

TO SUDHIR PANDYA AT HIS SYMPOSIUM

J.B. French

To describe the occasion of this symposium I borrow one of the graceful words of Delbruck who described Weisskopf's retirement as a new "graduation". I think of an earlier graduation of yours at which, reversing the usual order of things, you gave to us a present which we still have and still use. You yourself used it, the "Pandya transform", in showing that, even in such impossibly complicated things as nuclei, remarkable simplicities are to be found by an adept hunter. We have of course seen many other simplicities since that early day, but yours, I believe, was the first one of such generality (distinguishing, as it does, between two-body interactions and those of higher rank) and the first which exhibited itself with such precision. I recall with pleasure that, together, we used it to put a limit on the three-body part of the effective nucleon-nucleon interaction. We used there the argument that a "law", which is not trivially exact but is found to apply well in a particular case, can be used to give a measure for, or bound upon, the entity which would violate the law.

Curiously enough there is a parallel between the work done for your earlier graduation and that which V.K.B. Kota (also from PRL of course) and I would have described at this one, had I been able to attend it. The simplicity once again is about a spectrum (this time not in the ground-state region but millions of levels

above it) and the entity for which we (Pandey, Tomsovic, Kota and myself) find a bound also refers to the effective interaction (its time-reversal behaviour rather than its three-body nature). The intrinsic logic is similar to that used long ago though the calculations are very different. They are however related to statistical calculations of ground-state occupancies made around 1980 by Potbhare, Kota and yourself, and used also to determine features of the interaction.

Other persons will speak about their own research and about the influence which you have had on it. Let me speak now about different things: about the great kindness which Harshida and you have shown to Helen and myself during several of our visits to Ahmedabad; about the wonderful atmosphere which I found there and the many friends whom I made there; about the many Indian colleagues whom I have had to work with (you were of course the first); about the unequalled respect which they have shown for learning and with which they have enriched our Rochester department; about the beauty of the country and my immense pleasure in visiting it; and about my regret that I have not been able to come this time. I owe you a great deal and I thank you.

The Inspiring Personality

D.R. Kulkarni

In the middle of the academic year in 1964, Prof. Pandya came to the M.S. University, Baroda as a Visiting Professor to deliver a series of talks on 'Electrodynamics'. Among the first year M.Sc. students who formed his exclusive audience, I was one of them. We all were immensely impressed by his lectures and unanimously held him as a wonderful teacher. That was my first impression about him. Today after 25 years of long association with him my impression has not changed even a bit. Yes, it is very true that Prof. Pandya is a born teacher. However, to describe him as just an ideal teacher may not do full justice to his personality. The most important bearing of his personality is, in my opinion, his innate ability to look at the subject in a very uncommon and unconventional way. It is this spark of lateral thinking that alone can, perhaps, explain his spontaneous responses to various academic problems on different occasions. The off-beat way of thinking has been so natural and effortless to him that it verily forms the unique characteristic of his personality. It may, therefore, happen that his way of exploring the problem may not always seem to be in conformity with the conventional and widely accepted treatment of the problem, but still it, invariably, does pave the way to enrich your understanding and significantly, it often inspires you to take up the problem with a fresh vigour and

with a novel and imaginative point of view. His humane approach in dealing with people, very well reflected in his sympathetic, patient and encouraging attitude, further strengthens his image as an inspiring personality. It is, therefore, not surprising to see that in any academic gathering which may consist of students, teachers, research workers or scientists, he is always being looked upon as a central figure for guidance, advice and moral support irrespective of the position he may hold.

Prof. Pandya, as a thinker, has been solidly backed by his rigorous and disciplined homework that crystallizes and consolidates his thinking. He strives hard and takes painstaking efforts to grasp and organize the topic with all its details and subtle points before he presents it in his typical style which is extremely comprehensive and delightful. This has been amply evident from the crisp, lucid and up-to-date presentations made by him, from time to time, both through his writings and speeches. His rather informal style of presenting a speech readily enables him to establish immediate rapport with his audience and thus makes him an irresistible speaker in the scientific community.

