Except for a couple of visits of a few months' duration he never went back to India. He was somewhat unhappy about this for he felt that he could have done something valuable for Indian mathematics had he been able to make longer visits He would often express his admiration for Takagi who went back to Japan and played an important role in the creation of the influential modern Japanese school in number theory. But with increasing uncertainties in his health, any return to India became out of the question; and his dreams were to remain just that. This circumstance often lent a sense of poignancy to this heart-felt concern for India, Indian science, and Indian scientists.

Although he was well aware of what was going on in mathematics he would often say that too much learning hindered his originality. This is, of course, an over-simplified description of his attitude toward the creative process and so, to give you a better feeling for his thinking, I shall read you a brief passage from a talk he gave, a few months before his death, on the occasion of the eightieth birthday celebration of Dirac: 'I have often pondered over the roles of knowledge or experience on the one hand and imagination or intuition on the other, in the process of discovery. I believe that there is a certain fundamental conflict between the two; and knowledge, by advocating caution, tends to inhibit the flight of imagination. Therefore a certain naiveté, unburdened by conventional wisdom, can sometimes be a positive asset.' He made these comments while discussing Dirac's discovery of the equations of motion of the electron; but they apply equally well to his own work and capture its spirit completely. He could even laugh at the fact that he was, in his opinion of course, not as well-informed as he should be; his favourite description of himself was as a man who had a deficiency of iron in his blood but for whom the only available remedy was to swallow a pound of nails every day.

His view of science was a noble one and there was no place for ego in it. There was no doubt in his mind that any one who had a chance to contribute to the flow of science should regard himself as a very fortunate person He was critical of scientists, even, great ones, who were unable to distinguish between the progress of science and the progress of their own work Throughout his life his goal was to do as much as he could, for as long as he had the strength to work. This attitude allowed him to view the world around him with remarkable equanimity. It is my firm belief that he was, in the most demanding sense of that Sanskrit word, a *Sthithapragna* – one with a steady inner gaze, having conquered both disappointment and exultation.

V. S. VARADARAJAN

University of California
Los Angeles
California, USA

Some recollections of Harish-Chandra

I met Harish-Chandra for the first time in Summer 1949, in Zurich. He had come there to study German and maybe also to see W. Pauli, whom he had known while still a physicist. His conversion from theoretical physics to pure mathematics was fairly recent, so that he would still be asked for its reason. One answer, as I heard at the time, was that now he could believe in what he was doing. This should not be viewed as a disparaging comment on theoretical physics, quite the contrary. He had a very high regard for theoretical physics, but felt that a very special intuition, not mathematical, some sort of 'sixth sense', was needed to make progress in it Later I heard him on various occasions stating that 'no mathematician has ever made a dent in physics' (this is a quote), which, I think, is too sweeping a statement, in particular unfair to H Weyl. He could still dabble in physics, though. While we were walking along the lake around sunset, the reflection of light struck him as somewhat peculiar. The following morning, when I picked him up in his hotel room, I saw a sheet or two of paper full of computations, with some drawings of reflected light rays.

At that time he had already published some papers on Lie groups and Lie algebras. Since my main interests were Lie groups and topology there was a considerable overlap and it was natural for us to talk shop.

I still remember these contacts rather vividly since he had such a striking personality I had hardly ever met someone thinking and speaking so fast, although later I realized that this feature is not so uncommon among my Indian friends, or anyone so intense, with such a technical proficiency and concentration power His working habits, as he described them to me, were also somewhat out of the ordinary: he would usually get up rather late, then have breakfast, read the newspaper, so that he would really get going around ten or eleven, but then it would be 'straight to midnight'. In fact, it seems the habit of getting up rather late had been pretty much a constant in his life. Lily once told me that when he was living with his family, people would often sleep out of doors. In the morning everyone would get up and prepare for the daily work, but not Harish, who instead would go inside the house to sleep some more. His intense work, straight to midnight, may already have been taxing on him since he felt the need to stay away from it for about three months a year However, contrary to getting up late, this habit which, I presume, would have been later welcomed by his family, was not maintained. The self-imposed pressure from his work became greater and greater, and the time allotted for vacation shrank to practically nothing, until overwork took its toll and the doctor prescribed one month of vacation per year. His visit to Zurich was indeed part of a trip, he was coming from Paris

Text of a talk given during the unveiling ceremony of Harish-Chandra's bust in Allahabad, 10 October 1993

and spoke effusively of P. Gauguin, of whom there was a big exhibit at the time there, in particular of his marvelous sense of color.

