

TATA INSTITUTE OF FUNDAMENTAL RESEARCH
HOMI BHABHA ROAD, BOMBAY 400 005

Telex : 011-3009

Code : TIFR IN

Telephone : 219111

Telegrams : ZETESIS

Ref: TFR/2C/

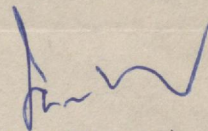
October 1, 1986

Prof. B.V. Sreekantan
Director
Tata Institute of Fundamental Research
Bombay 400 005

Dear Sir,

A xerox copy of the review appeared in the September issue of the '**Nature**', of the book '**Homi Jehangir Bhabha: Collected scientific papers**' which was brought out as a special volume on the occasion of late Dr. H.J. Bhabha's 75th birthday, is sent herewith for information.

Yours faithfully,



(K. Sankaranarayanan)
REGISTRAR

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Physics and Homi Bhabha

Rudolf Peierls

Homi Jehangir Bhabha: Collected Scientific Papers. Edited by B. V. Sreekantan, Virendra Singh and B.M. Udgaonkar. *Tata Institute, Homi Bhabha Road, Colaba, Bombay 400 005, India:1986. Pp.1,023. Institutions Rs 500; individuals Rs 250. Outside India \$150.*

HOMI Bhabha was a highly talented scientist, and also a painter of distinction. But he will be remembered above all for the part he played in the development of science and atomic energy in India.

Bhabha came from a well-to-do and sophisticated Parsee family. After studying mechanical sciences at Cambridge, he started research in theoretical physics in 1930. This was an exciting time for physicists and Bhabha became attracted by the phenomenon of cosmic rays. He wrote his first paper on this subject, which remained his dominant interest thereafter. He developed the theory of cascade showers (simultaneously with Carlson and Oppenheimer) which explained many of the otherwise mysterious observations, and led to the conclusion that the penetrating component could be explained only by a breakdown of the quantum theory, or by a new particle, which indeed turned out to be the muon. His many papers on other subjects, such as electron-positron collisions ("Bhabha scattering"), new kinds of wave equations, and meson theory, all had potential applications to cosmic rays, which he kept clearly in mind.

By the late 1930s Bhabha was well established in Cambridge, while also visiting many other European institutions. We do not know how long he would have continued in Britain, but he happened to be in India on holiday when the Second World War broke out and prevented his return. He became a Reader, and later a Professor at the Indian Institute of Science in Bangalore, and built up a strong group, mainly on cosmic-ray research.

Bhabha, however, was also endowed with formidable administrative energies. He saw the need for a national institute devoted to fundamental research, and on his initiative the Tata Institute was founded, with him as director. It became an institution of high standard and exerted a profound influence on science in India. Later he realized the importance for India of nuclear power and persuaded the government to set up the Atomic Energy Establishment in Bombay, of which he was put in charge. He also became the chairman of the Indian Atomic Energy Commission. As he was also chairman of the Scientific Advisory Committee to the

Cabinet, devotees of Gilbert and Sullivan might well have thought of him as the "Poo-Bhabha"! But he managed to carry out all these functions efficiently.

He did not, however, regard science from a narrow, national point of view — he was also concerned with the international relations between scientists. For three years he was president of the International Union of Pure and Applied Physics, he chaired the Geneva Conference on the Peaceful Uses of Atomic Energy in 1955 and also served in the International Atomic Energy Agency. Bhabha's death at the age of 56 in a plane crash on Mont Blanc was thus a sad blow not only to India, but also to international science.

On the 75th anniversary of his birth the Tata Institute has published this commemorative volume, most of which is taken up by his scientific publications. Some of these are familiar today, because they have become part of our recognized knowledge of physics, while others were exploring new paths which the development of physics did not follow. The collec-

tion is therefore not likely to become a research tool, but it is of great interest to the historians of physics, and to readers who want to appreciate the work of a remarkable man. Only his strictly scientific papers are included, and one hopes that Bhabha's speeches and writings on science policy and other general matters will be published separately.