It is indeed my good fortune that I had an opportunity to be among those very few students who were privileged to work under his able and illuminating guidance for their doctoral work.

Needless to say that I owe him a lot in many ways. Today when he is completing his sixty years, I sincerely extend my warm and whole-hearted CONGRATULATIONS to him. Incidentally it also marks the formal completion of his illustrious inning in PRL. On these twin occasions I earnestly wish him many more happy, purposeful and eventful years ahead.

RECOLLECTIONS OF A PUPIL

V.K. Thankappan

Twenty eighth July 1958. That was when I met Professor Pandya for the first time. He was sitting opposite to me, flanked on either side by Professor K.R. Ramanathan (the Director) and Dr. Sarabhai (the Founder), interviewing me for the position of a research student at the Physical Research Laboratory (PRL). I had actually reached Ahmedabad the previous day morning and paid a scouting visit to PRL the same day. When I mentioned this fact at the interview, Professor Pandya remarked that in that case I could have come for interview the previous day itself. I am mentioning this only to emphasize the informality with which PRL functioned in those early days. It was in keeping with this informality that I was asked to join soon after the interview (I had come prepared to go back home to await the result of the interview, as is usual with interviews conducted by government departments), but was paid the rail fare both ways as promised in the interview letter.

My recruitment was, as stated in the advertisement, for working on cosmic rays with Dr. Sarabhai's group. In order to acquire the necessary expertise in electronics, Dr. Sarabhai assigned me to Dr. U.D. Desai who was the Electronics Expert of PRL in those days. However, in the two weeks that I was with Dr. Desai, I met him only twice or thrice and learned little more than what I already knew. This slow pace of progress introduced a sense of frustration in me. And it was in this mood of frustration that I happened to meet Professor Pandya again in the reading room

The reading room was about twenty feet square with periodicals display racks on opposite walls, a glass outer wall and a rectangular table in the middle surrounded by backward-slanting chairs. We were sitting facing each other on opposite sides of the table. The conversation might have started with the usual pleasantries, but eventually turned to my asking him about his field of research. He told me that he was working on theoretical nuclear physics whereupon I said that I would like to join him as research student. He was obviously happy at this offer, lonely as he was among the cosmic ray, ionospheric and atmospheric physicists (He had joined PRL the previous September or so), but told me that he was willing to take me if Dr. Sarabhai had no objection. PRL formed only a minor (time-wise), though dearer, part of Dr. Sarabhai's activities in those days; he used to visit PRL once or twice every day. I approached Dr. Sarabhai the very next morning as soon as he entered PRL and disclosed my desire to him. Though not happy at my unexpected request, Dr. Sarabhai was magnanimous enough to permit me to join Professor Pandya. Thus it was that I got, about the middle of August 1958, the privilege of becoming the first research student of Professor Pandya. Y.R. Waghmare joined soon after and S.K. Shah within another year. We three students and Professor Pandya formed the, somewhat 'under privileged', theory group of PRL until the close of 1962 when Professor Pandya left for the U.S.A. on a two-year leave of absence.

I cannot say what exactly motivated me to make the change from Dr. Sarabhai to Professor Pandya. I knew precious little about

either cosmic rays or nuclear physics in those days to make an intelligent choice on that score. The feeling of frustration I mentioned earlier might have played a part. The thought that the youthful Professor Pandya would be always at hand to guide me in contrast to Dr. Sarabhai who was too busy to meet occasionally also might have been a factor. But I believe that it was fate (or divine will or whatever one chooses to call it) that brought me and Professor Pandya together. My blissful ignorance of the impropriety involved in deserting one teacher for another in the same institution certainly smoothed the way for the change (Though Dr. Sarabhai was good enough not to stand in the way, he did not quite forgive me for the transgression).

