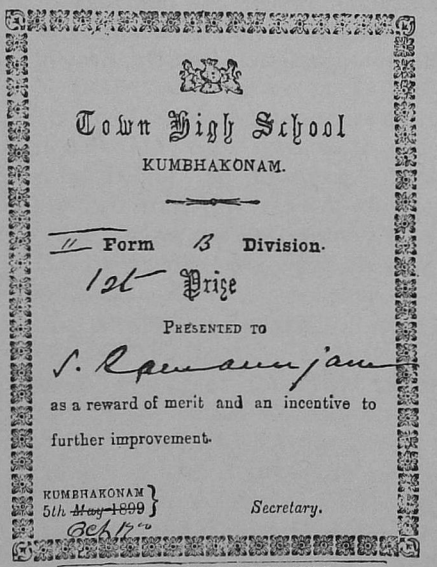
OUR FAMILY FRIEND

M. ANANTHARAMAN

Ramanujan was intimately known to Sri M. Anantharaman, Retired Co-operative Deputy Registrar and his brothers, Sri M. M. Ganapathy, a teacher and late S. M. Subramanian, an Engineer as their family friend. His reminiscences are therefore significant.

SCOLDING FROM MY FATHER

The late Mr. Ramanujan, so far as I could remember came into our family about the year 1905, or perhaps even earlier as he was a close class-mate of my elder brother late Mr. S. M. Subramanian, B.A., B.E., who used to say they were chums even from their fourth standard in the Town High School, Kumbakonam. I was then a stripling being younger to them by about nine years, and I remember he often used to fondle me by taking me in his arms and sometimes tease me also. He once took me to the River



Town High School

KUMBHAKONAM.

II Form B Division.

1st Prize

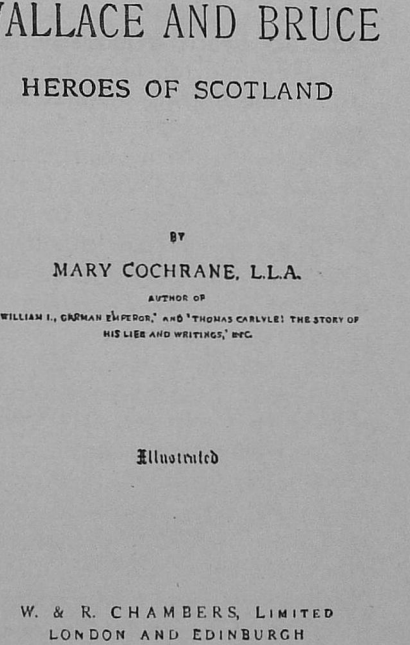
PRESENTED TO

S. Ramanujam

as a reward of merit and an incentive to further improvement.

KUMBHAKONAM 5th ~~May~~ 1899 } Secretary.

LORD RIPON PRESS—KUMBHAKONAM.



WALLACE AND BRUCE

HEROES OF SCOTLAND

BY

MARY COCHRANE, L.L.A.

AUTHOR OF

'WILLIAM I., GERMAN EMPEROR,' AND 'THOMAS CARLYLE: THE STORY OF HIS LIFE AND WRITINGS,' ETC.

Illustrated

W. & R. CHAMBERS, LIMITED

LONDON AND EDINBURGH

1897

Cauvery in Kumbakonam to teach me swimming and holding me in his outstretched arms, he let me down. I almost went down into

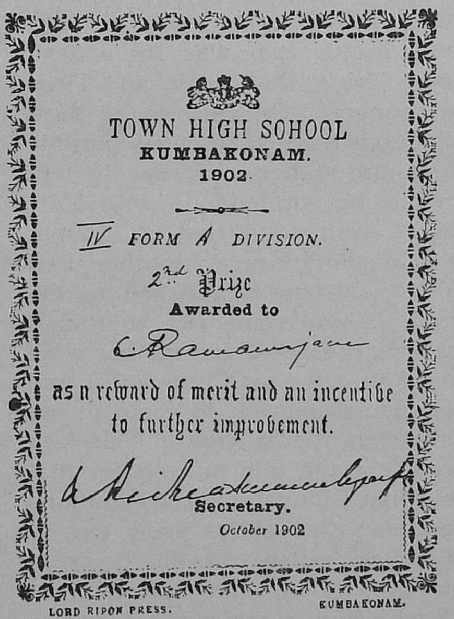
the water and he got a good bit of scolding from my father. Ever since, I never ventured to learn swimming though I was born and bred up on the banks of the River Cauvery, my house being only some two furlongs from it.

PRIZES

I have got even now with me a copy of the book given to Ramanujan as second prize in his IV form in 1902. He also secured the first prize in the V form A section, Gaskell's *Cranford* and some poetical selections while my brother S. M. Subramanian got the first prize in V form B section Goldsmith's *Oliver Twist* and Wordsworth's Poems.

HE DISAPPEARED

Mr. Ramanujan, I may say, practically formed part of my family from about 1905 till he left for England in 1914. He used to put some conundrums to me in arithmetic to solve. Mr. Rama-


TOWN HIGH SCHOOL
KUMBAKONAM.
1902.

IV FORM A DIVISION.

2nd Prize
Awarded to

S Ramanujam

as a reward of merit and an incentive to further improvement.

Secretary.
October 1902

LORD RIPON PRESS. KUMBAKONAM.

POEMS OF ENGLAND

A SELECTION OF

ENGLISH PATRIOTIC POETRY

WITH NOTES BY

HEREFORD B. GEORGE, M.A.
FELLOW OF NEW COLLEGE, OXFORD

AND

ARTHUR SIDGWICK, M.A.
FELLOW OF CORPUS CHRISTI COLLEGE, OXFORD, AND UNIVERSITY READER IN GREEK

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY
1900

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nujan used to be confined to a room in the upstairs of our house at 18, Dabir Middle Street, Kumbakonam, and it was in this

room, he used to say that he got one night, while sleeping, a vision of some bright angelic figure teaching him mathematics. He was always having a big slate without even the frame and working something on his slate. He had also a big sized notebook and it was with this notebook that he disappeared from his house about the year 1910 without informing anybody and went to the north. It was during this trip, he said, he came into contact with late Mr. R. Ramachandra Rao who was then Collector of Nellore and who, I remember, recognising his talents, was helping him financially by sending him a remittance of Rs. 25 p.m.

MY MOTHER AND RAMANUJAN

Ramanujan was born of poor parents. His mother belonged to the *Vadagalai* subsect and his father Srinivasa Iyengar to the *Thengalai* subsect. Ramanujan's maternal grandfather was, I was told, an amin or some court clerk in the Dt. Munsif's court at Erode where he was born after great prayers to Goddess Namagiri, the presiding deity at Namakkal and our association with Ramanujan's family resulted in my family also getting a strong devotion and attachment to the Namakkal temple. Ramanujan's father, a petty clerk in some cloth shop, was in very poor circumstances with three sons of whom Ramanujan was the eldest, Lakshmi Narasimhan, now no more living, the second and Tirunarayanan, B.A., now living, the youngest. On very many days Ramanujan used to take his meals in our house, and of my parents especially my mother was treating him as her own son. In fact after his return from England while he was laid up with T.B., he told my eldest brother Mr. M. M. Ganapathi, that he (Ramanujan) often would think, while in England how my mother used to feed him and give him hot *dosai** and how he relished it. On very many days my mother used to send some rice to Ramanujan's house and, on some occasions presented his mother with new *sarees* also. His mother used to call him Chinnasami and whenever he was missed in their house, she would come to my house to find him. One day, I remember, it was about 3 o'clock in the afternoon in 1908 his mother came and told my mother that there was no rice in the house and that Chinnasami (Ramanujan) had not taken any food. My mother after giving some rice to her, immediately sent me to fetch Ramanujan from his house in Sarangapani Sannidhi Street and as at that time there was no cooked food in my house also, I took him to my aunt's house in Pachaiyappa Mudali Street and she served him with a ball of good butter and rice which he relished.

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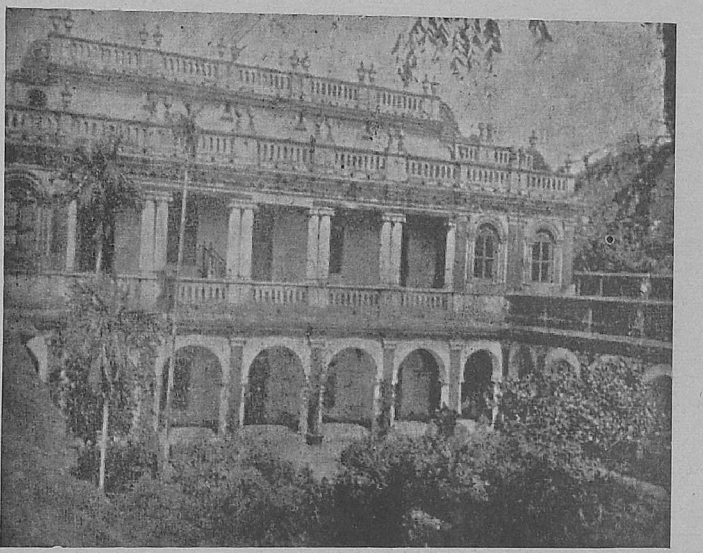
* pancake.



Town High School, Kumbakonam. It celebrated its centenary on September 20, 1964. Ramanujan had his schooling here from 1898 to 1904.

Goddess Namagirithayar of
Namakkal, family deity of Ramanujan.
(utsavar and moolavar)

HIS APPEARANCE AND MANNERS

Ramanujan looked more after his mother than his father and was fairer. He was potted slightly in his face owing perhaps to early small pox, well proportioned and slightly flabby with a round face, nose somewhat broad at base but pointed at the tip, bright eyes and long hands almost reaching to his knees, his palms being velvety (exceptionally smooth) and soft with long tapering fingers. He used to walk with a tilt with his forefeet and toes firm on ground and heels slightly raised. He was always of very cheerful disposition and smiling. Both upper cloth and dhoti he wore were 8 or 9 cubits.

He used to evince great curiosity in all odd things and particularly in street dramas (*terukkoothu and bommalattam*) and visit them even at odd hours and in distant places. One evening (it was) about 7 o'clock he came and knocked at the doors of my house and enquired if meals were ready. I told him that mother was just then cooking and that it might take some time. Without waiting for food, he immediately disappeared and when I went inside, my mother scolded me for having sent him away without food and asked me to go and fetch him. But I could not find him anywhere. He used to walk briskly. Next morning he returned to say that he went to Thepperumanallur a village about 5 miles off from Kumbakonam to witness a street drama (*terukkoothu*) and that while going he cut across unknowingly in the night a cremation ground where a corpse was burning.

INTERPRETING DREAMS

It is not quite correct to say that he knew much of astrology though his mother knew something of it. But Ramanujan had some intuition in interpreting dreams. I remember when my eldest brother Mr. M. M. Ganapathy told him that he dreamt something, Ramanujan told my brother that there would be a death in the street behind my house, and it so happened an old lady passed away in the house just behind mine and it was really a strange coincidence. There were other occasions also when his interpretations came correct.

THE FAMILY GODDESS NAMAGIRI

That Ramanujan's grandparents should have been staunch devotees of Goddess Namagiri, I should say is confirmed from one instance which came into my experience. There was one Vasudeva Rao, senior copy master in the Town High School, Kumba-

konam, who was living in the house opposite to Ramanujan's. There was also a junior copy master in the school by name Rangaswami Iyengar and it appears this junior was jealous of his senior and had resorted to some witchcraft practices to do away with Rao. One night it was about 8 o'clock when Ramanujan's grandmother who was pretty old at that time about 1907 and who was limping owing to some guinea worm disease in her toe was returning from the River Cauvery after a bath. When I met her near my street (Dabir Middle St.), I enquired what brought her to the river at that hour in spite of her infirmity. She said she had a vision of Goddess Namagiri and that the vision told her that Rangaswami had tried to kill Vasudeva Rao by resorting to witchcraft and that at the direction of Goddess Namagiri she was able to find and remove some odd material — egg wrapped up in hair with pins and nails driven in different parts of the egg — buried deep in the backyard of Vasudeva Rao's house and that it was Rangaswami who had done it and that she had taken the material to be thrown in the river and was returning after her bath. There were also other occasions when Namagiri used to appear through her medium. I mention these because there is some basis to associate the Goddess Namagiri with Ramanujan's birth and genius and the vision that Ramanujan said he had while sleeping in my house upstairs.

AN ANECDOTE

I remember one day, Ekadasi evening, he put a * *namam* and *srichurnam* on my forehead and took me to the Sarangapani temple to get me some *Uppuma prasadam*** (it was used to be said it would be very tasty) and he instructed me to stand in the shadow of the pillar as *Saivaites* would not be given prasadam in *Vaishnavite* temples. But unfortunately, the *namam* and *srichurnam* were so fresh that I was detected and refused the *prasadam* and we returned laughing at our discomfiture.

HIS ENGLISH

I have heard some people say that Ramanujan was poor in English or even did not know English. Such statements can only be attributed to their ignorance. How can it be said that one who was fairly very high in his classes, who, as I said above, secured II prize in his IV form and I prize in his V form and who passed his old matriculation in his first attempt was not well up in English ? His English might not have been as good as his

* white and red lines symbolising the feet and the consort of Vishnu
** pudding

Mathematics. No doubt he was detained in his Junior F.A. class while he was studying in the Kumbakonam College. But it must be remembered that at that time the standards were very high and the number of subjects for F.A. too many and what was more there was one Mr. T. O. Hodges, Principal, who was very strict in promotions and Mr. Ramanujan on account of his preoccupation with Mathematics had not paid due attention to the other subjects.

NOTICE OF HIS GENIUS

Mr. Ramanujan's genius was not recognised at that time by any of his professors and in fact I remember him telling that Mr. T. K. Venkatarama Ayyar, M.A. pooh-poohed him, Mr. P. V. Seshu Iyer was indifferent and that Sri K. S. Patrachariar evinced some interest, though all these later claimed him to be their student and to have in the early years seen the genius in him. My recollection is that Prof. V. Ramaswamy Iyer, M.A., as he was then called and who was Deputy Collector, Salem and later at Mannargudi took some interest in his work, but positive recognition and encouragement came from Dewan Bahadur R. Ramachandra Rao who was Collector of Nellore and with whom Ramanujan came into contact when he disappeared from his house in 1910 or thereabouts.

SUMMER HOUSE, TRIPLICANE

From 1911 to 1913 he was living with my brother Mr. S. M. Subramanian, then a student of the B.E. class in the Madras

Summer House, Triplicane.

Engineering College, staying in the Summer House, Triplicane and later Ramanujan got a job in the Madras Port Trust through

the kindness of Mr. Ramachandra Rao and one Mr. S. Narayana Iyer who was then the Manager of the Port Trust and one Sir Francis Spring who was its Chairman and he went to live with his wife and that for a short time.

HIS MARRIED LIFE

Ramanujan had no conjugal happiness. His wife was of course a nice and good girl, but most unfortunate. I had known her from the time of her marriage. Ramanujan's mother, one day about 1909 came and told us that Ramanujan's marriage had been fixed somewhere near Karur and she was responsible for it. They went for the marriage. None in my family went. It was told later that after the marriage party went, Ramanujan's father-in-law refused to give his daughter in marriage and, after some controversy and mediation by others, he yielded and the marriage took place. A short time after the marriage and after his wife joined him, he was operated upon for hydrocele by one Dr. P. Kuppuswamy at Kumbakonam. One day in 1910 some time after the operation Ramanujan and myself went to Valangiman by walk a distance of six miles, and as it had not completely healed, there was bleeding. Ramanujan lived with his wife only for a short time at Madras before he left for England and returned as a T.B. patient to India in 1919.

HIS DEPARTURE TO ENGLAND

It was in the beginning of 1914 when Ramanujan came from Madras one morning — his parents were then in Kumbakonam — to my house and told my parents and me that he was going to Calcutta and that he had come to take leave of us. Hardly did we know that he was going to England. As soon as my father came to know about it, he, being a very orthodox type of man, was afraid that Ramanujan might drag my brother Subramanian also who had just then completed his B.E. to England, and so went to Madras to dissuade Ramanujan from proceeding to England. Even Ramanujan was not very enamoured of going to England, but one might say it was fate that drove him. There was nobody who recognised the genius in him, and he used to say that he had no facilities by way of books of reference to work on his theorems.

My brother Subramanian used to say that Ramanujan had to be trained to accustom himself to wear the Western dress. He had a long tuft of hair and he took his hair to England as it was

saleable. While he was in England, I once arranged to pack and send some provisions, pickles, and other food preparations from Kumbakonam to England, but being war time they did not reach him in good condition.

THE LAST TIME I SAW HIM

On his return from England he was put up in Venkata Vilas in Luz. Perhaps it was the house of late Mr. Ramachandra Rao or his son-in-law. I went to see him from Kumbakonam, on my way to Samalkot where my brother Subramanian was, with a bunch of plantain fruits grown in the backyard of my house which he used to relish much. He was not the original Ramanujan. He could not even speak and his illness had made him peevish. That was the last time I saw him and a year or so later during which I was bed-ridden after a big operation in my leg in 1920, my uncle read from 'The Hindu' that Ramanujan was dead. That gave us a shock. Ramanujan after his return had no doubt come to Kumbakonam for a change, but it was painful to see him. Before he left for England, he was of a religious type, god-fearing with a devotion to Goddess Namagiri. He used to visit often a small Anjaneya temple in Karuppur some two miles east of Kumbakonam and would on occasions go to Gunasekharam (Elamanur) near Trichi and would advise persons with some mental ailments to go and stay in Gunasekharam for some time.

After his return from England, however, he had completely changed and he, it appears, told my eldest brother Mr. M. M. Ganapathy when he mentioned about gods and temples, that it was foolish talk, and they were only devils.

His life was a tragedy and I should say affected our fortunes also as his letters to my brother S. M. Subramanian would indicate. He had the greatest love and affection for us and particularly for me much more than what he had for his own brothers. I often used to visit his mother both at Triplicane and at Kumbakonam. Long after he passed away and as late as 1935-40 when we were living in No. 5, S. M. V. Koil Street, Triplicane, his mother often used to come to our house and console herself by seeing us and say she was feeling as though she was seeing her son Chinnasami (Ramanujan) himself.

WHILE IN SEARCH OF EMPLOYMENT

S. BALAKRISHNA IYER

Sri S. Balakrishna Iyer who retired as Lecturer in Mathematics from the Teachers' College, Saidapet gave on 17-6-'63 his reminiscences of Ramanujan who met him while in search of employment.

Allow me to confess that age (now I am 82) has been playing tricks with me, and many of my earlier experiences are passing beyond my recall. Such of them that still stick to my mind, I am setting down below.