Three introductory articles by B.V. Sreekantan, Virendra Singh and B.M. Udgaonkar outline Bhabha's work in cosmic-ray physics, general theory and science policy. Tributes to Bhabha at a memorial service by Cockcroft and M.G.K. Menon, and Penney's Biographical Memoir, are added as appendices.

I would have liked to see inclusion in this attractively presented book of reproductions of one or two examples of Bhabha's paintings. There is only a drawing of Blackett, hardly typical of Bhabha's work. □

Sir Rudolf Peierls is Emeritus Professor of Theoretical Physics in the University of Oxford.

Scanning standard

V.E. Cosslett

Scanning Electron Microscopy: Physics of Image Formation and Microanalysis. By Ludwig Reimer. *Springer-Verlag:1986. Pp.457. DM112.*

IN HIS preface to *Transmission Electron Microscopy* (Springer Monographs in Optical Sciences No.36), Ludwig Reimer stated that the scanning method would be covered in a complementary volume. He has now fulfilled this promise some two years later. In the present book (No. 45 in the same series), he uses the same approach as in the previous volume (*Nature* 309, 186). But perhaps this is not surprising, as both books evolved from lectures given at the University of Münster. Translated into very readable English, with the aid of the guest editor, Dr P.W. Hawkes, *Scanning Electron Microscopy* matches the standard of its predecessor to give an authoritative and up-to-date account of the subject.

Most aspects of the subject are dealt with, except for the applications of the scanning system, which were included in an earlier text of Reimer's (*Elektronenmikroskopische Untersuchungs-und Präparations-Methoden*), and are to be found in several congress reports that have since appeared. Special attention is here given to the physical basis of scanning microscopy. The detailed processes involved in beam-specimen interaction and in image formation are first considered. Naturally there is a degree of overlap with the previous volume in respect of the

former, but rather less emphasis is placed on the wave nature of the electron. A quantum mechanical treatment is given of elastic scattering and inner shell ionization, but multiple scattering and (in thicker specimens) diffusion enter frequently into scanning microscopy, and here the electron appears as a particle, especially in secondary and backscattered imaging. The simple concepts of mean free path and mean energy loss are consistently invoked. The consequences of the Bethe and other models are displayed, and compared with experiment. The emission of X-rays is fully discussed, in relation to microanalysis and to some extent with diffraction. There is a good exposition of the theory of electron diffraction and its part in channelling patterns.

Other chapters deal with cathodoluminescence, electron beam induced current, detectors and signal processing, but there is no detailed description of apparatus for microscopy or microanalysis. The author's aim is to make clear what happens inside them, and especially in image formation and interpretation. As he says in the preface: "Many SEM users do not give much thought to the origin of contrast, but when the signals are to be used more quantitatively it becomes necessary to know more about the physics of SEM". In this aim he has succeeded admirably, and his book is likely to become the standard work for all users of the instrument. Especially to be commended is the list of references (running to 140 pages) which closes it. □

V.E. Cosslett is Emeritus Reader in Electron Physics in the University of Cambridge, Free School Lane, Cambridge CB2 3RQ, UK.



No brown sugar tonight

Based on first-hand experience, Narcotics Anonymous believes that every addict, including the potential addict, suffers from an incurable disease of the body, mind and spirit.

Tamal Bandyopadhyay and Saisuresh discuss NA's therapy for addicts.

IT could be Mahim, Bandra, or Byculla in Bombay; the venue may change but never the dramatics. Never the emaciated faces, the drooping heads, the intense eyes. Never the promise and the hope. Never the graffiti on the blackboard staring at the living corpses: "One day at a time", "A drug addict by himself is in bad company"—a mute witness to the candid confessions.

Hounded by a harsh society, which very often drives them to dependence in the first place, they are treated as children of a lesser god. Breaking away is possible, they realise, but not while society treats them like vermin, or worse, not while they are denied sympathy and acceptance for what they are.

Which is what Narcotics Anonymous (NA)—a motley group of "recovering" and "suffering" addicts—offers them. NA was formed in July 1953, with the first meeting held in southern California. The fellowship grew sporadically but quickly spread to various parts of the USA. And inspired by the American experience, NA India came into being in 1982 at Mount Carmel Church, Bombay.