As I already said, Lie groups were a common interest. However, Harish told me he felt he had worked enough in Lie groups and their representations and he wanted to do something else. He was planning to go to Harvard for at least a year, to study algebraic geometry with O. Zariski 'this will be my next venture', as he put it. But it did not lead to a serious involvement, as it turned out. In fact, the next I heard of him was in Paris, in the following year, through letters of Chevalley to some friends, speaking of new extraordinary results on universal enveloping algebras and infinite dimensional representations. This heralded the famous Transactions AMS paper, for which Harish later received the Cole prize of the AMS, and the beginning of his 'long march', of about 25 years, to the explicit determination of the Plancherel measure for semisimple groups, in a long and amazing series of papers which displayed extraordinary technical power and resourcefulness. Later, I heard several times André Weil say that he knew only two mathematicians for whom technical difficulties simply did not exist, namely Chevalley and Harish-Chandra. However, this was technical power at the service of the highest goals. I would be hard put to give another example of a work by a single author extending over 2000 pages at such a consistently high level, or should I say relentlessly high level, devoted to one main goal, very broadly conceived. At the beginning, he was much influenced by the work of others, notably of some mathematicians in the Soviet Union (Gelfand, Naimark, Graev), but then he forged ahead, devised his own strategy and weaponry and became the unquestioned leader in that area. In 1966, at the Moscow Congress, Gelfand told me that at the beginning, they had had a somewhat dim view of his work. They were looking basically at special cases rather than at a general semi-simple group, but they felt that they had more insight and that Harish-Chandra was essentially a technician generalizing their ideas by using the theory of semisimple groups. However, they saw now, especially after having heard his lecture at the Congress and talked with him, that he was far ahead.

Harish-Chandra was a highly principled man, for whom one's life had to have a purpose. In his view, the main one of his own was no doubt to prove the hardest and most fundamental theorems accessible to him. He could look with much satisfaction at his monumental work on the Plancherel formula, which R. P. Langlands, at a memorial service, later likened to 'a Gothic cathedral, heavily buttressed below, but, in spite of its great weight, light and soaring in its upper reaches, coming as close to heaven as mathematics can'. I hope he did, but even assuming it, I have some doubt that he felt he had fully discharged his self-imposed duty. He did not view representation theory as an end in itself, his vision of mathematics was much broader and, all over the years, I detected in him a wish to branch out. But each attempt appears to have been cut short by the occurrence of new ideas pertaining to his main topic, which brought him back, if not forced him back, to it. I already mentioned his plan in 1949 to get into algebraic geometry. His next attempt started during his stay in Paris in 1957–58. It resulted in lasting contributions to the theory of automorphic forms, arithmetic groups, reduction theory, and is better documented, but still not fully, I think. There are also some unfulfilled wishes. Allow me for a minute to turn to the mathematicians here to summarize what he told me at a party, in 1960 I think, maybe 1961, but not later. We happened to be by ourselves for a moment and I asked him what his philosophy on automorphic forms was. He immediately outlined a program (at any rate for split groups): start from an Eisenstein series, attached to some maximal solvable group. It converges in some half-space of a complexified Cartan subalgebra. Extend it meromorphically to the associated positive Weyl chamber. To go from one chamber to another there should be a functional equation attached to a Weyl group element. These functional equations should involve meromorphic functions admitting Euler product expansions, which should contain a tremendous amount of number theoretic information; to get hold of them would be 'hitting the jackpot' (his expression). The specialists will have recognized in very rough outline a preliminary sketch of some features of the program realized later by R. P. Langlands (totally independently), at any rate of its analytic part. The connection with number theory, as envisioned later by Langlands, turned out to be much more sophisticated. However, somewhat to my surprise, he did not pursue this, did not go for the jackpot. I presume he got at the time some of the ideas which led eventually to the determination of the discrete series, arguably the highest peak in his work, and that, of course, had to be given priority. The wish to branch out surfaced again in 1970. Before going on leave to the I.H.E.S. near Paris, during the fall term 1970, he told me he wanted to 'take off' and get involved with number theory. But instead he came back full of projects on representations of p-adic groups, fired up by some new ideas of H. Jacquet.

Once the eminent analyst Solomon Bochner told me, half-jokingly, that he was really a frustrated arithmetician. I have somehow the feeling that there was a little of that in Harish. Number theory, in particular class field theory, had always attracted, if not fascinated, him. In 1961, while in a rather depressed state, he wrote to me that algebraic number theory was the most beautiful topic he had ever come across and that the sole consolation in his misery was his lecturing on class field theory. I submit there are only very few people who would find relief from suffering by coming to grips with a theory as forbidding as class field theory was at the time.

This was indeed the kind of mathematics he admired most, the main results are of great scope, of great aesthetic beauty, but the proofs are technically extremely hard, a description which applies also very well to his own work. In fact, as is often the case with a mathematician having a strong personality, he was naturally attracted to mathematicians with an approach akin to his. Speaking of exceptional technical power at the service of high goals brings to mind C. L. Siegel, whose work Harish-Chandra held indeed in great esteem. Once, in a conversation, A. Weil and I realized that, for a number of years, we had both viewed Harish-Chandra as a kind of spiritual heir to Siegel by his mathematical style, power and concentration on very difficult, basic, questions, and we both felt it was Siegel's loss never to have realized it.