SENT BY SESHU AYYAR

In the earliest decade of this century, I was an assistant of the Model High School, Teachers' College, Saidapet. One fine morning, a young man came to me, introduced himself by name and said that he was sent by Prof. P. V. Seshu Iyer. He straightaway placed in my hands a pair of stout note-books, and when I turned over their pages, I felt I was thoroughly unqualified to form any judgement about them; so great was my awe.

Mr. Ramanujan said that he was very poor and jobless and requested me to put in a word with Mr. Dodwell, the then Vice-Principal of the Teachers' College, who was under orders of transfer as Curator of the Central Records Office near the Egmore Railway Station, for a clerkship (however meagre the pay) under him. I gave him some coffee etc. After some time he left for Triplicane.

MY FAILURE

I spoke to Mr. Dodwell. He said that he did not know what staff he would be having, but he would remember the young man's case. Subsequent to his having assumed charge, I went to him three or four times, but every time he gave me evasive replies. I was not big enough for him. Then I gave up going, informed Mr. Ramanujan about my failure and also Mr. P. V. Seshu Iyer when I met him at his house at Triplicane. In one of my subsequent visits to the Professor, I learnt that Mr. Ramanujan had secured a clerical post in the Port Trust with the help of Mr. S. Narayana Iyer, the noted mathematical savant.

I happened to meet Mr. Ramanujan at Prof. Seshu Iyer's house on a few occasions subsequently, but the talks were ordinary and not worthy of record.

Long years passed ; Ramanujan was in England. I went to Rajahmundry as the Chief Mathematics Lecturer. Ramanujan had returned to Kumbakonam. I was unhappy to hear that he was unwell and did not venture to correspond with him.

BLESSED TO RECEIVE THE REQUEST

One day, I received a letter from Mahamahopadyaya M. V. Ramanujachariar of the Kumbakonam Tamil Department. He wrote that Ramanujan's health was none too good and he was slowly sinking, that he expressed a longing for *katharikkai vattral* (dried brinjal slices) and asked if I could send him (R) some of that stuff. I was blessed to receive the request and sent to my friend the Acharya packets to be passed on to Ramanujan.

At last the end came. God had called up unto his feet that great son of India.

MY GOOD FORTUNE

N. GOVINDARAJA IYENGAR

Sri N. Govindaraja Iyengar, retired Chief Engineer, Madras and retired Chairman of the Union Public Service Commission was another who took tuition under Ramanujan. His reminiscences though brief are touching.

I had the good fortune to be born in the same street as the late S. Ramanujan and within about eight doors from him but my good fortune stopped there. It is my regret that I had not followed his life after he entered the Madras Port Trust as an assistant.

MR. GANAPATHI SUBBIER AND SCHOOL TIME-TABLE

I wish to to say just a few words about my early contact with Ramanujan. He was born of poor parents but respectable. He had his schooling in the Town High School, Kumbakonam and in the sixth form, then called the Matriculation class, the Mathematics teacher was one Mr. Ganapathi Subbier who was also later my teacher. This sixth form had six divisions of almost 40 students in each and in the F division you can find some boys who had become fathers. The Town High School had perhaps on its rolls more than 1,500 students and it was a problem to prepare a time-table for the higher classes without producing any internal conflicts and this problem of preparing a workable time-table was always entrusted to Ramanujan by Mr. Ganapathi Subbier.

SO SIMPLE WAS HE

In his small house he would sit in his small pial with only a towel to cover the lower part of his body and in a squatting posture. His mischievous juniors and class-mates, of whom I was not one, used to throw pebbles into his, what may be called 'trouser-pocket' and even the irksomeness of this he would not notice and would go on with his solutions to the arithmetical questions that his friends might have taken to him. So simple was he.

TUITION UNDER RAMANUJAN

I completed my B.A. in the Kumbakonam College and when I got through my F.A. Examination in 1908 my brilliant class-mates, the late Panchapakesa Sastri who was a judge of the Madras High Court, the late V. K. A. Iyengar who was the Financial Expert to the Government of India and others left the Kumbakonam College and joined the Presidency College, Madras where they felt they would have better chances of getting the top ranks in the B.A. Examination, presumably with the idea, right or wrong, they would get an inkling of the questions to appear in the examination papers. In order that I who had been left behind in the Kumbakonam College to pursue my B.A. course, might benefit myself by taking tuition under Ramanujan, and with also the view that I might be of a little financial help to him, I got him to teach me ; I found after a few classes that he could speak only of infinity on one side and infinitesimal on the other and could not come to lower levels and so I gave up the tuition after a few lessons.

My father was a good astrologer of a rationalistic school and he had told me on examining Ramanujan's horoscope that it indicated that he would be a scholar in English in his thirty-second year and since, that was impossible it might indicate that his life might end in that year. I often wonder what the great creator's idea may be in snatching away from us men like Dr. S. Rangachari, and Ramanujan at a time when they could develop their science and prove even greater benefactors to their fellowmen.

FROM MY PRIMARY SCHOOL DAYS

K. SARANGAPANI IYENGAR

Sri K. Sarangapani Iyengar, an advocate of Kumbakonam was Ramanujan's classmate from primary school to college and has interesting things to say about Ramanujan.

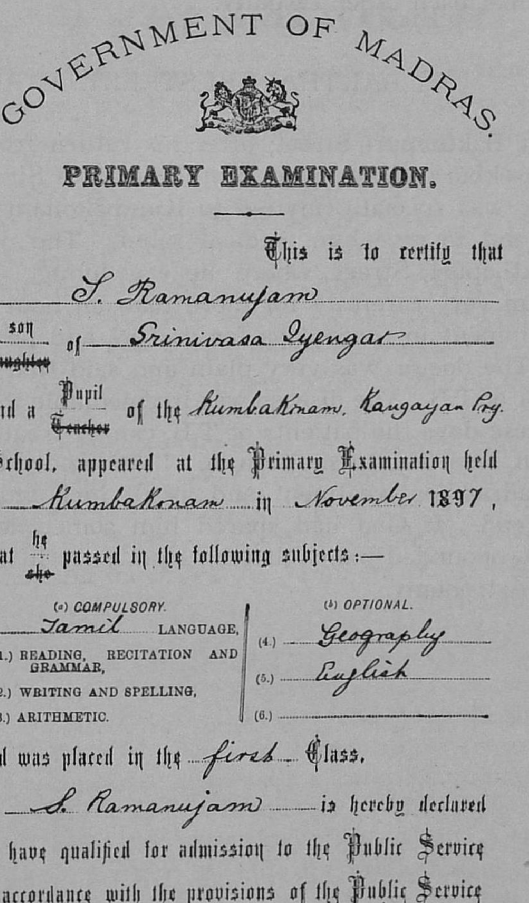
AT PRIMARY SCHOOL

We came to know each other in 1897 when we were students in the IV Std. called upper primary class. We read in the same class in the Town Primary School which was headed by a typical school master, Mr. M. Mahadeva Rao, whose care we still remember even today as he was a strict disciplinarian and 'the love he bore to learning was in fault' as Goldsmith says in the 'Village School Master.' We both appeared for the upper primary examination which was held in Porter Town Hall and the young boys answered each question only on slates and marks were given then and there. The first two subjects for examination in the morning were Tamil dictation and Arithmetic. Ramanujan had his primary schooling here from 1894 to 1898. In Arithmetic, Ramanujan got 42 out of 45 and I got 43. Ramanujan felt sorry for not getting the maximum and wept as he was very young and did not brook another person scoring over him.

AT HIGH SCHOOL AND COLLEGE

We read together in the Town High School under the then able teachers. We were good friends as my humble self too was considered to have some aptitude for Mathematics. We read together under the able masters, Messrs. T. K. Venkatarama Aiyar, Ganapathi Subbier, V. Ramachandra Rao and R. Swaminatha Aiyar. The late Mr. S. Krishnaswamy Aiyar was the renowned Headmaster then. We both went to college and read together. In the college he exhibited his great aptitude for Mathematics. He would even work questions in Integral Calculus and other subjects and used to take interest in books on Mathematics in languages other than English. When asked how he could understand the subjects in other languages, he used to reply that by the blessings of Lord Sarangaraja of Kumbakonam

and Namagiri Thayar of Namakkal, he was able to interpret by just noting the notations and symbols used. The professors themselves would often question him as to what he would do with those books and his reply was that he could understand even



GOVERNMENT OF MADRAS.

PRIMARY EXAMINATION.

This is to certify that

S. Ramanujam

son of Srinivasa Iyengar

and a Pupil of the Kumbakonam, Kangayan Pry. School, appeared at the Primary Examination held at Kumbakonam in November 1897, that he passed in the following subjects:—

(a) COMPULSORY.		(b) OPTIONAL.	
Tamil	LANGUAGE,	(4.)	Geography
(1.)	READING, RECITATION AND GRAMMAR,	(5.)	English
(2.)	WRITING AND SPELLING,	(6.)	
(3.)	ARITHMETIC.		

and was placed in the first Class.

S. Ramanujam is hereby declared to have qualified for admission to the Public Service in accordance with the provisions of the Public Service Notification,

Station Tanjore

Date 9th August 1898

J. Daniel
Addl
Chairman, Board of Examiners,
Primary Examination,
Tanjore District.

P. Exn.
12,500—28-11-98.

without the knowledge of the language. At times even in class rooms he used to puzzle the Mathematics lecturers by giving the answers to questions in two or three steps whereas under the routine method it would take 20 steps and more. The moment a

question was put, he used to give the correct answer. Our lecturers in Mathematics were Messrs. T. K. Venkatarama Aiyar, K. S. Patrachariar and P. V. Seshu Iyer. In the F.A. Examination we both failed and then we did not continue our studies at Kumbakonam. When I went to Madras to study in Pachaiyappa's College, we met each other casually.

AT BAKTHAPURI STREET

While at Bakthapuri Street, after his return from England, Dr. Chandrasekhara Aiyar, M.D., brother of late Sir P. S. Sivaswami Aiyar was specially invited to Kumbakonam to examine Ramanujan and to give him medical relief. The doctor and I went to Bakthapuri Street where he was living. The Doctor examined him very carefully for more than an hour. There was no good equipment in those days for doctors and he returned to my house. The doctor was very plain and said that Ramanujan had an attack of T.B. The disease was irremediable in those days, though in these days the patients of T.B. can be treated by medicines without resorting to sanitorium. I remember he was then taken to Madras for treatment and as ill luck would have it he had his end. If God had spared him sometime longer, he could have propounded many theorems not only in Mathematics but also in Astronomy.

MY UNFORGETTABLE COACH

K. NARASIMHA IYENGAR

Sri K. Narasimha Iyengar, an advocate of Kumbakonam gives his reminiscences of his late lamented friend Ramanujan to whom he owed his success in Intermediate Examination.

JOBLESS

In the years 1911 to 1912 Prof. Ramanujan lived with me as a part of my household in No. 9, Venkatarayan Lane, P. R. Square, P.T., Madras, where I was living with my brother and his classmate Sri Sarangapani Ayyangar, studying in the Christian College for the Intermediate Examination. At that time he had no job and he was spending most of his time in our house with his mathematical research. During that period I had occasion to take him to several gentlemen interested in Mathematics including my Mathematics professor, Mr. E. B. Ross himself, a wrangler in Mathematics, but none of them could understand his work and much less help him out of his wants to ensure his undivided devotion to research work in Mathematics.

PROPHETIC TIPS

During that period I had also the good fortune of being coached in Mathematics for my Intermediate Examination but for which I could not have passed my Inter Examination as would be apparent from the fact that even with his coaching I was able to secure only 35%, the requisite minimum for a pass, perhaps speaking volumes for my aptitude for Mathematics. During this period he was such a loving and kind person that Ramanujan, my brother and I were moving like loving brothers. For instance on the day of my Mathematics Examination in Intermediate he instinctively felt that he should meet me and persuade me to sit for the examination in the afternoon also without fail and came all the way from our house walking to the Presidency College, a distance of four miles. He saw I was depressed and I was hesitating whether to stay away from the afternoon examination. He encouraged me and gave me some last minute tips as if by prophecy or intuition and persuaded me to attend the examination and I found his prophetic tips very useful and they must have contributed to my pass.

TAKEN TO TASK

Prof. Hardy wrote to him enquiring whether he would be prepared to go to Cambridge as a research scholar. Prof. Ramanujan without telling any of us declined the offer and offered to send occasional problems and solutions for publication for remuneration in the mathematical journals in England and other European countries.

When the University of Madras was persuaded to agree to the grant of a scholarship of £ 250 per year for him to go to Cambridge for research work in Mathematics, this time Prof. Ramanujan brought to us the offer of the University and asked for our advice as we had taken him to task on the former occasion for his not informing us of the previous offer which he declined. We actually drafted the reply accepting the University's offer and got his signature to it and posted it.

SAIL TO ENGLAND

When the matter was taking concrete shape for his proceeding to England his mother raised strong objections to it and Ramanujan would not go without the consent of his mother. With great difficulty, the writer and his cousin, Sri G. Aravamudha Ayyangar, advocate, Mayuram, persuaded Ramanujan's mother eventually to agree to his going to England. He would consent to have his head cropped and dress in European style, only after his family left Madras for their native town Kumbakonam.

Doctor Muthu, a specialist in Tuberculosis was also travelling by the same boat by which Ramanujan was going with the result that Prof. Ramanujan, being very little conversant with worldly affairs and having very little capacity to move freely with others and take care of himself, had one to take care of him during the voyage and on arrival at Cambridge.

The day previous to his sailing, my cousin and I had the privilege of having him in our room in Triplicane and the whole night we spent talking about men and things and the prospects of his stay in England and the next morning we saw him off in the Harbour.

In Cambridge, as he wrote, the first few days were not very congenial as he was not communicative enough with other students in the University and as that brought him some little annoy-

ance from the students. Later however on the intervention of the University authorities, the students began to treat him with great respect.

BACK TO MADRAS

When he arrived in Central Station I met him at the platform but alas I found him not a cheerful, chummy and affectionate Ramanujan that he was but a thoroughly depressed, sullen and cold Ramanujan even after seeing me, a close and affectionate friend of his.

When he came again to Madras after sometime for treatment, I met him at his residence in the Harrington Road, Chetput and found to my great grief that though physically living, he was mentally dead to the world and even to his once dear friends.

MY FATHER AND RAMANUJAN

N. SUBBANARAYANAN

Sri N. Subbanarayanan of Port Trust Office, Madras relates the role played by his father Sri S. Narayana Iyer in Ramanujan's career.

I remember my father telling me that he made the Chairman, Sir Francis Spring understand that Sri Ramanujan will not do any record work but will submit weekly his jottings and notes on Mathematics, to the Chairman through the Manager.

My father S. Narayana Aiyar was also the Asst. Secretary and Treasurer of the Indian Mathematical Society for several years from the time of its inception. The first letter of Sri Ramanujan to Prof. Hardy was actually drafted by my father and perused by Sir Francis Spring. It is well known that Sri Ramanujan was not quite well up in English in spite of his proficiency in Mathematics and could not with confidence draft formal letters.

The period of stay of Ramanujan in England was short as he had to live under strange surroundings. Being an orthodox Brahmin and a Srivaishnavite he refused to partake of any foreign food. He lived on fried rice powder (*Sathumavu* as it is called in Tamil) and buttermilk. The powdered rice was sent to England by my father every month through Messrs. Binny & Co. in a tinlined box. Consequently Ramanujan's stomach became small and he is supposed to have contracted stomach T.B.

A MIGHTY TASK OF BOREDOM TO HIM

To illustrate the depth of his genius, I can quote one of the incidents which happened during the stay of Sri Ramanujan with my father when we were living in No. 580, Pycrofts Road, Triplicane. During that period, every night both Ramanujan and my father used to work Mathematics in two big sized slates sitting on a small parapet upstairs. This used to be carried on till about 11-30 p.m. and was a source of nuisance to other inmates of the house who used to sleep in the adjoining rooms. I distinctly remember the noises of the slate pencils which used to be a back-

ground music for my sleep. Several nights I have seen Sri Ramanujan get up at 2 o'clock in the night and note down something in the slate in the dull light of a hurricane lamp. When my father asked him what he was writing, he used to say that he worked out mathematics in his dreams and now he was jotting the results in the slate to remember them. Evidently, this goes to show that he must have had a remarkable power of subconscious working and grasp of intellectual strides in mathematics. Peculiarly

The house at Pycrofts Road, Triplicane where Narayana Iyer and Ramanujan spent nights discussing mathematical discoveries.

enough, my father used to ask Ramanujan some doubts in these jottings. Between one step and another step there used to be a big gap. My father, being a fairly good mathematician himself, was unable to capture the strides of Ramanujan's discoveries. He used to tell him "When I am not able to understand your steps, I do not know how other mathematicians of a critical nature will accept your genius. You must descend to my level of understanding and write at least ten steps between the two steps of yours." Sri Ramanujan used to say "When it is so simple and clear to me, why should I write more steps?" But somehow my father slowly got him round, cajoled him and made him write some more, though it used to be a mighty task of boredom to him.

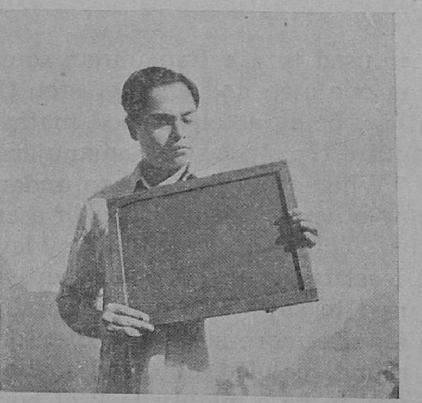
TRIP TO NAMAKKAL

How an orthodox young man accepted to go to foreign countries crossing the seas is another interesting episode in the life of Sri Srinivasa Ramanujan. When it was decided to send him to England, strangely enough Ramanujan refused to go. My father knowing the gravity of the situation took the task on

himself. Ramanujan's family deity was Goddess Namagiri of Namakkal. I remember the trip to Namakkal with my grandmother, father and Ramanujan. We halted at Salem *en route*, in the house of Deputy Collector Ramaswamy Iyer, a great geometer and one of the founders of the Indian Mathematical Society. Both Ramanujan and my father went to Namakkal and stayed in the temple of Goddess Namagiri at nights for three days. On the last night Sri Ramanujan got a command from the deity to go to foreign countries. Only after this he accepted to go to England. This shows the faith and devotion of Sri Srinivasa Ramanujan to his *kula devata.**

RAMANUJAN'S MOTHER

Sri Ramanujan's mother was an exceptionally gifted lady with psychic powers and a remarkable imagination. She was blessed with three sons after a long period of worship to the deity at Namakkal, the first one being the genius Ramanujan. The old lady had a remarkable repertory of mythological stories and used to tell me stories from ancient Mahabharata and Ramayana to later Vikramaditya legends. Constantly she used to utter the name of Goddess Namagiri with a devotion whenever she used to pause during story-telling to me.