Vijay, an NA member—who recently completed four years of abstinence from drugs—was earlier both an alcoholic attending Alcoholics Anonymous (AA) meetings, and a drug addict. One day he admitted, "I am an alcoholic, and I'm also a drug addict". At this point other addicts, too, came forward and the need to have a separate body of addicts, along the lines of AA, was felt.

Based on first-hand experience, NA believes that every addict, including the potential addict, suffers from an incurable disease of the body, mind and spirit. They are caught in a powerful vortex and the only succour is spiritual. Recovery through NA is a step by step process. Addicts are enjoined to obey implicitly the 12 steps which take them to recovery and to respect the 12 traditions.

Some of the 12 commandments are to recognise one's powerlessness over one's addiction, to realise that their lives have become unmanageable and to believe that only a power greater than themselves could restore them to sanity; to take a searching moral inventory of themselves; to admit to God, to themselves and to another human being the exact nature of their wrongs; to be ready to have God remove all these defects; and to seek through prayer and meditation to improve their conscious contact with God.

JOSEPH Verghese — following his recovery he took on the role of an NA counsellor.

thing unusual in his behaviour "as he was a growing boy". His record in school was consistent; as he says, during his school leaving exams he laid off drugs for a whole month and passed with a first division.

But in college he wasn't so lucky. His principal informed his parents that he was taking drugs. "Our son, we believed, would never do such a thing. In a way, we did not want to believe it," say his parents. His mother, a successful doctor, used to attend her clinic twice a day and his father, a disciplinarian, believed that his son should be brought up the way he was. And the son rebelled in the only way he knew how to.

The parents' concept of a happy family was that the children be sent to the best schools and excel in their studies. Their only contact was at the dining table and conversation was limited to "Have you done that, have you done this?" and a battery of do's and don'ts.

It was not as if Joseph was unaware of the trauma he was causing at home. In fact, he did try to break the habit and only then did he come to know how deep he had sunk into it. Fear

one day if there was anyway she could help him. "Yes, please stay at home with me, all the time." "But what about my job?" "You are not the only doctor in town. If you are not there, your patients will go elsewhere. But you are my only mother. Whom else can I turn to?" For over a week his mother did not go to her clinic. And that brought about the miraculous change...

THE recent admission of Vijay Merchant that drugs have penetrated "even hospitals and we are helpless against it" is an indication of how deep the gangrene has set in.

Various figures are bandied to make us aware of the enormity of the situation: 80,000 addicts in Bombay, says one report while another offers 1,50,000 as the exact figure. Terming all such reports as "guesstimates", Mr. Singaravel, additional commissioner of police, Bombay, says even the fatality rate of five a day due to drugs is doubtful, for there is no way of ascertaining the exact cause of death through a post-mortem, for the drugs are so adulterated, he says.

Unlike its predecessor, the new Narcotic Drugs And Psychotropic Substances Act has strengthened the police's hands in combating the evil. "The old Act put the police on the defensive, while the new one has made us aggressive," says Mr. Singaravel.

Under the new legislation that came into effect on November 22, 1985, which is "projected as a major weapon to stop addiction", all offences are cognisable and non-bailable. While letting the addicts off the hook, maximum

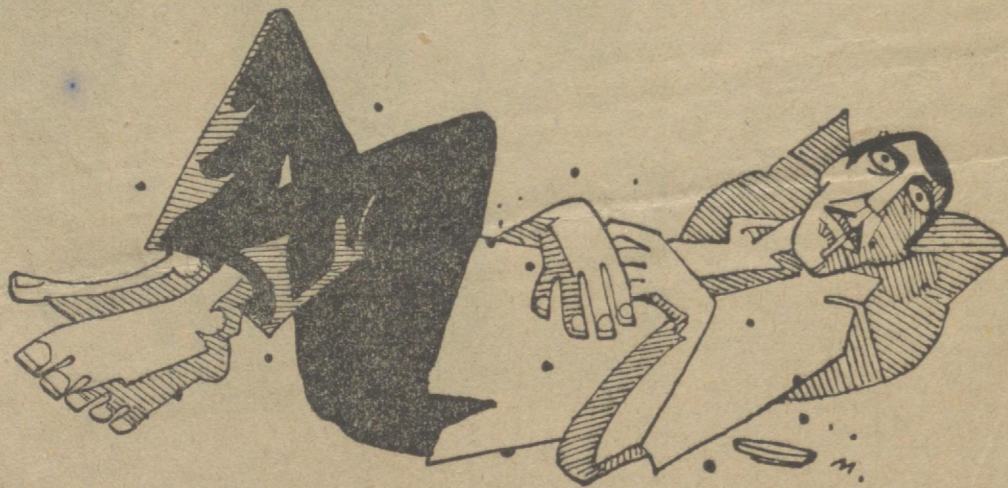
chary of picking up an addict "as we only invite trouble doing this", for there is no proper treatment in police stations. Worse, "even in hospitals there may not be a bed available".