Underlying this tremendous productivity were very strict, almost ascetic, discipline and routine. In his exposition he was extremely meticulous, giving complete proofs (even in his personal

seminar notes, which could almost have gone to a printer). It was of course in his nature to do so, but there was also a resolve stemming from a bad experience he had had early, when he discovered a gap in the proofs of results announced in a Note in the Proceedings of the U S. National Academy of Sciences. He then vowed never to announce a result in print without having written down full proofs in all details. He had 'burnt his fingers' once, as he told me, and did not want this to happen again. However it did, though not with published results, because there was another side to his personality, a juvenile, almost childish enthusiasm when a new idea seemed to work, which belied his stern style of exposition. Sometimes he was so eager to share these new results that he would lecture or announce a lecture without having submitted their proofs to his exacting scrutiny, and a gap might appear unexpectedly. In the last occurrence, it led to a feverish month in which he did fill the gap, but at a high price for his health

He wrote everything by hand, in an extremely regular writing. In 1966, during the Moscow Congress, a mathematician from the Soviet Union (maybe Kirillov or Kostrikin) remarked to me that a surprising number of papers by Harish-Chandra had either 33 or 66 pages and was mildly wondering why. Somewhat baffled, I could not offer any explanation at the moment but later, while I was looking at some of Harish's manuscripts, a simple one occurred to me At practically any time, Harish had a big backlog of material to write up. Somehow, he had decided that a convenient way to parcel it out for publication was to write papers of either fifty or one hundred handwritten pages. He managed to do so fairly often and the writing was so regular that the contraction factor from the handwritten to the printed pages was one-third.

His lecturing style reflected faithfully his personality· very precise, complete, clearly written on the blackboard, but technically very demanding and fast. Later, he attempted to slow down, and could do so at least in the first part of a lecture. It was also delivered with much elegance. Once, when he was starting to write at the blackboard, standing erect, half turned to the blackboard, holding the chalk at some distance, as usual, my neighbour turned to me and whispered: 'he really looks like a prince.' But then, in the course of a lecture, he would often get so involved with his material, so excited, that the pace became faster and the old speed came back. That was really his natural tempo to think and speak

He felt that, because his exposition was so systematic and complete, his papers were easy to read He was a bit miffed when, at a party in his home, this statement was greeted with a big laugh We outlined some of the hurdles facing a prospective reader, notably the cascades of references: in a given paper, the reader would be told that the notation of such and such papers was used. Then, if he would look at those works, he might again read the same, referring to still earlier papers, an almost infinite regress. We finally agreed that a given paper, though by no means easy to read, could be understood with a reasonable amount of effort by a fastidious reader, provided he would know thoroughly all of Harish's previous work. So, in a way, there was little difference of opinion because, for a logical, systematic and powerful mind such as his, this last *proviso* was a rather obvious prerequisite for anyone seriously interested in his work.

The sense of purpose Harish gave to his life had some spiritual, even religious underpinning. His religion was not a traditional one with the usual paraphernalia of stories, rituals, prayers and direct intervention of a personal god. Rather it was on an abstract, philosophical level, a yearning for some universal principle, transcending our lives, which would give a sense to the universe. Mathematics was maybe for him a way to approach it this life. He often said that semi-simple Lie groups are so perfect that they must have a divine origin. How seriously this was meant I really did not know for a long time However, once in a seminar, he stated that a problem had occupied him for years, namely. 'Why has God created the exceptional series?' Together with the previous statement, this seems to me to express a very logical and genuine concern· without the exceptional series, harmonic analysis on a semi-simple group would be essentially well understood and the whole theory, to a large extent based on his work, would be definitive, of great elegance and harmony. The exceptional series complicates matters considerably. Now, if you start from the assumption that semi-simple groups are perfect, you are led to wonder how the exceptional series, which, at this time, seems to us to obscure the theory, will ultimately enhance it. The rather serious tone in which he stated his question makes it appear to me as expressing a frustration that some essential and undoubtedly beautiful feature of the theory remained hidden from him, after so many years of efforts.

In mathematics, Harish's life was indeed a search for fundamental general theorems, with the belief that they should be beautiful, and combine to harmonious theories. He pursued this quest with awesome single-mindedness, persistency, power and success.

ARMAND BOREL

Tata Institute of Fundamental Research
Homi Bhabha Road
Bombay 400 005, India

My Father

Ladies and gentlemen, on behalf of my entire family, I would like to thank you for your remembrance of my father on his seventieth birthday. It is particularly poignant that we are gathered for this occasion in Allahabad, the place where my father's scientific career began Though he spent almost all of his professional life abroad, culturally my father was always very deeply rooted here in India For me today's event represents a symbolic homecoming· the return of my father's mathematical spirit to the land of his birth

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