The slate used by Ramanujan is considered as heir-loom by S. Narayana Iyer's family.

EXCHANGE OF SLATES

Before Ramanujan went to England my father made a strange request to him. As a memento my father wanted to

* Family Deity.

exchange his slate with Ramanujan's which was granted. Perhaps my father thought he may get an inspiration from the slate during the absence of Ramanujan. He was at the time working on 'The Elliptic Functions'. This I remember because for a long time he used to send me to the University library for the book Jacobian Elliptic Functions.

It is really unfortunate that it was left to foreigners to recognise the real geniuses of our land and present them back to us with great honours which they could not have obtained here.

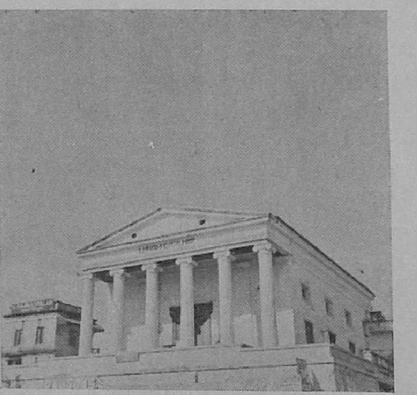
RAMANUJAN AND I AT PACHAIYAPPA'S

C. R. KRISHNASWAMY AYYAR

Sri C. R. Krishnaswamy Ayyar of Tirupattur was a classmate of Ramanujan in Pachaiyappa's College. In his letter to the Editor of "The Hindu" (cf. the issue dated 30-12-1962) he recounts a few interesting incidents of their college days.

FULL FEE SCHOLARSHIP HALVED

I was a classmate of the late Srinivasa Ramanujan in the Junior F.A. class in the Pachaiyappa's College, Madras, in 1906. After passing the Matriculation Examination, when I approached the Principal of the Pachaiyappa's College, Mr. J. A. Yates, one day in January 1906 for a full fee scholarship in the Junior F.A.



Pachaiyappa's College then at Esplanade, Madras.

class, he granted me my prayer and asked me to come the next day with only the library fee of eight annas. The next morning, I went to the Principal as directed. Ramanujan had just then been introduced to him by Prof. N. Ramanujachariar, who was teaching mathematics for F.A. and who appeared to have told the Principal that Ramanujan had a special aptitude for mathematics and that he (the professor) himself had found some of the mathematical problems and theorems Ramanujan had worked out in his notebook very startling and difficult to follow. Thereupon, the Principal cut the full free scholarship he had given me in two halves and made us accept one half each.

JUMP TO THE LAST STEP

During the mathematics classes, Ramanujan would be working his own mathematical problems in a corner of the top gallery. When Prof. Ramanujachariar sometimes drew Ramanujan's attention to a problem he was working out on the blackboard and asked him to give the next step or continue the problem, Ramanujan would have the boldness to say that the several intermediate steps worked out by the Professor were unnecessary and he would jump to the last step and give the answer quite to the surprise of the whole class and much more of the Professor. The Professor would then ask him to come down to the blackboard to explain to the class how he had arrived at the answer.

ATTENDING CLASS WITHOUT HEADDRESS

Ramanujan and I had for our second language Sanskrit and one day he came to the Sanskrit class in the morning wearing his usual coat of black Calicut check, but without his usual wool-knit red Hassan cap which, he said, had been blown off by a gust of wind when he got into the tram. Our Sanskrit Pandit, Sri Krishna Sastriar (the father of Mr. M. Patanjali Sastriar, the retired Chief Justice of India) asked him to go out and get himself a cap from the adjacent China Bazaar shop as attending class without a head-dress covering his tuft was against discipline. Ramanujan begged to be excused saying that he was too poor to find the six annas for buying a cap !

A POT OF WATER OVER RAMANUJAN'S HEAD

While working as a clerk in the Port Trust on Rs. 30 per month in 1912-13, he shared an upstairs room in Swami Pillai Street, Triplicane, with me (then a student in the Law College) and a cousin of mine who was a clerk in the South Indian Chamber of Commerce. One night, when Ramanujan was speaking to me about the wonders of the astronomical world, my cousin who felt his sleep disturbed, poured a pot of water over Ramanujan's head, saying it would cool down his heated brain. Ramanujan in joy and with the patience of a mathematician exclaimed that he had a good '*Gangasnanam*'* and would like to have another downpour.

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* Bath in the waters of the Ganges.

MY JUNIOR CONTEMPORARY

M. PATANJALI SASTRI

Shri M. Patanjali Sastri, retired Chief Justice of India, was senior to Ramanujan in Pachaiyappa's College. A few things that are remembered by him about Ramanujan form this brief note.

I knew Ramanujan as a junior contemporary of mine in Pachaiyappa's College, but I had not many contacts with him. He was a class-mate of my late cousin, M. Ramaswami Sastri, Mathematics Assistant in Pachaiyappa's High School.

THE NUMBER 7

I remember Ramanujan once explaining to him, when I happened to be present, the significance of the number 7 in theory of numbers, as understood by our ancestors who spoke of Sapta Rishis, Sapta Dweepas, Ratha Sapthami etc., much of which I was unable to follow, and I wonder if there is any reference to it in his famous Notebook.

HIS TALENT FOR MATHEMATICS

I also remember Prof. Singaravelu (then Prof. of Mathematics in Pachaiyappa's College) once telling me that he was unable to understand some of Ramanujan's equations, and that the young man's talent for Mathematics was extraordinary. This is about all that I can recall about Ramanujan at this distance of time.

WE WERE BENCH-MATES

T. SRINIVASACHARYA

Ramayana Ratnakara Sri T. Srinivasacharya was a bench-mate of Ramanujan in Pachaiyappa's College. He recalls a few things that he still remembers about him.

ALL MENTAL SUMS

Mr. S. Ramanujan was my classmate in the F.A. class in the Pachaiyappa's College, Madras. I was seated almost next to him. He looked more like the late Dr. K. S. Krishnan. He was often absent-minded, deeply engrossed in mathematical research which made many think he was brain-sick. During this period he was hale and healthy. Our mathematics Professor was Mr. N. Ramanujachari. After he had worked out some mathematics problem, Mr. Ramanujan used to stand on his legs giving short and alternative methods of solution saying 'or thus', 'or thus'. He used to jump from the 1st step almost to the last step mentally working all the intermediate steps. Mr. M. Patanjali Sastri, the Retd. Chief Justice of India, who was one year senior to us was occasionally discussing with him on some point in Mathematics. Regarding the problems given in our text books in Geometry, Algebra and Trigonometry he used to remark "Those are all mental sums". To a certain extent he was uncouth in his dress, probably due to his poverty. He rarely got more than 10% in Physiology for which subject he had a supreme contempt and got something more than 15 to 20 per cent in Greek and Roman History but managed to get about 25% in English. Prof. J. R. Cunningham at times remarked 'Can't you improve Mr. Ramanujan?'. This accounted for his failure in the F.A. although he would finish the 3 hours' Maths. paper in half an hour. He used to tell me 'I will give you shortly some startling Theory of Numbers' but he never told me anything about it.

IN RED INK ACROSS WRITTEN PAPERS

After a few years later, accidentally I met him near the Madras Harbour when he was presumably employed in the Port Trust as a clerk. When I asked him 'What are you doing, Ramanujan?' he said, 'I am picking up plain unwritten paper used for packing, as I am unable to get enough paper to write mathematical problems.' Sometimes he used to write mathematical problems in red ink across already written papers for want of plain paper.

WE TWO TOGETHER IN THE COLLEGE

N. HARI RAO

Late N. Hari Rao, a college-mate of Ramanujan at Kumbakonam, gives an absorbing account of Ramanujan. Fuller version appears in the Centenary Souvenir 1954 of the College.

HIS AMAZING POWERS

There is nothing extraordinary about his parents or his ancestors, which could be said to have been inherited by him to account for the greatness that awaited him later in life.

At twelve he could solve unaided every problem in Loney's Trigonometry, Part II. He, then, borrowed, through a friend

TOWN HIGH SCHOOL

KUMBAKONAM.

18th November 1905.

II Form C Division.

1st PRIZE 1903

Awarded to

S. Ramanujam

as a reward of merit and an incentive to further improvement.

Secretary.

CRITICAL AND HISTORICAL

ESSAYS

CONTRIBUTED TO THE EDINBURGH REVIEW

BY

LORD MACAULAY

A NEW IMPRESSION

S. VIJAYARAGHAVA & BROTHERS,
Book-Sellers & Stationers,
KUMBAKONAM.

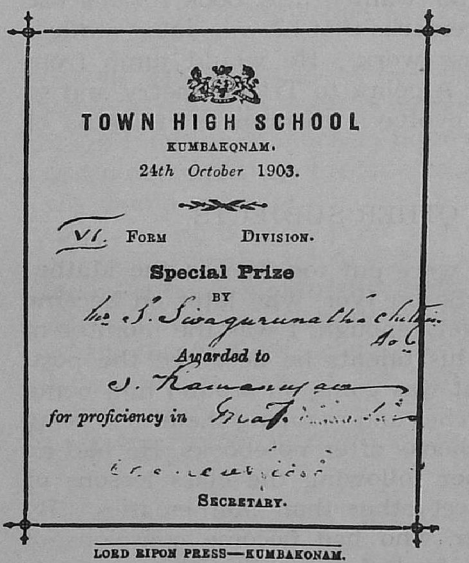
LONGMANS, GREEN, AND CO.
39 PATERNOSTER ROW, LONDON
NEW YORK AND BOMBAY
1899

from this college Carr's Synopsis of Pure Mathematics, containing 6,165 formulae without proofs in Algebra, Trigonometry, Geo-

metry and Calculus and worked out all of them, each being a piece of research by itself. This opened up to him a vista to all the higher branches of Mathematics. In this period, his teachers and classmates were struck by his amazing powers and he readily helped one and all including even undergraduates who came to him for getting difficult problems solved.

PRIZE FOR MATHEMATICS

The first public recognition of his extraordinary powers was on the occasion of the Annual Prize distribution in 1904. He was the recipient of Sri K. Ranganatha Rao's prize for Mathematics,



TOWN HIGH SCHOOL
KUMBAKONAM.
24th October 1903.

VI. FORM DIVISION.

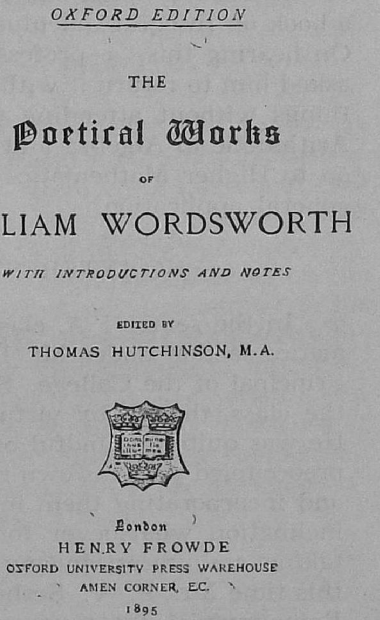
Special Prize
BY
Mr. S. Sivaguruna tha Chetty Avl.

Awarded to
S. Ramanujan

for proficiency in Pure Mathematics

SECRETARY.

LORD RIPON PRESS—KUMBAKONAM.



OXFORD EDITION

THE
Poetical Works
OF
WILLIAM WORDSWORTH

WITH INTRODUCTIONS AND NOTES

EDITED BY
THOMAS HUTCHINSON, M.A.

London
HENRY FROWDE
OXFORD UNIVERSITY PRESS WAREHOUSE
AMEN CORNER, E.C.
1895

Note that even for Mathematics Ramanujan was awarded a literary book.

when Sri Krishna Iyer, the reputed Head Master of the Town High School, introduced him to Sri V. Krishnaswamy Iyer, the President of the function, and to the distinguished audience in such terms as these — 'Here is a student, who, my Mathematics assistant says, has displayed in his answer papers a remarkable ability and deserved many more marks than even the maximum itself'. He passed the Matriculation Examination in 1903 and joined the Junior F.A. class of the College in 1904. Unfortunate-

ly he was detained on the score that he obtained only three marks out of hundred in English, with the result that he lost the scholarship he had earned.

CONSTRUCTING MAGIC SQUARES

I matriculated in 1904 and was his classmate at College for two years. We used to sit together in the class and I developed a friendship with him which continued till his death. I had thus an opportunity of observing his powers somewhat at close quarters. The Goddess of Number seemed to dance before him and unravel to him her mysteries without reserve. He could repeat prime numbers up to a crore. He taught me the method of constructing magic squares. He was at that time going through a book on Integral Calculus which he had taken from the library. On hearing this, a professor who wanted the book for his use asked him to return it with the remarks that he was doing aimless things without attending to class work. He would jump from Arithmetic to Algebra and from Algebra to Trigonometry and so on to Higher Mathematics and evolve a theorem or formula of general application.

NO INTEREST IN OTHER SUBJECTS

In the senior F.A. class we were put together in the Mathematics section under Mr. P. V. Seshu Iyer, who later on became Principal of the College. Strangely enough, I was the monitor of the class, though by virtue of his talents he deserved the post. He was quite unmindful of what was going on around him being preoccupied with his own researches and reducing them to writing and incorporating them in notebooks after notebooks. He had no inclination whatsoever for either following the class lessons or taking an interest in any subject other than Mathematics. By this time Mr. P. V. Seshu Iyer who had become conscious of Ramanujan's innate powers let him alone while other students including myself were asked to do home exercises, to work problems on the board and to write impositions, a rare punishment nowadays even in the high school, not to speak of the college classes. It may be noted that the Professor encouraged him to solve problems in the mathematical journals like the London Mathematical Gazette.

SOMETHING NEW TO GIVE THE WORLD

In 1909 he was married and the burden of maintaining his family and his poor aged parents added to his troubles and diffi-

culties. He was conscious that he had something new to give to the world and he yearned for any help he could get for having his papers printed and published. Nowhere could he find any encouragement. I have heard of an instance where he had a rebuff from a Mathematics professor of note, who remarked that unless he passed his B.A. Degree there was no hope for him. Fortunately for him, soon he got into touch with reputed mathematicians of the day, who were destined to play an important role in shaping his future career .....

I had occasions to visit him at Summer House in Triplicane, when he would open his notebooks and explain to me intricate theorems and formulae without in the least suspecting that they were beyond my understanding or knowledge.

A PURE AND PIOUS LIFE

In religion, he had a firm belief in the existence of a supreme being and he practised it by trying to lead a pure and pious life. He did not know much of philosophy. He used to talk about God and our conduct in life in a mathematical way. He told me that we should regulate our lives to reach Godhead by approximating to the upright path, even as an asymptote approaches along the curve and finally touches it at infinity. A peculiar feature in his character was his utmost credulousness. This is instanced by his adoration of one Satyapriya Rao, the then gymnastic instructor of the Town High School, who had a mental aberration. The latter used to gaze at the sun and blurt out some nonsense of which nothing could be made out, but which struck Ramanujan as extraordinary and which he attributed to his occult powers.

INTEREST IN PALMISTRY

He himself believed that Goddess Namagiri inspired him in his dreams with formulae which, rising from bed, he would jot down and verify. Besides Mathematics, the only subject in which he took some interest was Palmistry. On seeing the lines of his palm he used to tell his friends that his span of life was short and that it would not extend beyond 35 years or so — a prophecy, which, alas, proved to be too true.

MY CONTACT WITH RAMANUJAN

P. V. SESHU IYER

This is an extract from late Prof. P. V. Seshu Aiyar's account of Ramanujan's career appearing in June 1920 of the Journal of the Indian Mathematical Society. Seshu Aiyar joined Hardy and Wilson in bringing out 'Collected Papers of Ramanujan'.

LOSS OF SCHOLARSHIP

From the Town High School, he passed his Matriculation Examination in 1903, and entered the Government College, Kumbakonam, in 1904 for the F.A. course. As a result of a competitive examination in Mathematics and English composition, Ramanujan secured the Junior Subramaniam Scholarship. It was there I, the present writer, came in contact with Mr. Ramanujan for the first time, when I was Lecturer in Mathematics at the Government College. He went to me with a number of results in Finite and Infinite Series, which at once struck me as something very ingenious and original. I exhorted him to go on with his results without at the same time neglecting his other studies. Unfortunately, however, he was found too weak in English to deserve promotion to the Senior F.A. class in January 1905. He had therefore to forego also his scholarship at the College, and being too sensitive to ask his parents for help, he next moved to Vizagapatnam to see if he could shift for himself to go on with his studies. Not receiving much encouragement there, he came to Madras, joined the Pachaiyappa's College and presented himself for the First Examination in Arts in December 1906 without, as is well known now, any success.

SENT TO RAMACHANDRA RAO

It was then after some four years' interval that Mr. Ramanujan met me at Madras, with his two well-sized note-books. I sent Ramanujan with a note of recommendation to that true lover of Mathematics, Dewan Bahadur R. Ramachandra Rao, who was then District Collector at Nellore, a small town, some 80 miles north of Madras. Mr. Rao sent him back to me saying that it was cruel to make an intellectual giant like Ramanujan not at a mofussil station like Nellore, and recommended his stay at Madras, generously undertaking to pay Mr. Ramanujan's expenses for a time.

HIS CONTRIBUTION IN J.I.M.S.

He never slackened his work at Mathematics. His earliest contribution to the Journal of the Indian Mathematical Society was in the form of questions communicated by me in Vol. III (1911). His first long article on 'Some Properties of Bernoulli's Numbers' was published in the December Number of the same volume. Mr. Ramanujan's methods were so terse and novel and his presentation was so lacking in clearness and precision, that the ordinary reader, unaccustomed to such intellectual gymnastics, could hardly follow him. This particular article was returned more than once by the Editor before he gave it a form suitable for publication.

HARDY'S TRACT

It was during this period that he came to me one day with some theorems on Prime Numbers, and when I referred him to Hardy's Tract on '*Orders of Infinity*', he observed that Hardy had said on p. 36 of his Tract, "The exact order of $\rho(x)$ (defined by the equation

$$\rho(x) = \phi(x) - \int_2^x \frac{dt}{\log t}$$

where $\phi(x)$ denotes the number of primes less than x) has not yet been determined and that he himself had discovered a result which gave the order of $\rho(x)$. On this I suggested that he might communicate his result to Mr. G. H. Hardy together with some more of his results. That communication excited Mr. Hardy's interest in Ramanujan which never abated .....