The number of persons who have been arrested in Maharashtra between November 22, 1985 and February '86 is 519. And thus far, there have been no convictions under the new Act, "owing to the long time it takes for such cases to come up for hearing. Moreover, under the Indian Evidence Act, the police officer's statement is not accepted as proof." "How many people are willing to come forward to testify?" Mr. Singaravel asks.

"SHATTERED dreams, wounded hearts and broken toys" are the reasons for drug addiction, according to Fr. Joe Pereira who runs the Kripa Rehabilitation Centre at Bandra. "It is nothing but an escape into the world of make-believe. Then there's the neo-addict who takes drugs to be 'with it'. He tries it for kicks and eventually gets hooked. This is more apparent in schools and colleges — the utter meaninglessness of education drives the students to drugs."

Drug addiction, Fr. Pereira believes, is a two-fold disease. "You've to treat both the afflicted and the affected — the addict and the family. And ignorance on the part of the parents often compounds the problems. Once an addict, always an addict. No doctor can cure this malaise — at best the drug addict becomes a doctor addict."

"NA makes a person feel the true spirituality of a human be-



Contrary to belief, drug addicts are not sensitive people. Rather, they are very skilful and manipulative. What is bad about addiction is not the drug or the habit but the rituals that go along with it — stealing, coercion and plain beguilement merely to have their own way.

now seized him — a sort of paranoia — even his music system frightened him and seemed to engulf him, deeper and deeper, its sound reaching his head and seeming to wrench it free.

Drinking a cup of tea became an ordeal, his hands started trembling, the only way out was suicide, it seemed. But even that was not possible. He only could

punishment for self-consumption is six months. Mr. Singaravel says it comes down heavily on peddlers and dealers. Bail, for them, is a matter of the court's discretion, the amount being as high as a lakh or two, and "courts are not releasing these people on bail as they used to earlier". The judges are enjoined upon to give maximum punishment under this

ing; for by himself man is nothing. And only when you know that you are nothing can you become everything." At Kripa, which was set up in August 1981, "we shatter your ego even if we have to beat the daylight out of you. The addict often makes everything revolve around him — the family, loved ones, the entire world, for which they need a Copernican revolution," says Fr. Pereira.

The therapy he offers is four-fold: "Work therapy, where they are taught some craft, currently it is screen-printing, occupational therapy, encounter therapy and, of course, NA therapy. Kripa accommodates addicts and alcoholics from all over the country.

Dr. Dayal Mirchandani, a psychiatrist who also treats drug addicts, says, "The result is what

study of 2,110 admissions to PH revealed that 53 per cent of the addicts admitted to the programme withdrew from it and only four per cent of those admitted completed the course of treatment." And NA, he believes, is working on the lines of the western therapeutic communities.

Dr. Mirchandani is of the opinion that drug addiction is an indication that there is something wrong in the dynamics of the family. "In the conflict between parents, the 'problem child' becomes the neutraliser — a sort of stabiliser in the family". As the family is the genesis, he treats not only the addict but the entire family — treatment which he describes as "family therapy".

He brushes aside the cold turkey method — as withdrawal symptoms are known — as obsolete. His method, "narcotic antagonists", only makes an addict dizzy. He gives medicines to block or antagonise the opiates, preventing them from acting. They do not by themselves exert a narcotic effect, nor are they addictive.