Whatever might have been the reasons or circumstances that brought us together in a pupil-teacher relationship, there was no ambiguity about the result. My mood of frustration was transformed into one of elation. The very first thing Professor Pandya did after I joined him was to take me for a cup of coffee to the ATIRA canteen (PRL itself did not have a canteen). This action on his part was symbolic of the informality and the intimacy which were to characterise his relationship not only with me but also with his other students. Of course, the atmosphere of PRL itself in those days was that of a combined family (the total number of members being around 30), everybody knowing everybody else irrespective of whether one was a professor, student, technician or clerk. This family was headed by the venerable Professor Ramanathan

while the bread-winner of the family was the dynamic and energetic Dr. Sarabhai. Professor Pandya was the junior who had a family of his own. The other two juniors were Dr. J.D. Desai and Dr. K.P. Kane. Thus, the theory group constituted a family within a family. Professor Pandya used to invite us often to his house for tea. His ever-hospitable wife also treated us as family members.

There can, perhaps, be no better illustration of the affection and care Professor Pandya lavished on me than the time when I was to follow him to the United States. He left for UCLA (California) at the end of August or early September 1962. I followed him in December, headed for the Davis campus of the University of California. Since I was travelling abroad for the first time, Professor Pandya might have felt that I needed help on the way. So he sent me the name of an Indian in Tokyo whom I should contact, and the name of the hotel in Honolulu to which I was to write for advance reservation. Finally in Los Angeles, he himself came to take me to his residence from the Airport, and I spent the first two or three days of my stay in the mainland U.S.A. with Professor Pandya's family. Before he saw me off in a plane to San Francisco, I had visited with him the UCLA campus, the Warner Brothers Studio in Hollywood and a supermarket, thus receiving practical lessons on American institutions. Eventhough since then I had occasions to play host to him, I had always the feeling that I received more from him than I could give him. Perhaps

it is the law of Nature binding all noble relationships: the net flow is always from the higher to the lower level. A son receives from his father and mother more than what he can ever hope to give in return; a pupil's attempt to repay his debt in full to his teacher is also found to be futile.

Professor Pandya had a small room in the ground floor of the two-storey building that was PRL at that time (one more floor was added before I left PRL) to himself. We students were accommodated in an adjacent large room. Probably because of this proximity, I used to run to Professor Pandya every time I did not understand something while reading, without bothering to make a real hard effort to understand it on my own. Never even once did Professor Pandya chide me for taking such an easy course; on the contrary, like an indulgent father to his first-born son, he acted as if he welcomed these frequent interruptions.

By the end of the first year, I had a published paper jointly with Waghmare. Actually, all we did was to perform some calculations which Professor Pandya asked us to do and write something that passed for a first draft; we did not understand the significance of the paper. Professor Pandya's justification for such a publication was that it would boost our morale. And it surely did! I cannot describe the thrill we both experienced when we saw our names in an international journal for the first time.

I used to marvel at Professor Pandya's ability to make papers out of seemingly innocuous material. In this respect, he was only being pragmatic. He knew well that, along with quality, the number of publications also mattered a great deal in a world afflicted with the 'publish or perish' mania.

Another gift of Professor Pandya which has greatly impressed me (and others too) is his ability to separate the physics from the maze of mathematics. This quality is most impressive in Colloquium lectures. I remember a colloquium lecture he gave at Davis. Everybody was very much impressed because everybody could understand what he was talking about, though most of the listeners were experimentalists. The interesting thing is that Professor Pandya is able to deliver such impressive lectures with the help of only a blackboard and a piece of chalk. In fact, he is averse to the use of artifacts like slides (though he seems to have started using the overhead projector in place of blackboard) in such lectures. He once related to me the case of a V.I.P. lecturer who was to deliver an important lecture at a premier institution of the country. The V.I.P. came well prepared with lot of slides for his talk. Unfortunately for him, the electricity failed (a common enough occurrence in our country) and the poor lecturer was left with no lecture to deliver. Such a thing could never happen to Professor Pandya.