FAREWELL MEETING

Ramanujan sailed for England about the end of March 1914. And just prior to that, the event was marked by a public demonstration held in honour of him by his admirer and well-wisher Mr. Sreenivasa Iyengar, Ex-Advocate General.

REMARKABLE GENIUS IN SEARCH OF HELP

R. RAMACHANDRA RAO

The following is an extract from late Dewan Bahadur Ramachandra Rao's reminiscences. His entry into the life of Ramanujan proved a turning point in his mathematical career.

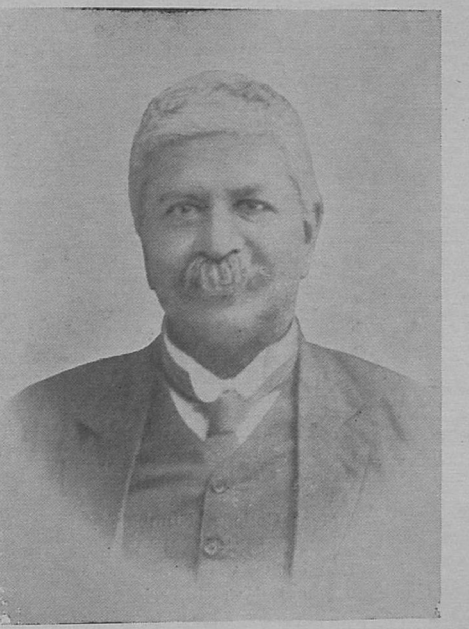
A VISITOR

Several years ago, a nephew of mine perfectly innocent of mathematical knowledge, spoke to me, "Uncle, I have a visitor who talks of mathematics ; I do not understand him ; can you see if there is anything in his talk ?" And in the plenitude of my mathematical wisdom, I condescended to permit Ramanujan to walk into my presence.

A short uncouth figure, stout, unshaved, not overclean, with one conspicuous feature, shining eyes, walked in, with a frayed notebook under his arm. . . . . He was miserably poor. He had run away from Kumbakonam to get leisure in Madras to pursue his studies. He never craved for any distinction. He wanted leisure, in other words, simple food to be provided for him without exertion on his part and that he should be allowed to dream on.

SENSE OR NON-SENSE

He opened his note-book and began to explain some of his discoveries. I saw quite at once that there was something out of the way, but my knowledge did not permit me to judge whether he talked sense or non-sense. Suspending judgement, I asked him to come over again. And he did. And then he had gauged my ignorance and showed me some of his simpler results. These transcended existing books and I had no doubt that he was a remarkable man. Then step by step he led me to elliptic integrals, and hypergeometric series and at last his theory of divergent series, not yet announced to the world, converted me. I asked him what he wanted. He said he just wanted a pittance to live on, so that he may pursue his researches. It is a matter of considerable pride to me that I was in some way useful to this remarkable genius in his earlier days. In a year's time, I introduced him to Sir Francis Spring who gave him a sinecure post in his office.....



Dewan Bahadur R. Ramachandra Rao, M.A., the then District Collector of Nellore and a lover of mathematics who met the expenses of Ramanujan's stay in Madras for a year.

Government College, Kumbakonam, Madras State. It celebrated its Centenary in 1954. Ramanujan did his F.A. here. He had access to books in the library of the college even from his school days through his admiring senior friends.

MYSTERIES OF FORK AND KNIFE

Ramanujan consulted me and perhaps unfortunately I lent all the weight of my influence to induce him to go . . . (abroad). The last two or three days of his stay in India before he proceeded to England he spent with me in a mofussil station. I took him to the house of a friend living in European style to initiate him in the mysteries of the fork and the knife, under the strict stipulation that nothing but vegetable food should be served. He was not happy. He did not relish food being served by strange servants. He was not very jubilant over his future journey and over his assured distinctions to come. He seemed to have moved as if he was obeying a call.

PREMATURE END

When I met him alighting from the Railway train, I foresaw the end. He died young but illustrious.

AS I REMEMBER HIM . .

This is an extract from what a classmate (name not known) of Ramanujan wrote to P. V. Seshu Aiyar.

HIS EARLY LIFE

Throughout his school course he held a free scholarship, and his teachers had already noticed his extraordinary and precocious intellect. He used to borrow Carr's "Synopsis of Pure Mathematics" from the College Library, and took delight in verifying some of the formulae given there. He would clear in half the time examination papers in Algebra and Geometry and a few seconds' thought always used to suggest to him, the solution to any question however difficult. He used often to entertain his friends with his theorems and formulae even in those early days which doubtless appeared to his hearers as mathematical tricks.

HIS RELIGIOUS DISPOSITION

He had a distinctly religious turn of mind, and was a staunch believer in Hinduism. He never missed, if he could help it, a single '*sraavanam*'* ceremony at the Uppiliappan Koil near Kumbakonam. No wonder then that while at Cambridge he could not be persuaded to take the food cooked by others, and always cooked his own food. He had an extraordinary memory and could easily repeat the complete lists of Sanskrit roots (*atmanaepada* and *parasmaipada*) ; he could give the values of $\sqrt{2}$, π, e etc., to any number of decimal places. In manners, he was simplicity itself.

HIS CONCERN FOR OTHERS

On one occasion when I was seriously laid up with fever just before the Matriculation Examination, he used to read for me every night. After his return from England and during his brief stay at Kumbakonam, he insisted on seeing my aunt, who was an old widow on the wrong side of 70 and whom he knew while at school some 20 years ago.

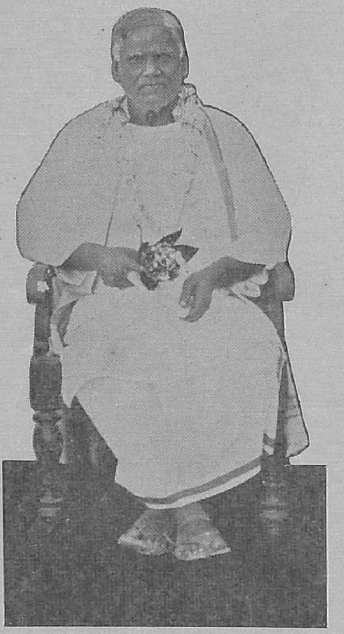
HIS PECULIAR FRAME OF MIND

Perhaps, Ramanujan's peculiar frame of mind and philosophic temperament is forcibly illustrated by the following incident ; when about to undergo a serious operation under chloroform at Kumbakonam, he was trying to discover within himself as to which of the five senses lost its power first and which afterwards.

---

* Annual renewal of sacred thread.

Prof. P. V. Seshu Ayyar, B.A., L.T., who served as Prof. of Mathematics in Govt. Colleges at Kumbakonam and Madras, had known and helped Ramanujan from his college days and collaborated with Hardy and Wilson in bringing out the 'Collected Papers of Ramanujan'.



Prof. V. Ramaswamy Iyer, Founder of the Indian Mathematical Society, whose patronage Ramanujan sought in 1910 for getting an employment.

TWO PROUD THINGS I DID

Prof. V. RAMASWAMY IYER

Late Ramaswamy Iyer was never a professor in any college, though he was always called a professor for his great devotion to and high attainments in Mathematics. While working as Deputy Collector, he founded in 1907 the Indian Mathematical Society which brought Ramanujan to the notice of the Mathematical world.

When I review my life, dividing it into eight octaves, I am proud of two things which I have done. Both of them occurred in the fifth octave marking the prime of my life. The first of them is the founding of the Analytical Club in 1907, later changed to Indian Mathematical Society and the second is the discovery of the renowned mathematical genius, S. Ramanujan, F.R.S.

When I was Deputy Collector in Tirukoilur in 1910, Ramanujan, who had heard of my mathematical interest, sought my patronage asking for appointment as a clerk in a taluk office or in a taluk board office in my jurisdiction. The only recommendation he carried with him was his famous Notebook, now deposited in the Madras University Library and hardly believed by any, till then, to contain anything of considerable value. On perusing the Notebook, I was struck by the extraordinary mathematical results contained in it. I sensed what a gifted mathematician the author of the Notebook was. I had no mind to smother his genius by an appointment in the lowest rungs of the revenue department. But he required something to live on. So I sent him to Madras with notes of introduction to my mathematical friends occupying positions of influence in Madras.

The story is well known how eventually Ramanujan was made a research student of the Madras University, was deputed to the Cambridge University and was helped to achieve his lasting world fame.

A PURE MATHEMATICIAN OF THE FIRST ORDER

LORD PENTLAND

Lord Pentland, the then Governor of Madras, made the following observations while delivering his opening speech at the First Conference of The Indian Mathematical Society held at the Presidency College, Madras, on 27-12-1916. He sanctioned a sum of Rs. 10,000 in order to secure Ramanujan's visit to England for a couple of years.

The methods of mathematics play an increasing and important part in the discussion and elucidation of numerous problems in sociology, economics and other studies in the expanding complex of our environment and it is a matter of great moment that among those who have to deal with these studies should be a body of men who are accustomed to the rigorous principles of mathematical proofs and who find intellectual relaxation and refreshment in keeping themselves informed of modern developments in what is, I suppose, the oldest science in the world. Moreover it is at any rate a science which has always made a strong appeal to the Indian intellect and has received from it important contributions. It is for example I suppose probable that to India we owe the decimal notation and the invention of algebra; and India can point to at least one epoch in which it produced a number of brilliant mathematicians and astronomers. Is there any reason why such an epoch should not recur ? None that I can see.

At the present time a young Indian student Mr. S. Ramanujan is studying at Cambridge whose career we in Southern India are watching with keen interest and high anticipations. You know the story of the discovery of his unusual talent and all here will be glad to hear how entirely he is justifying the efforts which were made to give it full scope. I shall quote merely one sentence from a letter written from Cambridge by one of the most distinguished mathematicians of the present day. "In him", he says, "India now possesses a pure mathematician of the first order whose achievements suggest the brightest hopes for its scientific future." Not a few Indians have earned high distinctions in the Cambridge schools. Some of them, I believe, are members of this Society and they will be able to realise what is required to earn an encomium of this nature.

RAMANUJAN'S ARTICLES IN THE JOURNAL OF THE INDIAN MATHEMATICAL SOCIETY

M. T. NARAYANAIENGAR

Late M. T. Narayanaiengar, one of the earlier editors of the Journal of the Indian Mathematical Society refers to the difficulties experienced in accepting contributions from Ramanujan for the Journal.

The proudest achievement of the Society was perhaps the discovery of the great South Indian Mathematician the late S. Ramanujan, F.R.S. His contributions began to appear in our Journal in 1911, and his first article on 'Some Properties of Bernoulli's Numbers' attracted considerable attention. It is however a sad confession to say that the Editor's work in connection with Ramanujan's contributions was by no means light. Ramanujan saw intuitively many things and could not bring himself to explain and the first article had to be referred back to him no less than three times.

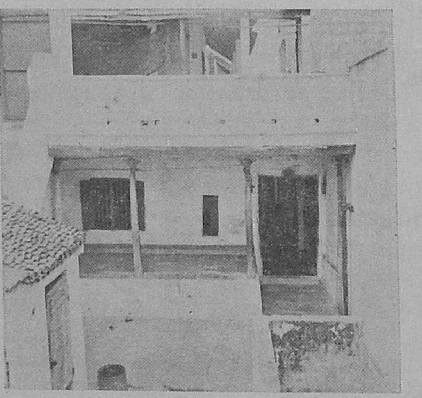
MY ACQUAINTANCE WITH RAMANUJAN

K. B. MADHAVA

Prof. K. B. Madhava, a famous statistician recalls his brief association with Ramanujan prior to the latter's departure to England.

IN THE SAME STREET

I first met Mr. Srinivasa Ramanujan in 1913 in the house of Prof. P. V. Seshu Aiyar where I was frequently going, among other purposes, for correcting the galley-proofs of the Indian Mathematical Society's Journal which was then being printed at the Kapalee Press in Thambu Chetty Street, George Town, Madras. I used also to pass by the house where Mr. Ramanujan



The house at Hanumantharayan Koil Lane where Ramanujan lived while he was working as the first research scholar of the University of Madras. Now it carries a tablet in his honour.

lived in Hanumantharayan Koil Street several times everyday as I myself was living in that lane only a few houses away. Mr. Ramanujan also came to my house on more than one occasion and used to take away some book or another on 'higher' Mathematics from my library but I must confess that I parted with them with great hesitation or reluctance thinking that it was beyond his capacity to use them properly. Apart from my own conceit which was the primary cause of this, I should say that Ramanujan's own natural shyness and unassuming nature

must have contributed to this. I had by then seen his paper on Bernoulli's numbers which had been published in 1911 in the J.I.M.S. but had been told that it had been edited many times by many persons.

A SOLUTION TO RAMANUJAN'S PROBLEMS

It was only after he had gone to England in 1914 and after I had opportunities to study books like Bromwich's 'Infinite Series' and others, that I furnished some solutions to a few of the problems which he proposed in the J.I.M.S. Like others I was greatly struck by many of his uncanny definite integrals connected with cosine nx divided by $\exp(2\sqrt{n}\,x) -$ and with the reciprocal of the continued product of $(1+x^2)\ (1+r^2\,x^2)\ (1+r^4\,x^2)\ldots$ and with the extraordinary but familiar series, n to the power of 13 divided by $\exp(2\sqrt{n}\,x) - 1$ and with $\coth \pi$ series divided by the 7th powers of natural numbers etc. The late Dr. T. Vijayaraghavan mentioned to me that Prof. Hardy had asked him whether I was keeping up my interest in Ramanujan's "Problem".

A FELICITATION MEETING

In 1918 when Ramanujan was elected to the Royal Society a public meeting was got up in the Presidency College, Madras, to felicitate him, and I remember the opportunity given to me to participate in that function as I recited many an anecdote that had been collected in de Morgan's book about the Fellowship and the play on the initial letters of F, R and S constituting the honour. It is my recollection that that meeting was held in the Big English Lecture Hall, but another esteemed friend of mine, Prof. G. A. Srinivasan tells me that the meeting was held probably in Prof. Seshu Aiyar's Applied Mathematics room.

ON THE EVE OF SAILING TO ENGLAND

R. GOPALA AIYAR

Prof. R. Gopala Aiyar retired from the Zoology Department of the Presidency College, Madras, describes the visit of Ramanujan to the College before his sailing to England.

I was one of those who had the privilege of meeting him. Though our fields of interest were wide apart, Prof. P. V. Seshu Aiyar, who was a respected colleague of mine at the Presidency College, was the common link and I, for one, used to meet Ramanujan both at the residence and in the college rooms, of Prof. Seshu Aiyar pretty often.

The one occasion which vividly comes to my memory is the visit to the common room of the Assistant Professors in the Presidency College of Ramanujan on the very eve of his sailing to England. He arrived there with a huge suitcase in which he had packed quite a few articles of western dress which he had stitched for his use abroad. He laid them all one by one on the table and sought the help of those among us who were accustomed to wear western dress to show him how they should be worn correctly. He had, in particular, much difficulty in making the knot with the neck-tie, and he amused himself and us by confessing his inability to tackle that simple encumbrance.

From this, he went on expressing his diffidence as to how he would be able to conform rigorously to the austerities and observance of orthodox Hindu life in regard to food and other forms. So the conversation went on in childlike innocence and simplicity which only illustrated how unassuming that great man of achievement and potentiality was.

A FALSE STORY

Dr. S. R. RANGANATHAN

Dr. S. R. Ranganathan, the renowned founder of Colon Classification in Library Science was formerly on the staff of the Presidency College. He explodes a false story that circulated about Ramanujan.

Ramanujan's mathematical ability came to be recognised at last by about 1914, but a false story gained currency. According to it, Ramanujan was supposed to have failed even in Mathematics. This story gave an easy handle for cynics to decry our University system. It even caused disaster to a remarkably gifted young mathematician who was my student. He systematically neglected his legitimate work in his honours class in mathematics, thereby equating himself with Ramanujan on the basis of the above-mentioned false story.

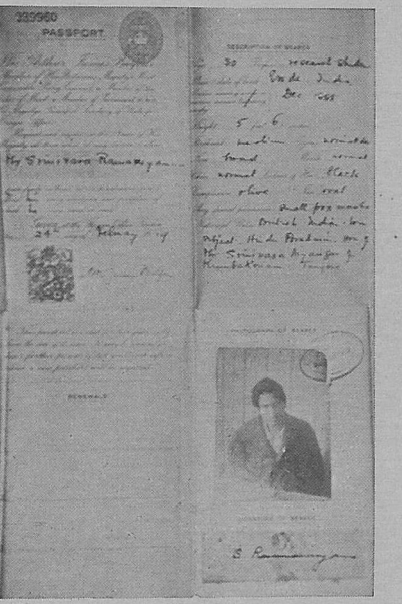
I had an unexpected chance to discover the falsity of this story. About 1922, Statistical Methods came to be prescribed as a special subject in the honours course for Mathematics of the University of Madras. Prof. Seshu Ayyar was then a Member of the Syndicate of the University. He therefore got me permission to have access to the old marks-books of the University for about fifteen years. These marks-books related to the Intermediate Examination from 1911 onwards and its predecessor F.A. Examination during the earlier years. For my statistical study, I had to transfer the marks to the usual 125×75 mm. cards — of course without the mention of the names of the candidates. I found Ramanujan's F.A. marks in one of those volumes. He had really scored cent-per-cent in Mathematics. His failure was due to poor marks in the other subjects.

A DESIRE FULFILLED

C. S. RAMA RAO SAHIB

Sri C. S. Rama Rao Sahib, son-in-law of Dewan Bahadur Ramachandra Rao, recalls a touching incident in Ramanujan's last days.

During one of my visits to Ramanujan's place in one of late Namberumal Chetty's compound after his return from U.K., he expressed a desire for *Rasam* prepared in Victoria Hostel as he knew that it always had a good flavour and taste particularly as it was prepared in large quantities. I remember he expressed great satisfaction when he got his desire fulfilled. I found that he was quite enthusiastic and human, notwithstanding he was seriously ill at that time. It appeared that he was quite cheerful in spite of his emaciated condition.



Ramanujan's London Passport dated 24-2-1919.

His Excellency, Lord Pentland, Governor of Madras, who supported the moves made to send Ramanujan to England by exercising his special prerogatives.

AN ANECDOTE

S. V. IYER

Sri S. V. Iyer of Tambaram narrates an interesting incident about Ramanujan with whom he travelled once in a tramcar.