While Fr. Pereira is all praise for police activities and the government alert, Dr. Mirchandani does not support the new legislation which he thinks treats drug addicts like criminals.

"While Britain has successfully solved the problem by a legislation which recognises registered addicts and thereby eliminates the blackmarket, the USA whose statute we've copied has a very high rate of addiction." The only way that the situation can be arrested in India, he feels, is to allow registration of addicts, not making addiction a criminal offence and providing proper rehabilitation centres — preferably run by specialists from abroad.

Like Dr. Mirchandani, Fr.

Campaign

Elly Rodriguez, one of the moving spirits behind NA (who once sent an addict to NA meetings "not to be cured but for the free cup of tea they serve"; ultimately he was cured) also believes that the root-cause is the family where the personalist relationship is lost. "If you cannot relate to your children properly, they take recourse to drinks, drugs, gambling or sex as a way of releasing their pent-up feelings."

The reason one does not see female addicts at NA meetings, Fr. Rodriguez says, is because they are hesitant to come forward, for fear of social stigma.

But Russel Pinto, a former drug addict who runs his own rehabilitation centre (Seva), believes that there are as many female addicts as male ones, but it is very difficult to treat them, as their psychological make-up is far more complex. At Seva, too, they believe that drug addiction can be tackled through communication therapy — love, encouragement and sharing of experiences. Seva has two branches in Goa, and two in Bombay. The addicts pass through these centres, phase by phase.

On February 26, the day of the Bharat Bandh, when public transport was off the roads, addicts from all over the city cycled to the NA meeting at Mount Carmel. Doesn't it seem like a mere shift of one's dependence — from one obsession to another — from drugs

Business/Economic Diary

by Gangadhar Gadgil

Small industries have developed rapidly over the years. But they are angry about a lot of things.

SMALL is beautiful! This has been the slogan of recent decades. Like many other things it has been imported from abroad. After importing it, we realised that Gandhiji had been saying the same thing for decades. So we felt mighty proud that we knew all along what the West took a lot of time to realise.



In any case, we took some time ago a decision to encourage small scale industries for economic, social, and political reasons. Small industries were favoured because they were labour intensive, avoided concentration of economic power, gave entrepreneurial opportunities to many and also made possible decentralisation of industrial development. Small industries were and are being encouraged by reservation of certain products for small industries as well as tax exemption and concessions. Various facilities like sheds are made available on favourable terms. Loans and credit are provided on a priority basis at concessional rates of interest. Supply of raw materials, technical assistance and preference in government purchases are also provided.

But the small entrepreneurs are angry about a lot of things.

Small industry, big grouches

prices to uneconomic levels. When they sell in the market, they find themselves at a disadvantage. In case of loans and advances, it is a case of too little and too late. The facilities they are promised in industrial estates remain to a large extent on paper, at least in many cases. When one hears the litany of their woes at conferences and workshops one wonders how they have survived at all. If things were really so bad, all the small industries by and large should have been dead by now. One finds, however, that they are growing.

Why then do they complain? Is it because they are young and numerous and do not labour under the stigma of being dirty capitalists? Do they unreasonably expect, that all their problems, technical, financial and in marketing should be solved by the government? Or is it because

it is ridden with corruption certainly does not improve matters. Delays are expensive and difficult to bear even for big industries. For small industries they are killing. Yet delays dog almost every step of a small entrepreneur.

This pent up anger burst with a bang when Mr. V. P. Singh presented his new budget. He must have been quite surprised by the storm that burst over his head. He actually gave some worthwhile concessions to small industry. He must have, therefore, expected small industry not to mind a small excise levy and introduction of some procedures to make possible the operation of Modvat. But small industry hit the ceiling, when faced with the prospect of visits by excise inspectors. What they minded was not the tax but the inspectors.

Findings of a working group, constituted by the ministry of industry, certainly seem to justify this angry response. The report says that there is a plethora of acts and rules regulating industry, which are quite confusing. Sometimes the implementation of a provision of one act leads to a violation of the provision of another act. Many of the labour laws act as deterrents to the employment of more persons. They also cause a lot of harassment to the entrepreneurs.