I submitted thesis in March 1962, within less than four years of my joining PRL - a record for PRL till then. Waghmare and Shah

also completed their theses within another year or so. Professor Pandya went to the United States in September 1962. Myself, Waghmare and Shah followed him one after another. But we all returned to different institutions in India. Professor Pandya returned after two years to PRL to start a new generation. I joined the Tata Institute of Fundamental Research but later moved first to Kurukshetra University and then to Calicut University. Waghmare joined the Kanpur I.I.T. and Shah came back to the Baroda University. To say that we all went in our different ways would be correct in more than one sense. For, I have practically left nuclear physics research; Shah has left research altogether. Thus, Waghmare is left with the responsibility of carrying on the 'family tradition'. And he is doing it admirably well. It is unlike Professor Pandya to feel unhappy over the fact that two of his pupils have strayed from the original field. He used to tell me that after I finish Ph.D., I should try to work in other fields like nuclear reactions or plasma physics. He was, I think, trying to tell me that the field of theoretical physics is vast and that I need not confine myself to a narrow part of it.

Professor Pandya joined PRL when it was like a village where everybody is concerned with everybody else. He is retiring at a time when PRL has grown to be a metropolis where even neighbours could be strangers. Whether one likes it or not, change and growth are inevitable parts of life. Professor Pandya has not only been a witness to this growth but has also been a participant in it. He is the 'junior' of yester year who has grown

to be the 'venerable Old Man' of PRL. Like the venerable Old Man of PRL's early days, I am sure he will also continue to guide the destiny of PRL for many years to come. At this juncture, I cannot but thank my destiny which bestowed upon me the privilege of being the first student and pupil of this fine teacher and finer human being.

A TRIBUTE

Ram K. Varma

Prof. S.P. Pandya completes sixty years on July 11, 1988. With this, he also completes nearly four decades of active scientific career which continues and will continue. Of these four decades, three have been spent in the service of PRL; and of these three, I have had the pleasure of being associated with him during the last two.

My first contact with him occurred at TIFR some time during 1957-58 (I do not exactly remember) when I was a Research Assistant at TIFR and he was visiting as one member of the 'trio' (Profs. A.N. Mitra and Manoj Banerjee being the other two members) to deliver a series of lectures on nuclear physics. I had felt completely overwhelmed by the series of lectures by these three stalwarts just returned after doing their Ph.Ds. from their respective highly reputed universities. I don't think I remember anything about the material presented except the mannerism of their presentations which seems to survive to this day.

My real contact and the two decade long association with him began in the last days of March 1968 when I visited PRL to give a set of talks in connection with my proposed move from TIFR to PRL. Finally I did join PRL on July 03, 1968 and I was given a nice cosy

corner by Prof. Pandya to share in his own office, because of lack of space for theoreticians in those days. I liked that corner because it was in his office.

Beginning with that contact, I have had the opportunity over these last two decades to see the various facets of his personality: as a physicist, as a scientific administrator and as an educationist and, above all, as a high principled critical and self-critical human being. I am afraid, I embarrass him when I say all this about him. His sense of devotion and commitment to his work and duties whatever they happened to be at a given time is something that has influenced me a great deal.

As a nuclear physicist, his work is well known and internationally recognized. I first learnt about the "Pandya transformation" from a foreign physicist in 1967 but not even once I have heard even a hint about it from its author. I am not sure I can say the same thing about myself. As an educationist, he is always worrying about taking the message of science to the young ones in an exciting manner. He is constantly doing his bit and best in a quiet determined fashion. As a scientific administrator, he had always worried about the too little freedom that the young scientists enjoy today in the present set up in the pursuit of their ideas. He has also complained that the young scientists do not

seem to take time off to see nature, go hiking and involve themselves in issues other than the day-to-day mundane things. Excellence is a more rounded concept according to him and not to be interpreted and practised in a narrow sense. I agree with him totally. But these ideas run counter to the demands of the system that has evolved or misevolved wherein things must happen in a certain prescribed manner and the show must go on as it pleases the system.