Ramanujan would always be in a contemplative mood. In the tramcar of the olden days there used to be a bench just behind the driver and Ramanujan and myself were returning to Triplicane in the evening sitting on the long bench at the driver's back. The driver was alternatively accelerating the speed or applying the brakes with gusto. Ramanujan burst out, " See how that man is imagining that he has the power to go slow or fast at his pleasure. He forgets that he gets the power through the current that flows in the overhead wires, which is not visible to him, unless he tries to see it. That is how *maya** works in this world."

* Illusion making power of God.

FROM OBSCURITY TO FAME

E. H. NEVILLE

Late Prof. E. H. Neville of Cambridge played a notable part in Ramanujan's meteoric rise. He gives a very moving account of his association with Ramanujan.

FIRST LETTER TO HARDY

. . . . Ramanujan's name had become well known in Cambridge, the home of mathematics in England. G. H. Hardy, then a young lecturer at Trinity College and now the dominant figure among English mathematicians, who was destined to be closely associated with Ramanujan in the future, has sometimes said that Ramanujan was his discovery, but the truth is that Ramanujan chose Hardy. In a booklet dated 1910, Ramanujan found for the first time formulae like some of his own, and acting on the advice of Seshu Aiyar, he wrote on January 16, 1913, a letter to the unknown author. No one who was in the mathematical circles in Cambridge at that time can forget the sensation caused by this letter. An obscure Indian clerk was appealing for advice because he was inexperienced, for help in the publication of his theorems because he was poor. 'But only', he said, 'if you are convinced that there is anything of value. Of the theorems sent without demonstrations by this clerk of whom we had never heard, not one could have been set in the most advanced mathematical examination in the world'. It must be confessed that the first suggestion was that the letter was a hoax, that the theorems must be familiar theorems, skilfully disguised, but this explanation was soon abandoned for there were some formulae in the letter for which it certainly could not account.

Of these Hardy has said, "They defeated me completely; I had never seen anything in the least like them before. A single look at them is enough to show that they could only be written down by a mathematician of the highest class. They must be true because, if they were not true, no one would have had the imagination to invent them." A great mathematician who has discovered formulae of an entirely novel kind does not use them to mystify his friends.

END OF INTELLECTUAL SOLITUDE

Hardy answered the letter promptly and Ramanujan knew that at last his intellectual solitude was at an end. His friends in India encouraged him and supported him, but none of them had the knowledge to bring him the human satisfaction of being understood and appreciated . . . . .

I visited Madras myself in the opening of 1914. After my first lecture Ramanujan was introduced. We sat down, and he turned the pages of a notebook. Two days later he turned the pages again, and after our third meeting he said, " Perhaps you would like to take it away with you ". The astounding compliment took away my breath. The priceless volume had never been out of his hands : no Indian could understand it, no Englishman was to be trusted with it. The truth was, of course, that the English were objects of suspicion not as individuals but as components of the governing machinery ; I came from outside the machine, and for no other reason than that, I enjoyed an overwhelming advantage which was grossly unfair. Richard Littlehailes, the Professor of Mathematics, in particular, had done and was to do far more for Ramanujan in Madras than I did.

IMPORTANCE TO HIM OF A STAY IN ENGLAND

Ramanujan's trust having been won so completely, I raised immediately the question of Cambridge, and found to my delight and surprise that Ramanujan needed no converting and that his parents' opposition had been withdrawn. In a vivid dream his mother had seen him surrounded by Europeans and heard the Goddess Namagiri commanding her to stand no longer between her son and the fulfilment of his life's purpose. Lest he should be harassed presently by attempts to dissuade him, I addressed myself to the task of convincing his friends that the proposal was in Ramanujan's own interest. I wrote at once to Hardy that the intangible obstacles had disappeared and that he must see that financial provision was made ; I should try to obtain grants in Madras. But if I failed, the money must somehow be found in England. I do not know what account I gave of Ramanujan and the notebooks, but I made it abundantly clear that if Ramanujan was willing to come, financial difficulties simply must not be allowed to interfere. For a moment Hardy faltered. ' Be careful what you promise ', he wrote, and he forwarded cautious memorandum of the " We-have-heard-of-those-untaught-geniuses-before " types, from the India Office in London. I claim no credit for ignoring this warning and laughing at Hardy's endorsement

of it ; I had seen the notebooks and talked with Ramanujan, and Hardy had not. Moreover while letters were travelling between Madras and London, it was becoming likely that all the money wanted would be found in India. Littlehails introduced me to everyone who carried weight in the University or in the civil administration ; everywhere I talked of Ramanujan, explained as I have tried to do now the importance to him of a stay in Cambridge, and urged generosity. On January 28, I addressed to the University authorities a prospective memorandum. Littlehails drafted proposals in detail, and within a week the University, with the approval of the Government, had created a scholarship ample to maintain Ramanujan in Cambridge and his wife and mother in Kumbakonam. A few days later I left Madras.

LIFE IN A STRANGE CIVILIZATION

It was in April 1914 that Ramanujan arrived in Cambridge, where he lived in my house until residential accommodation became available for him in July in Trinity. He felt the petty miseries of life in a strange civilization, the vegetables that were unpalatable because they were unfamiliar, the shoes that tormented feet that had been unconfined for 26 years, but he was a happy man, revelling in the mathematical society, which he was entering, and idolized by the Indian students.....

A LOVABLE MAN

I must not end without making an attempt to describe the man himself. In figure he was a little below medium height, and stout until emaciated by disease ; he had a big head with long black hair brushed sidewards above a high forehead, his face and his complexion never really dark, grew paler during his life in England ; his ears were small, his nose broad, and always his shining eyes were the conspicuous features that Ramachandra Rao observed in 1910. He walked stiffly, with head erect and toes outturned : if he was not talking as he walked, his arms were held clear of the body, with hands open and palms downwards. But when he talked, whether he was walking or standing, sitting or lying down, his slender fingers were for ever alive, as eloquent as his countenance. He had a fund of stories, and such was his enjoyment in telling them that in his great days his own irrepressible laughter often swallowed the climax of his narrative. He loved a paradox, but I do not know of any that he invented ; the paradoxical element in some of his own early work must have made him aware that the wildest nonsense of today

may receive a logical interpretation of tomorrow. He had serious interests outside mathematics, and was always ready to discuss politics or philosophy. Loss of caste was a price he was prepared to pay for coming to England, but he kept the price as low as he could by adhering as closely as circumstances permitted to the observance of his religious practices and in particular in maintaining the strictest vegetarianism. " When I go back ", he said to me once, " I shall never be asked to a funeral " and if he spoke with a sigh there was no sense of pollution mingled with his regret. In everyday life he had an instinctive perfection of manners that made him a delightful guest or companion. Success and fame left his natural simplicity untouched. To his friends he was devoted beyond measure, and he devised curiously personal ways of showing his gratitude and expressing his affection. The wonderful mathematician was indeed a lovable man.

Had Ramanujan not left India he might be alive today ; but he would have had always the sense of power and frustration, not of power and accomplishment. Death, too, was a frustration, but the life's purpose of which his mother dreamed was at last in part fulfilled and it is better to be frustrated by unsought death than by life. So Srinivasa Ramanujan believed, for he told me just before he left England that he had never doubted that he did well to come.

PROF. NEVILLE THUNDERSTRUCK

This is an extract from an article appearing in the July issue of "The Journal of the Kumbakonam College Library Society" 1920. The author of the article is not known.

I well remember a conversation at which I was privileged to be present between Messrs. Ramanujan and Neville. The latter was referring to some mathematical work which Mr. Hardy and himself had recently been doing in England and was remarking that a certain result had been arrived at after great trouble. Ramanujan at this stage struck in with these words : "Oh, I have known this result for the last three years. I don't think it gives you any great trouble. It can be got by differentiating two and a half times." Mr. Neville was thunderstruck, for here was a young obscure brown man scarcely out of his teens who was acquainted with a mathematical operation which had been found capable of interpretation by distinguished European mathematicians only a fortnight back. This conversation served to give a practical turn to the idea which had for sometime past been taking shape in the minds of some Indian gentlemen interested in him, namely, that of sending him to England.

HAD RAMANUJAN LIVED LONGER . .

K. ANANDA RAO

Prof. K. Ananda Rao, a distinguished Professor of Mathematics retired from the Presidency College, Madras recalls his association with Ramanujan. Ramanujan was at Trinity while Prof. Ananda Rao was at King's. The Committee had the privilege of having an interview with him on 25-11-1962 and getting his reminiscences.

AT TRINITY

Some time before Ramanujan left for England he was living in Triplicane. I first got acquainted with him when I, along with some of my friends, paid him a visit at his residence in Triplicane. He went to England a few months before I did, and he returned to India a few months after my return. At Cambridge, he was at Trinity College and I was at King's. I used to meet him often during this period. During vacations, he used to stay mostly in Cambridge. His room was electrified and was provided with a gas stove. He cooked his food, and his menu generally consisted of cooked rice, curds, fruits, *sambhar** with potatoes, onions and other vegetables.

HIS SIMPLICITY

In his nature he was simple, entirely free from affectation, with no trace whatever of his being self-conscious of his abilities. He was quite sociable, very polite and considerate to others. He was a man full of humour and a good conversationalist, and it was always interesting to listen to him. On occasions when I met him, we used to talk in homely Tamil. He could talk on many things besides mathematics, and he was particularly interested in psychic research and the experiments of Oliver Lodge and others.

He rarely talked of his family, except for occasional references to his mother, for whom he had great affection. He never mentioned to me even once about his brothers. Only recently, I came to know that a brother of his was now residing in Triplicane.

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* Spiced tamarind vegetable soup.

HIS POPULARITY

He was very popular with Indian students at Cambridge and he had also many English friends with whom he moved freely. He was often seen at tea-parties and other social gatherings, where he, of course, rigidly adhered to his vegetarian habits.

SMITH'S PRIZE

I recall an incident which showed his unassuming nature. When I told him that I was preparing an essay for a Smith's Prize, he went and asked Hardy, in dead earnest, whether he could also try for that Prize. Hardy had a hearty laugh over his question and assured him that what he had achieved deserved far higher recognition than a Smith's Prize.

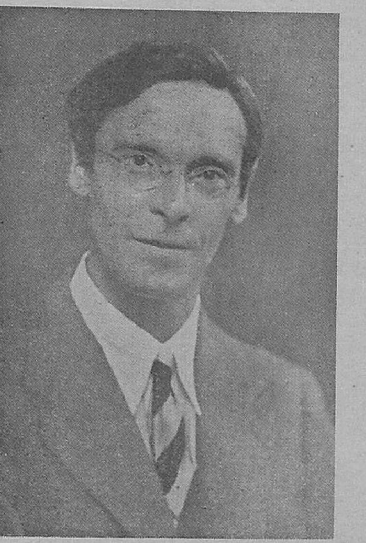
KRISHNA RAO

Among those who helped Ramanujan in his early career, the names of Ramachandra Rao and Seshu Iyer are familiar and appear in the published accounts of Ramanujan's life. There was another, not so well-known, who stood by Ramanujan during his difficult days and was of considerable help to him. This was R. Krishna Rao who was a cousin of my mother. Owing to my close relationship with Krishna Rao, I know the extent to which Krishna Rao rendered help to Ramanujan. Krishna Rao's association with Ramanujan deserves to be better known.

HIS ORIGINALITY

About Ramanujan's mathematics extensive accounts have been written by Hardy and others. His best work bears the stamp of remarkable originality. It is still a mystery how he was able to arrive at his conjectures of some very deep results. The unique underlying feature of Ramanujan's work was his masterly manipulative skill, which was often of a staggering character. In this ability, Hardy compares Ramanujan to Euler and Jacobi. Ramanujan's example may give the hope that the cultivation and exercise of such skill have not yet reached their finality. A close study of his writings is worth-while and may provide clues to his techniques.

I cannot escape feeling that if Ramanujan had lived longer, he would have obtained far greater and more wonderful results in mathematics.



Prof. E. H. Neville, Fellow of the Trinity College, who came to Madras in 1914 as Visiting Professor and who prophecied the emergence of Ramanujan as a world-renowned mathematician.

Senate House, University of Madras, where Prof. Neville as a Visiting Professor delivered lectures on Differential Geometry. It was here he saw Ramanujan and his Notebooks.

MY FRIENDSHIP WITH RAMANUJAN IN ENGLAND

P. C. MAHALANOBIS

Prof. P. C. Mahalanobis, the eminent statistician, recalls the days of his friendship with Ramanujan in England.

BERRY'S CLASS

I joined King's College, Cambridge, in October 1913. I was attending some mathematical courses at that time including one by Professor Hardy. A little later, we heard that S. Ramanujan, the mathematical prodigy, would come to Cambridge. I used to do my tutorial work with Mr. Arthur Berry, Tutor in Mathematics of King's College. One day I was waiting in his room for my tutorial when he came in after having taken a class in elliptic integrals. He asked me : "Have you met your wonderful countryman, Ramanujan ?" I told him that I had heard that he had arrived but I had not met him so far. Mr. Berry said : "He came to my elliptic integrals class this morning." (This was some time after the full term had begun, and I knew Mr. Berry had already given a few lectures on that subject.) I asked "What happened ? Did he follow your lecture ?" Mr. Berry said, "I was working out some formulae on the black board. I was looking at Ramanujan from time to time to see whether he was following what I was doing. At one stage, Ramanujan's face was beaming and he appeared to be excited. I asked him whether he was following the lecture and Ramanujan nodded his head. I then enquired whether he would like to say anything. He then got up from this seat, went to the black board and wrote some of the results which I had not yet proved". I remember Mr. Berry was greatly impressed. He said that Ramanujan must have reached those results by pure intuition as Professor Hardy had advised Ramanujan to attend the lectures on elliptic integrals because Ramanujan had not studied that subject before.

I was fortunate in becoming good friends with Ramanujan very soon. It came about in a somewhat strange way. Within a few days of his arrival I had managed to get acquainted with him and was meeting him from time to time. One day I went to see Ramanujan in his room in Trinity College. It had turned

quite cold. Ramanujan was sitting very near the fire. I asked him whether he was quite warm at night. He said he was feeling the cold ; he was sleeping with his overcoat on and was also wrapping himself up in a shawl. I went to his bedroom to see whether he had enough blankets. I found that his bed had a number of blankets but all tucked in tightly, with a bed cover spread over them. He did not know that he should turn back the blankets and get into the bed. The bed cover was loose ; he was sleeping under it, with his overcoat and shawl. I showed him how to get under the blankets. He was extremely touched. I believe this was the reason why he was so kind to me.

In my second year, I got rooms in King's College ; one term I had rooms in the staircase overlooking Queen's (just below where J. M. Keynes, at that time, a brilliant young fellow of King's, had his rooms). On Sunday mornings Ramanujan and I often went out for long walks. One Sunday it had been arranged that we would both have our breakfast in my room and then go out for a walk. It was a cold morning with some snowfall. I was a bit late in getting up and was shaving in my bedroom when he arrived. I asked him to wait in the sitting room. When I came out I found that he was reading Loney's Dynamics of a Particle with great interest. Seeing me, he put back the book on the table and said it was very interesting. Evidently he had never studied dynamics but had got interested in what he was reading.

A PROBLEM FROM STRAND MAGAZINE

On another occasion, I went to his room to have lunch with him. The First World War had started some time ago. I had in my hand a copy of the monthly Strand Magazine which at that time used to publish a number of puzzles to be solved by the readers. Ramanujan was stirring something in a pan over the fire for our lunch. I was sitting near the table, turning over the pages of the Strand Magazine. I got interested in a problem involving a relation between two numbers. I have forgotten the details but I remember the type of the problem. Two British officers had been billeted in Paris in two different houses in a long street ; the two numbers of these houses were related in a special way ; the problem was to find out the two numbers. It was not at all difficult ; I got the solution in a few minutes by trial and error. In a joking way, I told Ramanujan, " Now here is a problem for you ". He said " What problem, tell me ", and went on stirring the pan. I read out the question from the Strand Magazine. He promptly answered " Please take down the solu-

tion" and dictated a continued fraction. The first term was the solution which I had obtained. Each successive term represented successive solutions for the same type of relation between two numbers, as the number of houses in the street would increase indefinitely. I was amazed and I asked him how he got the solution in a flash. He said "Immediately I heard the problem it was clear that the solution should obviously be a continued fraction; I then thought, which continued fraction? And the answer came to my mind. It was just as simple as this."

HIS THEORY OF REALITY

I have mentioned that Ramanujan and I often used to go out for long walks on Sunday mornings. During these walks our discussions ranged over a wide variety of subjects. He had some progressive ideas about life and society but no reformist views. Left to himself, he would often speak of certain philosophical questions. He was eager to work out a theory of reality which would be based on the fundamental concepts of "zero", "infinity", and the set of finite numbers. I used to follow in a general way but I never clearly understood what he had in his mind. He sometimes spoke of "zero" as the symbol of the Absolute (*Nirguna Brahman*) of the extreme monistic school of Hindu Philosophy, that is, the reality to which no qualities can be attributed, which cannot be defined or described by words and is completely beyond the reach of the human mind; according to Ramanujan, the appropriate symbol was the number "zero", which is the absolute negation of all attributes. He looked on the number "infinity" as the totality of all possibilities which was capable of becoming manifest in reality and which was inexaustible. According to Ramanujan, the product of infinity and zero would supply the whole set of finite numbers. Each act of creation, as far as I could understand, could be symbolised as a particular product of infinity and zero, and from each such product would emerge a particular individual of which the appropriate symbol was a particular finite number. I have put down what I remember of his views. I do not know the exact implications.

Ramanujan's facility in the theory of numbers was in a large measure intuitive. He made numerous conjectures, like other pure mathematicians. Many of the results apparently came to his mind without any effort. He was, however, aware that a good deal of intellectual effort would be required to establish his philosophical theories. This probably was the reason why he seemed to have been perhaps emotionally more interested in his philosophical ideas than in his mathematical work. He spoke with

such enthusiasm about the philosophical questions that sometimes I felt he would have been better pleased to have succeeded in establishing his philosophical theories than in supplying rigorous proofs of his mathematical conjectures.

RAMANUJAN — THE MAN

Ramanujan had a somewhat shy and quiet disposition, a dignified bearing and pleasant manners. He would listen carefully to what other people were saying, but would usually remain silent. If he was asked any question, or on rare occasions, if he joined in any general conversation, he would speak in a frank and open way, but briefly. In speaking to a friend or in very small groups, he would, however, expound his own ideas with great enthusiasm, not only on philosophical questions but occasionally also on other subjects in which he was seriously interested. Although I could not follow his mathematics, he left a lasting impression on my mind. His bright eyes and gentle face with a friendly smile are still vivid in my mind.

AS I THINK OF RAMANUJAN . .