Finding Faults

To top it all, there are the innumerable visits of inspectors to ensure compliance with laws. Apart from state legislation, there are 45 central acts and rules applicable to industry. On an average 40 inspectors from various departments visit a unit. A visit by an inspector is an intimidating experience. He often comes with the sole intention of finding faults. Considering the complexity of regulations, this is not difficult to do at all. If the fault of harassment is not removed, an inspector is satisfied, in a manner that is well-known, the entrepreneur escapes harassment. This involves a cost which sometimes is quite stiff. The visits of 40 inspectors obviously cost the entrepreneur a substantial amount.

One feels happy that the finance ministry has acknowledged the genuineness of the grievances of small entrepreneurs and is taking positive steps to deal with them. The way government deals with small industry is certainly not beautiful. Let me hasten to add that the small industry is not beautiful either. There is a great deal of hanky-panky going on in the small sector. Some small units are non-existent. They exist only on paper to obtain raw materials at concessional prices or to secure other benefits to which small industry is eligible. Some small units are merely creations of large units for securing tax benefits. If a refrigerator assembled by a small unit is subject to lower excise, a big unit will create small units to assemble its refrigerators. There are small units which are really parts or sections of one large unit. There are small units, which because of their size, are not successfully pro-



Whatever his shortcomings, Kipling wrote beautifully and enriched the language. He spent his early years in journalism but he was essentially a writer.

by Govind Talwalkar

A KIPLING revival is on, judging from the reprints of his books, new anthologies as well as books about him.

Of the two books under review, Kipling's India, is a volume of uncollected articles by him and the other, Kipling, is a collection of interviews with and recollections about him.

Rudyard Kipling started his career as a journalist in his early teens on the Civil and Military Gazette, at Lahore. Unfortunately his boss was suspicious of him. In those days newspapers were not adequately staffed, at least not in India and the CMG was no exception. Kipling had to work very hard in and out of office hours. The newspaper confined itself to an Anglo-Indian readership and as such news and articles about officials in India was given importance. This official India was eager to know about the doings of royalty, about parliamentary debates and sport events in England etc.

Kipling wanted to try his hand at independent writing but his editor, Stephen Wheeler, would hear nothing of it. But whenever Wheeler was indisposed or out of station Kipling was free to write whatever he wished to. He was by and by given more responsibility and was sent to Simla and other places to cover important events. The two subjects close to his heart were



THE MAN OF FIVE FAMES: A drawing of Rudyard Kipling.

The Great Kipling Bazaar

English life in India and social life in Simla.

He was fond of children and of their play. A piece in the book about the Simla babies is delightful and touching.

As a staffer on the CMG, he was privileged to move in high society and mingle with the entourage of the viceroy. Unlike his fellow countrymen he was not a keen sportsman or horse rider; but he liked horses, dogs and monkeys of which there were many in Simla.

Kipling was in Patiala when the viceroy was on an official visit there. He describes graphically the palace of the maharaja of Patiala. He was at Peshawar when the Ameer of Afghanistan was received on Indian soil. All the pomp and glory comes out well in Kipling's account.

The heat and dust and disease are constantly referred to by Kipling. The heat was oppressive and the roads were in poor condition. Nothing positive could be said about the sanitation. The sahibs were new to all this and were often bedridden. We come across the most obedient and trustworthy servants who

worked for the British officials. But Kipling was not fortunate enough to have such servants. His servant did not care to do his duty properly, would pinch money and leave him unattended even while he was ill.

Kipling lived in India for a fairly long time but he belonged to that category of Englishman who did not think there was anything worthy of praise in India. He writes sarcastically about municipal affairs. Local self-government had been recently introduced and it was expected of Kipling to view this experiment kindly. But he was very critical of it.

Like many of his fellow countrymen he believed in the superiority of his people and thought that they had a duty to perform to civilize the Indians. It mattered little to him that England even in the latter half of the

19th century was not above corruption and there was poverty in the "other England". It was true that he work here was by and large slipshod, a sense of hygiene was lacking; there was no proper sanitation. All this continues to this day but despite being a creative writer Kipling was not sensitive enough to understand his surroundings.