Today as I look back on my two decade long association with him, I find myself enriched in a number of ways. To be sure, I have had my differences with him and he with me. But they are only an indication of the honesty, our individual opinions and a commitment to the common cause.

With these few words, I pay my tribute to my long time colleague Sudhirbhai, as we all affectionately call him, who has been a silent but powerful force who has played a great role in the growth and development of PRL during all the three decades that he has been here.

A few reminiscences from my student days

Y.R. Waghmare

There are two most unforgettable episodes of my research career - and Sudhirbhai taught me in such a tender way as to how to treat a student who is just starting his research career, and at the same time firmly implant the essential ingredients required for becoming a professional research physicist.

Once I was stuck with some problem which looked reasonably simple but somehow I was not able to do it. It also looked to me embarrassing to take it to Sudhirbhai and at the same time I was not able to do it. It was indeed frustrating, so much so, that finally I went to Sudhirbhai in a complete state of despondency, almost tears in my eyes, and said "Sir, I am totally unfit for doing research". Sudhirbhai understood my plight (He always understood his students extremely well). In his usual calm and soothing tone he pacified me with just a few sentences "Yeshwant, in a research career everyone goes through a phase like you are in at the moment. Even I went through it and so did my boss. It is essential to go through it lest one may misunderstand oneself. So do not worry; everything will be alright". I do not know whether what Sudhirbhai said was true or not, but I know for sure that many of my students have gone through it and I told them the same pacifying words.

I loved sports. Once I wanted to see a kho-kho match. Instead of telling him so I told him that I was not feeling well and left the Institute early. Somehow Sudhirbhai came to know of it. Next morning he asked me a simple question " who won?". I felt miserable and looked rather dumbly. Sudhirbhai said kindly and with a smile "I know you like sports. You could have told me the real reason. The scientific research requires a straight approach".

SUDHIR P. PANDYA - THE PHYSICIST

C.S. Warke

Professor Pandya is one of those rare physicists who probe beyond mathematical formalisms to seek out the physical phenomena hidden in the experimental facts. His interest has always been to look for the simplest explanation. Having formulated and understood the mathematical framework, the physics is beautifully presented devoid of all complexity.

A study of his scientific contributions reveals the history of the theoretical development of nuclear structure. His early work on the shell model was timely. Mayer and Jensen had just put forward a model which very successfully explained the ground state spins and parities of almost all known nuclei. The nuclear magnetic moments agreed qualitatively. This gave a great impetus to the experimental nuclear spectroscopists too. Very soon a vast amount of data, on low lying excited level spacings, electromagnetic transition rates, beta decay rates, nuclear magnetic and electric quadrupole moments and single particle spectroscopic factors from (d,p) reactions was accumulated. This spectroscopic data called for nuclear models, a data based phenomenology with vast correlative powers between different pieces of the data. Prof. Pandya, in one of his

most important contributions, has shown that the energy spacings of a nucleus having n neutrons in a single shell j_ν and p protons in the single shell j_π can be expressed in terms of the spacings of another nucleus having a proton and neutron in the same shell. Further, these are related to the energy spacings of nuclei with a single neutron hole and a single proton or a neutron hole and a proton hole in the same shell. In simple terms, this means that the energy spacings of several nuclei can be predicted from the experimental values of only one nucleus. This has been confirmed in Chlorine, Argon and Potassium isotopes.