G. H. HARDY

The following are excerpts taken from the 'Obituary Notice' and the 'Twelve Lectures on Ramanujan' by Prof. G. H. Hardy whose memory is cherished by all lovers of mathematics in India for the help he rendered in enabling Ramanujan to get recognition for his mathematical contributions. The subtitles are professor's own phrases.

THE MOST ROMANTIC FIGURE

Ramanujan is ..... the most romantic figure in the recent history of Mathematics.....and.....a man whose career seems full of paradoxes and contradictions, who defies almost all the canons by which we are accustomed to judge one another, and about whom all of us will probably agree in one judgment only, that he was in some sense a very great mathematician.....

He worked for most of his life, in practically complete ignorance of modern European mathematics and died when he was a little over thirty and when his mathematical education had in some ways hardly begun. He published abundantly — his published papers make a volume of nearly 400 pages — but he also left a mass of unpublished work which had never been analysed properly until the last few years. This work includes a great deal that is new but much more that is rediscovery, and often imperfect rediscovery.....

HE INVENTED HIMSELF

Ramanujan was, in a way, my discovery. I did not invent him — like other great men he invented himself — but I was the first really competent person who had the chance to see some of his work, and I can still remember with satisfaction that I could recognise at once what a treasure I had found.....

I saw him and talked with him almost everyday for several years, and above all I actually collaborated with him. I owe more to him than to anyone else in the world with one exception, and my association with him is the one romantic incident in my life..

RAMANUJAN MADE IT FAMOUS

.....Until he was sixteen he had never seen a mathematical book of any higher class ..... It was Carr's Synopsis,* which first aroused his full powers. The book is not in any sense a great one, but Ramanujan has made it famous, and there is no doubt that it influenced him profoundly and that his acquaintance with it marked the real starting point of his career. It contains enunciations of 6165 theorems, systematically and quite scientifically arranged, with proofs which are often little more than cross-references and are decidedly the least interesting part of the book. ....Any student of the Note-books (Ramanujan's) can see that Ramanujan's ideal of presentation had been copied from Carr's ....The formal side of Integral Calculus seems to have been Carr's pet subject and the treatment of it is very full and in its way definitely good.....On the whole, considered as an inspiration for a boy of such abnormal gifts, Carr was not too bad and Ramanujan responded amazingly.....

A RATIONAL HUMAN BEING

It is significant that though Indians could befriend him, it was only the English who could get anything effectively done...

....For myself, I liked and admired him enough to wish to be a rationalist about him ; and I want to make it quite clear.... that Ramanujan, when he was living in Cambridge in good health and comfortable surroundings, was, in spite of his oddities, as reasonable, as sane, and in his way as shrewd a person as anyone here....The picture I want to present.....is that of a man who had his peculiarities like other distinguished men, but a man in whose society one could take pleasure, with whom one could drink tea and discuss politics or mathematics ; the picture in short was not of a wonder from the East, or an inspired idiot, or a psychological freak, but of a rational human being who happened to be a great mathematician.....

....The tragedy of Ramanujan was not that he died young, but that, during his five unfortunate years** his genius was misdirected, side tracked and to a certain extent distorted....

HIS LETTERS TO ME

....Ramanujan's letters to me....contain the bare statements of about 120 theorems, mostly formal identities extracted from his notebooks. The formulae (1-10) — (1.12) defeated me

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* See page 151 for title page of the famous book.

** (1907-1912)

A SYNOPSIS

OF

ELEMENTARY RESULTS

PURE MATHEMATICS:

CONTAINING

PROPOSITIONS, FORMULÆ, AND METHODS OF ANALYSIS,

WITH

ABRIDGED DEMONSTRATIONS.

SUPPLEMENTED BY AN INDEX TO THE PAPERS ON PURE MATHEMATICS WHICH ARE TO BE FOUND IN THE PRINCIPAL JOURNALS AND TRANSACTIONS OF LEARNED SOCIETIES, BOTH ENGLISH AND FOREIGN, OF THE PRESENT CENTURY.

BY

G. S. CARR, M.A.

LONDON:
FRANCIS HODGSON, 89 FARRINGDON STREET, E.C.
CAMBRIDGE: MACMILLAN & BOWES.

1886.

(All rights reserved.)

completely; I had never seen anything in the least like them before. A single look at them is enough to show that they could only be written down by a mathematician of the highest class. They must be true; no one would have had the imagination to invent them.....

SO LITTLE WAS WANTED

....There was no gain at all when the College at Kumbakonam rejected the one great man they had ever possessed and the loss was irreparable; it is the worst instance that I know of the damage, that can be done by an inefficient and inelastic education system. So little was wanted, £ 60 * a year for five years, occasional contact with almost anyone who had real knowledge and a little imagination, for the world to have gained another of its greatest mathematicians.

AN IMPOSSIBLE HANDICAP

....It was inevitable that a very large part of Ramanujan's work should prove on examination to have been anticipated. He had been carrying an impossible handicap, a poor and solitary Hindu pitting his brains against the accumulated wisdom of Europe. He had had no real teaching at all; there was no one in India from whom he had anything to learn....

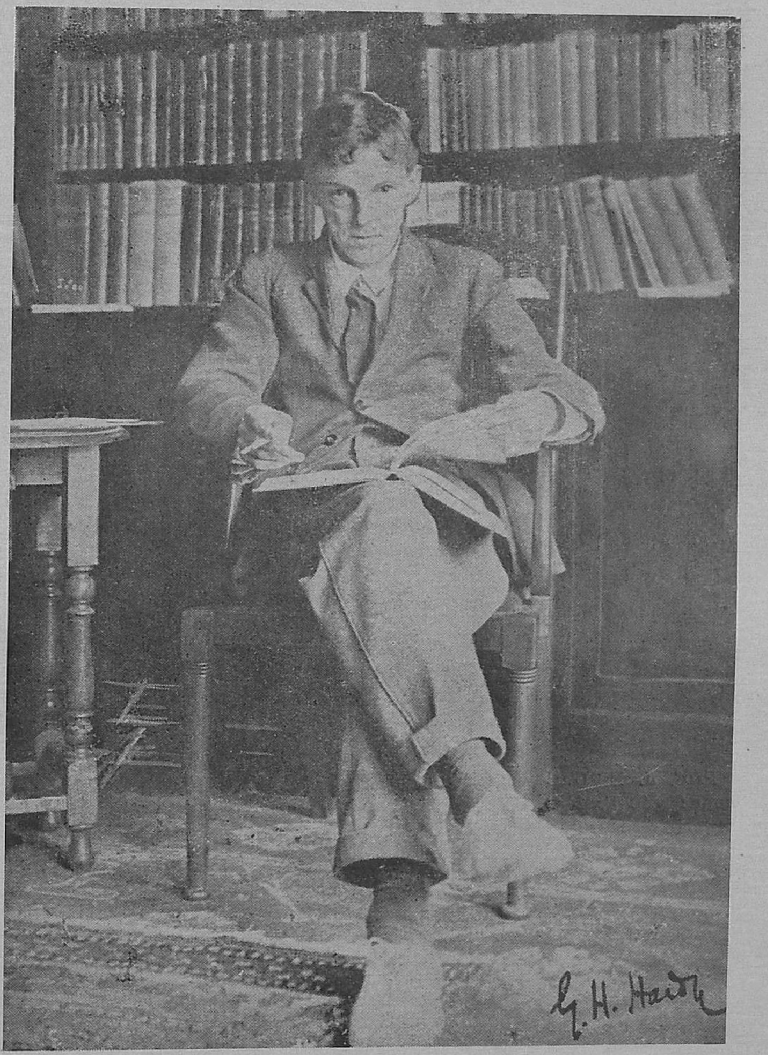
....I should estimate that almost two thirds of Ramanujan's best Indian work was rediscovery and comparatively little of it was published in his lifetime, though Watson, who has worked systematically through his Notebooks, has since disinterred a good deal more.

AS ODD AND INDIVIDUAL AS EVER

....The great bulk of Ramanujan's published work was done in England. His mind had hardened to some extent, and he never became at all an 'orthodox' mathematician, but he could still learn to do new things, and do them exceedingly well. It was impossible to teach him systematically, but he gradually absorbed new points of view. In particular he learnt what was meant by proof, and his later papers, while in some ways as odd and individual as ever, read like the works of a well informed mathematician.

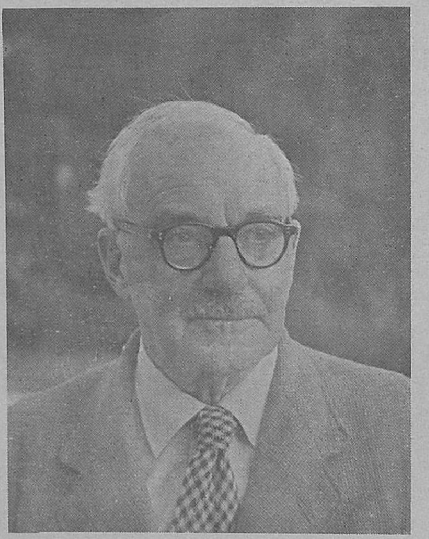
....After all I too was a mathematician, and a mathematician meeting Ramanujan had more interesting things to think

* Rs. 75 p.m.



Prof. G. H. HARDY, as Ramanujan knew him.

'I have found a friend in you (Prof. Hardy) who views my labours sympathetically'.— Ramanujan



Prof. J. E. Littlewood, who joined hands with Prof. G. H. Hardy in helping to secure recognition of the mathematical gifts of Ramanujan.

about than historical research. It seemed ridiculous to worry about how he had found this or that known theorem, when he was showing me half a dozen new ones almost everyday.

As Littlewood says, "the clear-cut idea of what is meant by a proof, nowadays so familiar as to be taken for granted, he perhaps did not possess at all; if a significant piece of reasoning occurred somewhere and the total mixture of evidence and intuition gave him certainty, he looked no further".

TAXI-CAB NUMBER

It was Littlewood who said that every positive integer was one of Ramanujan's personal friends. I remember going to see him once when he was lying ill in Putney. I had ridden in taxi-cab No. 1729 and remarked that the number seemed to me rather a dull one, and that I hoped that it was not an unfavourable omen. "No", he replied, "it is a very interesting number; it is the smallest number expressible as a sum of 2 cubes in 2 different ways."* I asked him, naturally, whether he could tell me the solution of the corresponding problem for 4th power; and he replied, after a moment's thought, that he knew no obvious example, and supposed that the first such number must be very large.....

....His own knowledge was remarkable both for its extent and for its limitations. .... all this work of Ramanujan with its flashes of inspiration and its crude mistakes, was an individual and unassisted achievement .....

For detailed study refer

1. Ramanujan: Twelve Lectures on subjects suggested by his life and work — by G. H. Hardy, Cambridge, at the University Press. 1940.

2. Collected Papers of Srinivasa Ramanujan — Edited by G. H. Hardy, P. V. Seshu Aiyar and B. M. Wilson, Cambridge, at the University Press, 1927.

* $1729 = 12^3 + 1^3 = 10^3 + 9^3$.

RAMANUJAN'S GENIUS

J. E. LITTLEWOOD

Prof. J. E. Littlewood while reviewing Ramanujan's Collected Papers gave an exciting account of the collaboration between Hardy and Ramanujan. It is reproduced here with permission from the Mathematical Gazette (Apr. 1929). The first six lines are from his letter to us dated 5-6-'63.

I saw him* once a week in his rooms, but I cannot remember any details. We usually drifted into his telling me what his latest work was.

I myself was away from Cambridge from about June 1, 1914 and probably did not see Ramanujan after that date and the war disorganised everything after August.

HARDY AND RAMANUJAN

I must say something finally of the paper on partitions written jointly with Hardy. The number $p(n)$ of the partitions of n increases rapidly with n, thus :

$$p(200) = 3972999029388.$$

The authors show that $p(n)$ is the integer nearest

$$\frac{1}{2\sqrt{2}} \sum_{q=1}^{\nu} \sqrt{q}\, A_q(n)\, \psi_q(n) \qquad (1)$$

where $Aq(n) = \Sigma\, \omega_{p,q}\, e^{-2np\pi i/q}$, the sum being over p's prime to q and less than it, $\omega_{p,q}$ is a certain 24 q-th root of unity, ν is of the order of $\sqrt{n}$, and

$$\psi_q(n) = \frac{d}{dn}\left[\exp\left\{C\sqrt{\left(n-\frac{1}{24}\right)}\Big/q\right\}\right]. \quad C = \pi\sqrt{\frac{2}{3}}$$

We may take $\nu = 4$ when $n = 100$. For $n = 200$ we take $\nu = 5$; five terms of the series (1) predict the correct value of

* Ramanujan.

$p(200)$. We may always take $\nu = \alpha\sqrt{n}$ (or rather its integral part), where α is any positive constant we please, provided n exceeds a value $n_0(\alpha)$ depending only on α.

The reader does not need to be told that this is a very astonishing theorem, and he will readily believe that the methods by which it was established involve a new and important principle, which has been found very fruitful in other fields. The story of the theorem is a romantic one. (To do it justice I must infringe a little the rules about collaboration. I therefore add that Prof. Hardy confirms and permits my statements of bare fact). One of Ramanujan's Indian conjectures was that the first term of (1) was a very good approximation to $p(n)$; this was established without great difficulty. At this stage the $n - \frac{1}{24}$ was represented by a plain n – the distinction is irrelevent. From this point the real attack begins. The next step in development, not a very great one, was to treat (1) as an 'asymptotic' series, of which a fixed number of terms (e.g. $\nu = 4$) were to be taken, the error being of the order of the next term. But from now to the very end Ramanujan always insisted that much more was true than had been established : 'there must be a formula with error $O(1)$'. This was his most important contribution ; it was both absolutely essential and most extraordinary. A severe numerical test was now made, which elicited the astonishing facts about $p(100)$ and $p(200)$. Then ν was made a function of n ; this *was* a very great step, and involved new and deep function - theory methods that Ramanujan obviously could not have discovered by himself. The complete theorem thus emerged.

ONE MORE CONTRIBUTION FROM RAMANUJAN

But the solution of the final difficulty was probably impossible without one more contribution from Ramanujan, this time a perfectly characteristic one. As if its analytical difficulties were not enough, the theorem was entrenched also behind almost impregnable defences of a purely formal kind. The form of the function $\psi_q(n)$ is a kind of indivisible unit ; among many asymptotically equivalent forms it is essential to select exactly the right one. Unless this is done at the outset, and the $-\frac{1}{24}$ (to say nothing of the $\frac{d}{dn}$) is an extraordinary stroke of formal genius, the complete result can never come into the picture at all. There

is, indeed, a touch of real mystery. If only we *knew* there was a formula with error $O(1)$, we might be forced, by slow stages, to the correct form of ψ_q. But why was Ramanujan so certain there *was* one ? *Theoretical* insight, to be the explanation, had to be of an order hardly to be credited. Yet it is hard to see what numerical instances could have been available to suggest so strong a result. And unless the form of ψ_q was known already, *no* numerical evidence could suggest anything of the kind — there seems no escape, at least, from the conclusion that the discovery of the correct form was a single stroke of insight. We owe the theorem to a singularly happy collaboration of two men,* of quite unlike gifts, in which each contributed the best, most characteristic, and most fortunate work that was in him. Ramanujan's genius did have this one opportunity worthy of it.

* Hardy and Ramanujan.

RAMANUJAN'S FIRST LETTER IN HARDY'S HANDS

C. P. SNOW

This is an extract from Prof. C. P. Snow's Rectorial Address delivered before the University of St. Andrews, Scotland on 13-4-1962.

SOMETHING NAGGING AT THE BACK OF HIS MIND

One morning early in 1913, a large envelope covered with Indian stamps was waiting on his* breakfast table in his rooms in college. He opened the envelope without much interest : and found, as he expected, that it contained a number of sheets covered with symbols. He was at that time thirty-six, already one of the best-known pure mathematicians in England. Eminent pure mathematicians suffer from a curious occupational risk, in that they are constantly being bombarded by proofs of the prophetic properties of the Great Pyramid — and so on. So Hardy gave the manuscript a perfunctory glance, and went on reading the morning paper. It occurred to him that the first page was a little out of the ordinary, even for a cranky correspondent. It seemed to consist of some theorems, very strange-looking theorems, without any argument. Hardy then decided that the man must be a fraud, and duly went about the day according to his habits, giving a lecture, playing a game of real tennis. But there was something nagging at the back of his mind. Anyone who could fake such theorems, right or wrong, must be a fraud of genius. Was it more or less likely that there should be a fraud of genius or an unknown Indian mathematician of genius ?

HIS REWARD

He went that evening after dinner to argue it out with his collaborator, J. E. Littlewood, whom Hardy always insisted was a better mathematician than himself. They soon had no doubt of the answer. Hardy was seeing the work of someone whom, for natural genius, he could not touch — who, in natural genius, though of course not in achievement, as Hardy said later, belonged to the class of Euler and Gauss. Well, that was pretty good, less

* Hardy's.

than a day after the manuscript arrived. But Hardy did not stop at passive recognition. He exerted himself, raised the money to get the author, whose name was Srinivasa Ramanujan, and who was a poor clerk in Madras, over to England. After a certain amount of delay, owing to the ambiguity of the wishes of the goddess Namagiri, in whom Ramanujan's mother passionately believed, he arrived. Then Hardy for some years, at the peak of his own career, devoted his whole professional life to Ramanujan. Hardy actually had to teach him a good deal of relatively elementary mathematics, for he had had little formal education. Hardy had his reward. Ramanujan produced, with astonishing speed, a great mass of original contributions. Hardy saw to it that he got all the proper honours. Fellowship of Trinity, Fellowship of the Royal Society.

The end of his life was sad. In a wartime winter, Ramanujan developed tuberculosis, and died in 1920 at the age of thirty-two. There is a touching story of Hardy visiting him, as he lay desperately ill in hospital at Putney. Hardy, who was a very shy man, could not find the words for his distress. The best he could do, as he got to the bedside, was : "I say, Ramanujan, I thought of the number of the taxi I came down in was a very dull number. It was 1729." "No, Hardee, No Hardee, that is not a dull number in the very least. It is the lowest number that can be expressed in two different ways as the sum of two cubes."

என் நினைவு அலைகள்

ஜானகி ராமானுஜன்

Mrs. Janaki, the widow of Ramanujan, presents a moving picture of her illustrious husband in her unsophisticated Tamil language. An English version is given in the appendix to this volume.

அவருக்கு தன் தம்பிகளிடமும், தாயார் தகப்பனாரிடமும் மிகப் பிரியமுண்டு. தம்பிகள் நன்றாகப் படித்து நன்றாக முன்னுக்கு வர வேண்டும் என்று எண்ணிக்கொண்டே யிருப்பார். தாயாரிடம் அவருக்கு உயிர். தாயாருடன் சிறுவயதில் பதினைந்தாம் புள்ளி அடிக் கடி விளையாடிக்கொண்டிருப்பார். இவ்விளையாட்டிலும் கணிதத்தை நுழைத்துப் பிறரைத் திகைக்கவைப்பார்.