These relations are analogous to the Gellmann-Nishijima mass relations in particle physics where interaction terms, which are commuting generators of a group, give rise to mass splittings of the multiplets which would be otherwise degenerate because of the group symmetry. Since there are only one or two interaction parameters and the multiplet degeneracy is much larger, the masses of the particles get related. In the shell model, the two-body interaction lifts the degeneracy associated with n neutrons and p protons in the absence of mutual interactions. The interaction parameters are uniquely obtained in terms of the energy spacings of a nucleus with a simple configuration. For other nuclei with protons and neutrons filling the same shell, these interaction parameters are the same. Hence their energy spacings can be expressed in terms of those of a nucleus with the simplest configuration.

Unfortunately, most nuclei do not have pure shell model configurations. Therefore, he extended the idea and exploited it to extract the best effective nucleon-nucleon interaction in finite nuclei. This was timely because the Brueckner-Bethe theory required such information to test its validity. Also, an important outcome of this work was that small mixing of other configurations produced large effects on (d,p) spectroscopic factors and electromagnetic properties of nuclei as required to explain the data.

Around the sixties, there was great interest in the Bohr-Mottelson unified nuclear model and Brueckner-Bethe many body theory of nuclear effective interactions. Prof. Pandya diverted his interest towards these problems. He analysed the incoming new experimental data on Si, P, Al and Mg within the unified model framework. He tested theoretical effective interactions using spectroscopic data. But the most valuable achievement came out from the extraction of qualitative properties of the experimentally deduced effective interaction. It was believed that interacting many body theory, within the shell model framework, could reproduce the rotational model in one extreme and the pure shell model on the other. In the intermediate approximation, it might as well reproduce the results of weak particle-vibration coupling model of the nucleus. Elliot succeeded in proving the SU(3) scheme, where the long range quadrupole-quadrupole (Q-Q) strong coupling reproduced the rotational model. The strong

attractive short range pairing model on the other hand was shown to lead to the shell model limit (seniority scheme). This study brought out the observation that competition between the rotational and seniority coupling scheme is determined by the importance of the short- and long-range domain of the effective interaction. Another important contribution of Prof. Pandya resulted from the study of qualitative properties of the experimental effective interaction. The effective interaction acts mainly in the $l = 0$, s-state of the relative motion of the interacting pair. In the lowest relative radial state it is attractive and is of the pairing type while in the second excited state it is of Q-Q type. The above rotational and seniority coupling scheme can be looked upon as a competition between the lowest and the second excited radial state of the relative motion of the pair. It is the repulsive core that produces the excited state of the relative motion. He also found out experimental quantities which are sensitive to the isospin dependent part of the effective interaction so that it could be studied accurately.

In the seventies, heavy ion facilities changed the face of nuclear spectroscopy. A large number of energy bands of high spins were observed in many nuclei. In some cases electromagnetic decay rates were measured, creating a wealth of valuable information for theorists to analyse in terms of new models or extend old ones. Amongst them, the most popular and successful was the projected

Hartree-Fock-Bogoliubov (HFB) method. He carried out the following interesting work in this topic of high spin spectroscopy. In Si^{28} and Ne^{24} nuclei the prolate and oblate shape HFB states were found to be degenerate. In order to improve the calculated high spin energy spacings, one had to mix these states and the particle-hole (ph) states based on these two intrinsic states in the projected formalism. He analysed the data of Ni, Zn, Ge, Se isotopes within this framework and demonstrated the role of high spin single particle orbital to produce high spin states. He also studied the effective interaction problem within this model using the statistical approach to avoid complexity of the calculations.

These few pages highlight some of the notable contributions made by Prof. Pandya to nuclear physics. They also provide an insight into the breadth and depth of his research career. He started out with pion-nucleus scattering from a classical field theory point of view and then turned his attention to nuclear models and effective interactions. Throughout his work, the common theme has been to be always on the look out for simple explanations of complex phenomena such as an understanding of the systematics of new experimental data. His long and illustrious career as a scientist is an example of how one can be actively engaged in research and an inspiration to all of us.