கணிதத்தில் தனி நாட்டம்

அவர் எப்பொழுதும் கணிதத்திலேயே முழு நாட்டத்தையும் செலுத்திவந்தார். கணக்கு என்றால் சில சமயம் இரவுக்கும் பகலுக்கும் வித்தியாசமின்றி நெடுநேரம் இடைவிடாது முனைந்திருப்பார். போர்ட் டிரஸ்டில் அவர் வேலையாயிருக்கும்போது ஆபீசிற்குப் போவதற்கு முன்னும், போய் வந்தவுடனும் அவரது மனம் கணிதத்திலேயே லயித் திருக்கும். அவருக்குக் கச்சேரி, மீட்டிங் முதலிய இதர விஷயங்களில் அவ்வளவு ஈடுபாடு கிடையாது. கணிதத்திற்கே பிறந்தவர் என்று யாவரும் சொல்வதுண்டு.

பிடித்த உணவு

சிற்சில சமயங்களில் சாப்பிடும்போதும் கணிதத்தில் நாட்டம் செல்லும். சாப்பிடுவதை நிறுத்திவிட்டு கணக்கில் முனைவார். இல்லா விடில் அரைகுறையாக சாப்பிட்டு முடிப்பார். சில சமயங்களில் தாயாரோ பாட்டியோ கையில் சாதம் போடுவதுண்டு. சில சமயங்களில் சாப்பாட்டுக்கும்கூட யாராவது ஞாபகப்படுத்தி அழைத்தால்தான் சாப்பாட்டு ஞாபகமே வரும். அவருக்கு மிகப் பிடித்தமானது தயிர். தாராளமாகத் தயிரைச் சேர்த்துக்கொள்வதில் அவருக்கு அதிக விருப்பம். மேலும், தயிர் சாதத்திற்கு ஊறுகாய்களுக்கு பதிலாக, மாம்பழம், வாழைப்பழம், பலாப்பழம் முதலியவைகளை உபயோகப் படுத்துவதில் அலாதி ஆசையுண்டு.

வேடிக்கைப் பேச்சு

ரொம்ப மனது கஷ்டமாயிருப்பவர்களுக்கு வேடிக்கையானவை களைச் சொல்லி மனநிம்மதியை உண்டுபண்ணுவதில் கைதேர்ந்தவர்

என்றே கூறலாம். இம்மாதிரி பிறரைச் சந்தோஷப்படுத்துவதில் இவருக்கு மிகச் சந்தோஷம்.

அவர் சீமையிலிருந்து வந்தவுடன் இராமசாமி அய்யர் என்பவர் அடிக்கடி வருவார். அவர் தஞ்சாவூரைச் சேர்ந்தவர். அவர் வந்து விட்டுப் போனபின் ஒரு நாள் 'என்ன சொல்லிவிட்டுப் போனார்' என்று விளையாட்டாகக்கேட்டேன். 'தன் சா வூருக்கு போகச்சொன்னர்' என்று விளையாட்டாகச் சொன்னர். அதேமாதிரி 'செட்பெட்டுக்குப்' போன போது 'சட்புட்'டென்று போவதற்கு வழி பிறந்துவிட்டது என்று விளை யாட்டாகப் பேசியதும் ஞாபகத்திற்கு வருகிறது.

நாராயண அய்யர்

'போர்ட்டிரஸ்ட்' பழைய மானேஜர் ஸ்ரீ. நாராயண அய்யர் என்பவர் ஒருநாள் 'இவரை கண்ணுடிக்கல் என்று சிலர் நினைக்கிறார்கள். ஆனல் இவர் வைரக்கல் என்பது கூடிய சீக்கிரம் தெரியும்' என்று சொன்னதும் இப்போது ஞாபகத்திற்கு வருகிறது. அடிக்கடி நாராயண அய்யர் வீட்டுக்குப் போய் கணக்குப் போடுவது வழக்கம்.

அவர் அக்காலப் பழக்கத்திற்கு இணங்க 'குடுமி' வைத்துக்கொண் டிருப்பார். இங்கிலாந்து செல்வதற்கு முன்பு குடும்பத்தினரை கும்பகோணத்திற்கு அனுப்பிவிட்டுக் கிராப் வைத்துக்கொண்டார்.

கஸ்தூரி ரங்க அய்யங்கார்

இவருக்கு இந்தியாவிலிருக்கும்போது சமைப்பதற்கு ஒன்றும் தெரியாது. ஆனல் இங்கிலாந்துக்குப் போனதும் தானே சமைத்து சாப்பிடவேண்டியிருந்ததால் சமைக்கப் பழகிக்கொண்டார். இவருக்கு பொங்கல் பண்ணுவதில் அதிகப் பிரியம். ஹிந்துப் பத்திரிகையைச் சேர்ந்த ஸ்ரீ கஸ்தூரிரங்க ஐயங்கார் இங்கிலாந்திற்கு வந்தபோது, இவரும், மற்றொரு சமயம் ஒரு ஆங்கில மாதும் தான் செய்த பொங்கலை சாப்பிட்டு நன்றுயிருக்கிறதெனக் கூறினதாக என்னிடம் சொன்னர்.

இவருக்கு ஜோதிடம், ஆரூடம் முதலியன சிறிதளவு தெரியும். தான் 34 வயதுக்குமேல் இருக்கமாட்டோம் என்பது இவருக்கு முன்பே தெரியும். ஒரு சில சமயத்தில், பிறருக்கு ஆரூடம் சொல்வதுண்டு. வைத்தியத்தில் இவருக்கு விருப்பம் கிடையாது. ரொம்ப நிர்ப்பந்தத்தின் பேரில்தான் வைத்தியத்திற்கே சம்மதிப்பார்.

இருந்த இடங்கள்

அவருக்குத் தனியாகப் பணிவிடை செய்யும் பாக்கியம் எனக்கு ஒரே ஒரு வருடந்தான் கிட்டியது. சாதாரணமாக அவருடைய தாயாரும், பாட்டி ரங்கம்மாளும் வீட்டை நிர்வகித்து வந்தார்கள். சென்னைத் துறைமுகத்திலிருந்த போர்ட்டிரஸ்ட் ஆபீசில் வேலை பார்க்கும்போது, பட்டணத்தில் சைவமுத்தைய முதலித் தெருவில்

Srimathi Janaki Ramanujan born in 1900, married to Ramanujan in 1909. Hers has been a life of quiet sacrifice.

Sri S. Tirunarayanan, the youngest brother of Ramanujan.

இருந்தோம். பிறகு சென்னை சர்வகலாசாலை கொடுத்த உபகாரச் சம்பளத்தைக்கொண்டு ஆராய்ச்சி நடத்த ஹனுமந்தராயன் கோவில் தெருவுக்குக் குடிவந்தார். பிறகு சில மாதங்கள் தோப்பு வெங்கடாசல முதலித் தெருவில் குடியிருந்தோம். அங்கிருந்துதான் சீமைக்குப் புறப்பட்டுப் போனர்.

இறுதி நாட்கள்

அவர் திரும்பியவுடன் அருகிலிருந்து வேலைக்கு வேலை சாதம், எலுமிச்சம்பழரசம், மோர் முதலானவைகளைக் கொடுத்து, காலுக்கு ஒத்தடம்போட்டு, மார்வலி எடுக்கும்போது மாருக்கு ஒத்தடம் போட்டும் கவனித்துக்கொள்ளும் கடைசி பாக்கியமும் எனக்குக் கிடைத்தது. அப்பொழுது வெந்நீர் போட உபயோகப்படுத்தின இரண்டு பித்தளைப் பாத்திரங்கள் என்வசம் இருக்கின்றன. அவைகள்தான் அந்த நாட்களின் ஞாபகத்தை இப்பொழுதும் கொண்டுவருகின்றன.

அவருடைய புண்ணியத்தில் இத்தனைநாட்கள் அவருடைய அருமை பெருமைகளைப் பற்றி நினைத்துக்கொண்டும் பேசிக்கொண்டும் கிடைக்கும் உபகாரச் சம்பளத்தைக்கொண்டும் நல்லபடியாக காலம் கழித்து வருகிறேன்.

MY AFFECTIONATE BROTHER

S. TIRUNARAYANAN

Sri S. Tirunarayanan retired Assistant Post Master from Post Master General's Office, Madras, recalls a few touching acts of affection he had from his eldest brother Ramanujan.

I don't know much about my eldest brother Ramanujan as the difference in our ages was 17 years. I was only 8 years old when he went to England and when he returned from England in 1919 he was very sick and no one was allowed to disturb him.

I being the youngest child of the family, he was very kind and affectionate to me. He used to cajole me and take me on his shoulders and tell me short stories.

While he was in England, he sent a parcel of books of English Literature for me and for my elder brother Lakshminarasimhan (now deceased).

When he returned from England he was thoughtful of bringing for me, in spite of his sickness, a box of big-sized dried grapes.

I remember him only as an affectionate brother.

HIS LAST DAYS

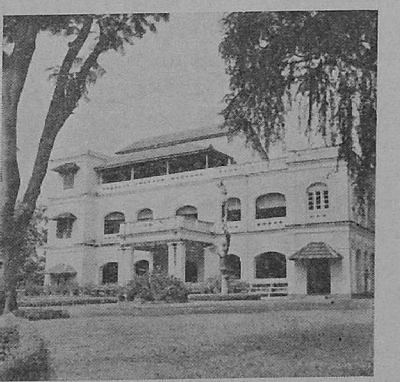
R. SRINIVASA IYENGAR

Sri R. Srinivasa Iyengar, retired Income Tax Officer, recalls the picture of Ramanujan, his brother-in-law in his last days.

My acquaintance with him covered just a few months in 1919-20 while he was lying ill in Chetput, and my sister and I, two inexperienced young people, were supposed to be nursing him. Incidentally, looking back at those times one cannot help feeling that his life might have been spared to us if on his return from England in 1919 he had been placed under competent medical care.

IN BED

Two or three facts stand out clearly in my recollections of that period. First, he was nearly all the time lying in bed. There was no furniture in the house, and the bed consisted of a mattress and a pillow laid out on the floor. Evidently he must have been suffering from acute pain or great weakness; the almost continuous lying posture could not be explained otherwise. If that



Namberumal Chetty's bangalow, Chetput.

were so he never showed any outward signs of distress of any kind. In fact, had it not been for the bed, nobody could have suspected that here was a man slowly dying of a serious malady. And he rarely lost his temper and never shouted at anybody.

FROM SLATES TO SHEETS OF PAPER

Secondly, even in that lying posture he was not idle for a moment. With his head propped up on pillows he was continuously working. From time to time he transferred his workings from the slate to sheets of paper by his side. And it was known that a vast quantity of papers containing his notes was handed over to the University after his death. We have all heard the word genius defined as the capacity for taking infinite pains and it was my special good fortune that it was given to me to watch that capacity functioning concretely before my eyes.

SOME EXPERIENCES IN ENGLAND

Thirdly, though he was thus continuously preoccupied with his numbers and problems, he was able now and then to take his mind off and descend to our level and talk to us about his experiences in England. I remember particularly his vivid and fascinating description of his visits to the British Museum and the wonderful animals and things he saw there and elsewhere in the country. This would show that his was not a one track mind as many scientists and philosophers are said to possess, but was one that could take delight in many things besides its own favourable topic.

THE MYSTIC MAKE-UP OF RAMANUJAN

R. SRINIVASAN

Sangita Kala Sikhamani, Natya Sastra Kovida, Vidya Visharada

Prof. R. Srinivasan gives a facet of the personality of Ramanujan, little known to many.

Thanks to Prof. G. H. Hardy and others, the name of S. Ramanujan has come to be writ large in the Mathematical history of the world. But very few people had opportunities to know him as a *man*, to know his inner make-up and his attitude to life. He was a *mystic*, a true mystic in the full significance of the term. He was intensely religious, almost superstitious in some daily observances — he will not take food unless cooked by people he approved; he was a very strict vegetarian. While in England he practically cooked his own meal. Some persons said that this was largely responsible for fatal failure in his health. I am not quite so sure.

That he was highly intuitive and got at the truth of things, as in a flash, cannot be denied. He saw truth and knew it, though he found it difficult to explain it to others in terms of logical sequence. When I was in Trivandrum, I used to go to Madras often on University and other business. Mr. Ramanujan was then a clerk in the Madras Port Trust Office. Somehow he took a fancy for me and used to visit me whenever I was at Madras; perhaps he found a sympathetic listener to what he intended to say. He used to show his notes to me, but I was rarely able to make the head or tail of some of the things he had written. One day he was explaining a relation to me; he suddenly turned round and said, "Sir, an equation has no meaning for me unless it expresses a thought of God." I was simply stunned. I had meditated over this remark times out of number since. To me, that single remark was the essence of Truth about God, Man and the Universe. In that statement I saw the real Ramanujan, the philosopher-mystic-mathematician.

SUPERNATURAL EXPERIENCES

He had also other strange experiences—what people would call supernatural. He could forsee events as in a vision. Finding a sympathetic spirit in me he used to mention even some of

his intimate experiences. Let me mention just one of them. One day he saw a vision. He was in a house he had not seen before. Under a pillar in one of the verandahs he saw a distant relative of his lying dead, with people mourning all round. The vision then vanished and he forgot all about it. Some time later he happened to visit a relation who was then employed in some town far away. Imagine his surprise when he found that the house of his relation was exactly like the house he saw in his vision years ago. When he was talking to him he learned that there was another relative who was undergoing medical treatment and was staying in the house. A few days later he saw that patient lying in a bed under the very pillar of his vision : and he was the same relation he saw in the vision. He was taken aback ; in a few moments the patient died under that very pillar.

A GOD-CENTRED MAN

Childlike simplicity was his dominant feature. He gave me the impression of a God-centred man, to whom every event down here was only an outer expression of an idea in the Cosmic Mind. A true philosopher tries to get at the Mind of God through such expressions in the manifested world. To him every phenomenon here is a window through which he could gaze at the typical thought in the Mind of God, where everything exists beyond time and space. Down here are we aware of things only in relationship in space and time. To Ramanujan God is the fountain-head of all ideas ; all our sciences and philosophies are intended only to link up this phenomenal world with the noumenal world in the Cosmic Mind.

To him all the religious observances had not only a spiritual aspect, but a disciplinary aspect as well. These train one in self-control without which there can be no development of the higher, spiritual side of human nature. Hence he clung to these observances so rigidly ; they meant so much more to him than mere forms. I do not wish to say more. What I have said is enough to give a picture of some of the unknown aspects of the great thinker, the late S. Ramanujan.

AN ARDENT DEVOTEE OF LORD NARASIMHA

T. K. RAJAGOPALAN

Sri T. K. Rajagopalan, the retired Accountant General bears evidence to the streak of mysticism in the make-up of Ramanujan.

I had the privilege of some intimate talks about 1912 or 1913 in Madras with the late Prof. Ramanujan, the famous mathematical genius. These talks took place long before he rose to fame, when he was still going about seeing people, in search of encouragement, with his wonderful Notebook containing complicated mathematical analysis and functions of triple integrals. He and his family were ardent devotees of God Narasimha (the Lion faced incarnation of God Vishnu) the sign of whose grace consisted in drops of blood seen during dreams. Ramanujan stated that after seeing such drops, scrolls containing the most complicated mathematics used to unfold before him, and that he set down on paper on waking only a fraction of what was thus shown to him.

APPENDIX

A

ENGLISH VERSION OF RAMANUJAN'S LETTER TO HIS MOTHER, KOMALATTAMMAL

Trinity College,
September 11.

Salutations to the great Ramanuja ! Ramanujan makes his countless prostrations to his mother and writes. Please write about your welfare. The letters you write reach me regularly. The three letters written on August 4, 10 and 11 reached me. I could not write letters for two weeks. You will henceforth be getting letters every week. There is no war in this country. War is going on only in the neighbouring country. That is to say, war is waged in a country that is as far as Rangoon is away from the city (Madras). Lakhs of persons have come here from our country to join the forces. Seven hundred Rajas have come here from our country to wage war. Ultimate victory will come only to the king of this country. You need not send any provisions. Ramachandra Rao's relative Ananda Rao, a youngster, has come to this country for study. He has not yet reached this place. He will come in October. Mr. Seshu Ayyar has told him to take with him numerous articles for being given to me. He and another youngster Sankara Rao have arrived in England.

When they reached the town of Port Said, the war commenced. Unknowingly they had sailed in the enemy ship. Their intention was to travel in an Austrian ship, get down at Austria and reach here by train. But while nearing the Island of Crete on the way to Austria after leaving Port Said, the crew of the English ship fired in the air to stop the ship and know its identity. Providentially, the ship stopped as it carried no guns. If the men of the ship had also fired, the ship would have been shot and sunk. The ship was captured and all the persons in the ship were taken prisoners and carried to Alexandria and the ship was seized. The people coming from our country and the Englishmen were put in another ship and sent here. These two youngsters reached after escaping this danger.

No war like this has raged before. The present war affects crores of people. It is not one or two crores. Germans set fire to many a city, slaughter and throw away all the people, the

children, the women and the old. The small country Belgium is almost destroyed. Each town has buildings fifty to hundred times more valuable than those in Madras city.

In many towns, the people of the towns themselves blow off the supports of the bridges over rivers, leave them hanging in mid air, spread gunpowder all over the streets, lay mines and cover them up and remain ready to flee. When enemies come, the bridges fall and half of them are carried off by the current of the river and when the rest enter the city, the dwellers themselves burn the city and flee. When streets are ablaze, the enemies try to escape but the iron wires get round their legs and they perish, unable to run away.

War is waging at many places. Each place has an extent of 200 miles. This is on the land. Many ships are sunk by battles raging in mid oceans. These are of two kinds. One is to fire directly at a ship ; the other is to go under water, knock at the enemy ship and sink it. Not only this. They fly in aeroplanes at great heights, bomb the cities and ruin them. As soon as enemy planes are sighted in the sky, the planes resting on the ground take off and fly at great speeds and dash against them resulting in destruction and death.

All that you sent got broken but reached me without falling off because of the supporting cloth. I get everything here. I get certain provisions from the city (Madras). You need not send anything.

Yours,

Ramanujan.

B

ENGLISH VERSION OF RAMANUJAN'S LETTER TO HIS FATHER, SRINIVASA AYYANGAR

Trinity College,
17-11-'14.

Salutations to the great Ramanuja! Ramanujan makes his countless prostrations to his father and writes. Well and wish to hear the same from you. I got your letter. I have also received the letter written earlier by Tirunarayanan. I have all the pickles. I get tamarind etc. from Madras. You need not send anything. Except the *kuzhuvidam* (dried up precooked foodstuff made of flour) which you are sending now, do not send any other thing. My college was closed last week. It is to open in the middle of January. I am getting on well. Keep the house in such a way that it is attractive to look at. Do not allow the gutter to run as usual. Pave the place with bricks and keep it well. I am getting on well. The students who have come from our place have joined the neighbouring college.

Yours,

Ramanujan.

C

ENGLISH VERSION OF JANAKI RAMANUJAN'S REMINISCENCES

'MY REMINISCENCES'

He (Ramanujan) was very affectionate to his brothers and parents. He desired that his brother should study well and come up in life. His affection for his mother was very high. In his younger days he often played with his mother '15 points game'. He put mathematics to use even in this game and baffled others.

He wholeheartedly devoted all his time to mathematics. Sometimes he forgot day and night while he was seriously engaged in mathematics. When he was employed in Port Trust, he was seen lost in mathematics before going to the office and after returning from it. He was not very much interested in concerts and meetings. Everyone used to say that he was born only for mathematics.

Sometimes, even while taking his meals, he would be up with mathematical problems. He could suspend eating and pursue the mathematical thought. Or he would finish off eating hurriedly. There were occasions when his mother or grandmother put '*sadam*' (cooked and consecrated rice) in his palm. There were also occasions when he had to be reminded of his food. He liked curds* most. He liked very much to add as much curds as he liked. For curds-rice he had a special liking to have as side dish mango, plantain or jack fruits instead of pickles.

It can be said that he was an adept in cheering up mentally afflicted people by telling them humorous anecdotes. He found great delight in making them happy.

After his return from England, Ramaswamy Iyer paid him frequent visits. He belonged to Tanchavoor (Tanjore). Once I asked him after his visit what he had told him. He replied in jest that he was asked to go to his dying place [Tan — one's; cha (pr. saa) — dying; voor — place]. In a similar vein when he went to Chetput, I remember his telling me in jest that time had come for him to quit (die) at once [che-put (pr. chut-put) in colloquial Tamil means at once].

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* yoghurt pr. — when pronounced as

I remember Sri Narayana Ayyar, the then manager of the Port Trust, telling one day, " Some people look upon him (Ramanujan) as ordinary glass piece but they will remain to see him soon to be a diamond ! " He (Ramanujan) often went to Narayana Ayyar's residence to do mathematics.

As was usual in his days, he had tuft. Before going to England, he sent his people to Kumbakonam and had his crop.

He did not know cooking while he was in India. As he had to eat in England by cooking himself, he started cooking. His favourite item in cooking was *pongal* (boiled green gram and rice). Mr. Kasturi Ranga Iyengar of *The Hindu** who had been once to England, told me that he on one occasion and an English lady on another occasion found his *pongal* tasty. He knew astrological prediction to some extent. He knew that he would not live beyond 34 years. He would offer predictions to others sometimes. He had no interest in medicine. Only after much persuasion he allowed himself to be medically treated.

I had the privilege of attending to his comforts for only one year. The household was run by his mother and grandmother Rangammal. When he was working in Port Trust, we were residing in Saivamuthia Mudali Street. He came to reside in Hanumantharayan Koil Street after he became a research scholar of the Madras University on stipend. For some months we resided in Toppu Venkatachala Mudali Street from where he started for England.

After his return, it was my good fortune to give him rice, lemon juice, butter milk etc. at regular intervals and to give fomentation to his legs and to his chest when he reported pain. The two vessels used then for preparing hot water are alone still with me ; these remind me often of those days.

All these long years, with the monthly pension that is being given to me, I have been spending my good days by thinking of and speaking about his great qualities.

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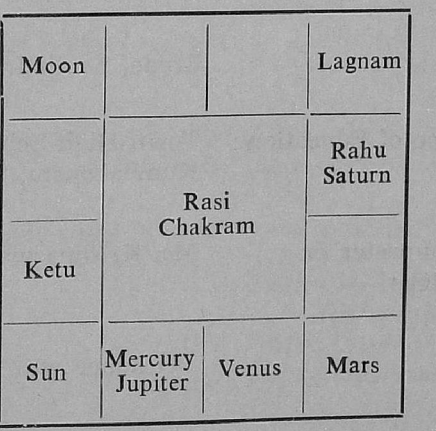
* The popular daily newspaper from Madras

D

FOR THE ATTENTION OF ASTROLOGERS

Ramanujan (*Tengalai Vaishnavite, Bharadwaja gotra*) was born at 9 secs. past 6-00 p.m. on Thursday the 9th *Margazhi* of Sarvajit year corresponding to 22nd December, 1887 at Erode [Lat. 11°20′ (N) and Long. 78°00′(E)]. His horoscope runs as follows :

Ashtami 40-37, *Uttirattadi* 60, *Mithunalagnam* (Gemini ascendent).



E

FOR VISITORS TO TRINITY

Entries regarding Ramanujan in the Trinity Admission Book

Name of Student :	Srinivasa Ramanujan.
Father's Name in Full : (with description or title)	Kuppuswamy Srinivasa Ayyangar.
Present Address : (Address in full)	17, Sarangapany Street, Kumbakonam, South India.
Date of Birth :	* December, 1888.
Place of Birth :	Erode, South India.
School or Place of Education :	Town High School, Kumbakonam, South India.
Name of Headmaster or Private Tutor :	Mr. Krishnaswamy Ayyar.
Status :	Pensioner with exhibition.
Date of Admission :	April, 18th, 1914.
Tutor :	Dr. Barnes.

(* Wrong entry ; his date of birth was 22-12-1887 — *Ed.*)

F

RAMANUJAN — A DESCRIPTION

from his London Passport dated 24-2-1919

Age : 30	Profession : *Research Student*
Place and Date of birth :	*Erode, India, Dec. 1888*
Height :	*5 feet 6 inches*
Forehead :	*medium*
Eyes :	*normal, dark*
Nose :	*broad*
Mouth :	*normal*
Chin :	*normal*
Colour of Hair :	*black*
Complexion :	*olive*
Face :	*oval*
Any special peculiarities :	*small-pox marks*
National Status :	*British — Indian born subject — Hindu Brahmin — son of Mr. Srinivasa Aiyangar of Kumbakonam, Tanjore*

G

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I

CHRONOLOGY OF THE LIFE OF RAMANUJAN

1887 **Dec. 22.** born of Komalattammal and K. Srinivasa Aiyangar at Erode in his maternal grandmother's house

1892 joins primary school

1897 **November,** passes Primary Examination in First Class

1898 **January,** joins Town High School, Kumbakonam in I Form .

1900 in III form, studies by himself Arithmetic and Geometric series, Loney's Part II Trigonometry, learns sine and cosine series before knowing them as ratios

1903 in VI form, gets Carr's Synopsis of Pure Mathematics from the library of the local Government College ; learns to solve cubic and biquadratic equations ; passes Madras Matriculation in **December**

1904 joins the F.A. class of the Kumbakonam College ; obtains Junior Subramaniam Scholarship ; tries to solve quintic equation and fails ; begins to investigate the series, 1, $\frac{1}{2}$ . . . etc. and calculates the Euler's constant in a regular series to 15 places of decimals and also Bernoulli's numbers without knowing that these existed ; develops summation of series and learns subsequently that it is only Integral calculus ;

learns differentiation and integration ; investigates Hyper-geometric series ;

reported to have a temporary unsoundness of mind for a period of six months, but without impeding his mathematical exertions

1905 not promoted to the Senior F.A. class because of failure to get the minimum in all subjects except Maths ;
travels for the first time to a place 750 miles away from home in search of patrons ;

investigates relations of many integrals and series and learns subsequently that they are related to what is now called Elliptic Function

1906 joins Pachaiyappa's College ; reads for 3 months, subsequently falling ill, discontinues his studies, involves himself in independent investigations in Mathematics ;

sits privately for F.A. examination, scores centum in Mathematics but fails to get the minimum in other subjects ; never tries again

1907 Indian Mathematical Society founded under the name of the Analytical Club

1908 develops continued fractions and investigates divergent series ; betrothal takes place

1909 married to 9 yrs. old Janaki of Srivatsa gotra ;

undergoes severe surgical operation and is completely prostrated for a year

1910 develops relations among elliptic modular equations ;

meets Prof. V. Ramaswamy Iyer ; C. V. Rajagopalachari and R. Krishna Rao take him to Dewan Bahadur R. Ramachandra Rao, (the uncle of R. Krishna Rao), the Collector of Nellore ; Ramachandra Rao at first doubts and hesitates and then volunteers to meet the expenses of Ramanujan's stay in Madras for a year

1911 His first contribution to the Journal of the Indian Mathematical Society appears ;

goes about contacting mathematicians to appreciate his work, does not get encouragement ; sees Prof. Ross of Christian College ;

Sep. 21. takes a testimonial from Prof. E. W. Middlemast, acting Principal and Professor of Mathematics, Presidency College

1912 contributes two more notes and several questions to the Journal of the Indian Mathematical Society ;

His wife comes of age and joins him

Jan. 12 to Feb. 21. works as officiating clerk in A. G.'s Office on Rs. 20/- p.m.

Feb. 9. applies to Madras Port Trust for a job

Mar. 1. joins Madras Port Trust in the Accounts Section in Class III, Grade IV on Rs. 30/- p.m.

resides in Saiva Muthia Mudali Street, George Town.

Nov. 12. Prof. Griffith writes to Sir Francis Spring and undertakes to send R's papers abroad to people in the same field

Nov. 14. A. G. Bourne, Director of Public Instruction writes to Spring suggesting R's seeing Littlehails, Middlemast, and Graham

Nov. 27. Graham, Accountant General, Madras writes to Griffith about his inability to judge Ramanujan who appears to him to be a calculating boy

Nov. 28. Griffith to Francis Spring suggesting to wait for Prof. Hill's opinion as Graham and Middlemast express inability to give a critical estimate about R's work

Dec. 3. Hill to Griffith suggesting R's study of Bromwich's Theory of Infinite Series to know his 'pitfalls' in the development of divergent series

1913 **Jan. 5.** Griffith to Francis Spring suggesting R's doing his utmost to make his proofs complete. He suggests Ramachandra Rao's buying Bromwich's Infinite Series for R.

Jan. 16. writes his first letter to Hardy

Feb. 3. The Secretary for Indian students in London writes to Arthur Davies, the Secretary to the Advisory Committee for Indian students in Madras informing the desire of the tutors at Trinity to get R to Cambridge

Feb. 8. Hardy to R expressing the need for providing rigorous proofs and acknowledging that some of R's results are new and important

Feb. 25. Gilbert T. Walker, Head of the Indian Meteorological Department, Simla visits Madras harbour, sees R's Notebooks, finds it difficult to make a reliable estimate and expresses his opinion that his work compares well with that of a Mathematics Fellow in a Cambridge College

Feb. 26. Gilbert T. Walker, to Madras University recommending facilities to R for a few years at least to spend whole of his time in mathematical research without any anxiety as to his livelihood

Feb. 27. writes to Hardy stating that he has found in him a friend who views his labours sympathetically and that his first consideration is to get food to preserve his brains

Mar. 10. Arthur Davies to B. Hanumantha Rao about the view of Cambridge Tutors

Mar. 13. B. Hanumantha Rao invites S. Narayana Aiyar to assist the Board of Studies in Mathematics in the Senate House in understanding R's results

Apr. 7. The Government sanctions the proposal of the Syndicate of the Madras University to grant R a special scholarship of Rs. 75 per mensem for 2 years

Apr. 9. Dewsbury, the Registrar, Madras University informs R about the grant of scholarship, tells him that its acceptance means devotion of whole time to study and submission of the statement of work every three months and mentions of arrangements for R's free access to the Mathematical books in the University Library

Apr. 12. expresses his willingness to accept the scholarship from May 1

Apr. 17. writes to Hardy about his securing Madras University scholarship of £ 60 per annum for two years at the instance of Dr. Walker

May 1. granted two years leave on loss of pay and starts working as the first research scholar of the Madras University ; resides in Hanumantharayan Koil Lane, Triplicane, Madras

Aug. 5. sends his first quarterly report to the University

Oct. 31. S. Narayana Iyer takes R to Littlehails and explains R's methods

Nov. 7. sends his second quarterly report to the University

1914 **Jan. 1.** does not find a favourable climate at home to accede to the request to go abroad

Jan. 14. expresses readiness to leave for Cambridge as the climate changes

Jan. 28. Prof. Neville to Dewsbury, the Registrar, University of Madras making his prophecy and emphasising the need to assist R in his passage from obscurity to fame

Jan. 29. Littlehails to Dewsbury recommending the giving of grant to R in the form of a scholarship of the value of £ 250 per annum for one year to start with and to extend it for another year on receipt of report from Trinity along with an additional sum of £ 100 for his initial outfit and passage to England

Feb. 5. Sir Francis Spring, Chairman, Madras Port Trust to C. B. Cotterell, personal secretary to Lord Pentland, the Governor of Madras pleading for his Excellency's interest in the speedy approval of the action of the University Syndicate in setting aside Rs. 10,000 for R's visit to England and stay there for a couple of years

Feb. 12. Government sanctions the appropriation of a sum not exceeding Rs. 10,000 from the University Vacation Lecturers' Fund for the grant to R of a scholarship of £ 250 a year tenable in England for a period of 2 years, a free passage and a reasonable outfit

Feb. 13. Dewsbury to R about the special grant to him for his going to England

Feb. 16. writes to Dewsbury accepting the special grant ; resides at No. 14, Thope Venkatachala Mudali Street, Triplicane, Madras

Feb. 26. Binny & Co. to R enclosing a II Class passage ticket for Rs. 440/- in his favour for passage to London by s. s. Nevasa

Mar. 5. to Dewsbury requesting him to forward to his mother every month Rs. 60/- and to arrange for quarterly payment of scholarship through Messrs. Barkley and Company, the English Bankers

Mar. 9. R sends his third quarterly report

Mar. 11. Francis Spring to Neville requesting the latter to receive R at London and to the Steam Agents to provide R with vegetarian food throughout the voyage

Mar. 17. sails by s. s. Nevasa to England

Mar. 30. reaches Suez

Apr. 14. arrives in London ; greeted and received by Prof. Neville and his brother, taken to Cromwell Road, admitted to Trinity College ; goes to Cambridge after remaining in Prof. Neville's house for some days

June 11. Hardy reads a paper on one of R's results before the London Mathematical Society

1915 Jan. 7. works on Arithmetical Functions

Nov. 8. E. W. Barnes, Fellow and Tutor of Trinity College writes to Dewsbury about the excellent progress of R

Nov. 11. Hardy sends a brief report to Dewsbury on R's work in England and recommends strongly the prolongation of R's stay by a year. R to S. Narayana Aiyar, expressing his desire for a short visit to India and long stay in Cambridge

Dec. 15. Francis Spring to Dewsbury recommending the uninterrupted continuance of R's studies at Cambridge by extending the period of scholarship up to the end of Mar. 1918.

Dec. 20. Further appropriation from the University Vacation Lecturers' Fund made and the continuance of the grant of scholarship to R for another year sanctioned

1916 March. conferred upon, B.A. degree by research

June 8. Hardy sends his detailed report on R's work to Dewsbury and expresses the need for careful supervision of its printing, R's formulae being not by any means easy to print

Oct. 18. granted a further year's leave

Dec. 14. collaborating with Hardy, R proves that almost all numbers say n are composed of about log log n prime factors

1917 March falls ill and hospitalised in Sanatoria at Wells, Matlock and London,

investigates with Hardy asymptotic formulae and combinatory analysis

Mar. 13. further appropriation from the University Vacation Lecturers' Fund

Oct. shows symptoms of improvement and resumes active work

Oct. 18. conferred upon, Trinity Fellowship consisting of £ 250 a year with no conditions about duties or residence

1918 **Jan.** investigates some definite integrals

Feb. 28. elected Fellow of the Royal Society ; Hardy sends telegram to Dewsbury, the Registrar, University of Madras

Mar. the Registrar to the dailies about R's selection to the Royal Society, Mar. 6

Public meeting to honour R. held at the instance of S. Srinivasa Iyengar, Ex-Advocate General

Apr. 11. Further appropriation from University Vacation Lecturers' Fund sanctioned by Government

Oct. 14. Hardy to Dewsbury, suggesting the creation of a post for R. in the University

Nov. 26. Hardy to Dewsbury, about R's illness and need for his short return to India

Dec. 9. Dewsbury to R. communicating the Syndicate's resolution granting him a sum of £ 250 a year for 5 years from Apr. 1, 1919 in recognition of his services to the Science of Mathematics

1919 **Jan. 11.** R's letter from Colinette Road, Putney, S.W. 15 to the Registrar, Madras University, accepting gratefully the generous grant offered by the University and expressing his desire to help poor boys.

Jan. 15. Hardy to Dewsbury appreciating the provision made by the University

Jan. 20. R. Rao writes to Dewsbury backing R's proposal to return to India in Mar. or Apr.

Mar. 13. leaves England by s.s. Nagoya ; Hardy's cable to Dewsbury ; investigation of congruence properties of partitions and algebraic relations between certain infinite products completed

Mar. 27. arrives in India by s.s. Nagoya ; reception at Bombay

Apr. 2. reaches Madras, reception at the Madras Central Station

Apr. 24. writes to Dewsbury from Venkata Vilas, Luz, Mylapore, suggesting reference to Hardy to know the full expenses of his stay in England and the cost of his voyage ; requests payment of his scholarship in monthly instalments

July in Kodumudi

Aug. 12. Dr. Pires, Civil Apothecary sends a medical report to the University on R.

Aug. 18. C. F. Fearnside, D.M.O. suggests R's shifting to Coimbatore

Sep. in Bakthapuri Street, Kumbakonam

Sep. 3. Dewsbury to R. Rao about the arrangements made to relieve R. from the financial strain through monthly contributions of the members of the Syndicate

Oct. 4. R. Rao to Dewsbury about S. Srinivasa Iyengar's donating Rs. 1,000 and arrangements made for R's stay in Coimbatore

1920 Jan. 20. notifies Dewsbury about the change of his residence to 'Kudia' Numberumal Chetty's Bungalow in Harrington Road, Chetput, Madras ;

writes to Hardy about his discovery of Mock-Theta functions

Feb. & Mar. ill, nursed by his wife and others, treated by Dr. Chandrasekara Iyer

Apr. 26. passes away, leaving behind his wife Janaki Ammal aged 20 years, his parents, brothers and maternal grandmother ; has had no issue

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