He made the most of his experiences in India but he did not love its people. He loved the horse, not the horsemen, as is constantly underscored when we go through his uncollected writings.

Whatever his shortcomings, Kipling wrote beautifully and enriched the English language. He spent his early years in journalism but he was essentially a writer. The experience he gained as a journalist served him well. Those were the days when the English empire was at its zenith

and Kipling represented the qualities of the empire-loving Englishman. His stories, poems and novels became popular instantly.

Apropos the second book, though he was a success in England he was not popular in America for a long time. In fact, some of the editors of magazines turned away from him and did not accept his writings. Kipling's visit to America did not go off too well. Of course, these editors later repented.

Kipling and Joseph Conrad were neighbours and loved each other's company. Kipling was amazed at Conrad's mastery of the language. He, however, did not like Bernard Shaw and it might well be that the feeling was mutual. They had an awkward time when both of them were pall-bearers at Thomas Hardy's funeral. After the ceremony they shook hands reactantly.

In the evening of his life Kipling was generous enough to excuse the follies of others. He himself suffered some tragedies and realised that grief and suffering could unite humanity; but this realisation came a little too late in the day.

The Fundamental Bhabha

Dr. Homi Bhabha was an outstanding scientist. But there was much more to him than that. The creative scientist and artist, administrator and institution-builder and the statesman in Bhabha are highlighted in this book.

by S. Kumar

"FOR every thousand scientists who can do reasonably good work in a good scientific atmosphere, there is only one who can create the atmosphere for himself in a place where it does not exist, and this alone is a test of the outstanding scientist."

Dr. Homi Bhabha was an outstanding scientist. The test prescribed by him in 1963 is valid even today.

A commemorative stamp was issued in his honour by the Government of India in 1966 and the Royal Society's biographical memoirs of Fellows says: "We can find no evidence that a scientific Fellow has ever before been commemorated by a postage stamp."

Now, the TIFR has paid fitting tribute to its founder with this volume. Bhabha is widely known as the architect of India's atomic energy programme; in fact the atomic research centre is named after him. But, there was more to Bhabha than that. The creative scientist and artist, painter, administrator and institution-builder and the statesman in him are highlighted brilliantly in this book.

The three introductory articles by the editors, dealing with Bhabha's contribution to cosmic ray physics, theoretical physics and to growing science successfully blend to bring out the image of the hero. The commemorative lectures on Bhabha delivered by Sir John Cockcroft and Prof. M.G.K. Menon in London embellish the tribute.

Theory Of Electrons

The collection contains one of the most celebrated papers which appeared in Nature in 1936 which formulated for the first time the Bhabha-Heitler cascade theory of electrons. According to this theory, high energy electrons in passing through matter gave rise to high energy photons and the photons in turn produced a pair of positive and negative electrons. These in turn led to further production of photons and the cascade process continued until the energy of the particles fell below a critical threshold value. This phenomenon precisely explained the showers observed in the cosmic rays whose origin is still a mystery.

Bhabha was the first to predict that "meson", a penetrating particle of cosmic radiation, would be unstable and spontaneously decay into electrons and neutrino, a weightless subatomic particle.

Bhabha initiated balloon flights to measure the intensity of the penetrating component at different altitudes and over the years, this activity led to the formation of a permanent National Balloon Flight Facility at Hyderabad. Today the centre has the capability to manufacture balloons upto 10 million cubicfoot volume and launch payloads upto 1,000 kg.

Another of Bhabha's achievements dates back to 1935. The process is known as "Bhabha scattering" which explains the

Homi Bhabha's views on science and technology and their growth today serve as a sad reminder of lost tracks. Bhabha made a pertinent point when he said that fundamental research could be judged only by world standards since there was no such thing as making a discovery which someone else had already made.

His concept of picking out an outstanding man and building an institution for him was in stark contrast to the current system of planning a project and making a futile search for suitable persons to run it.

A couple of weeks before his death in an air crash, addressing the International Council of Scientific Unions, Bhabha said

time establishing modern science in the country as a live and vital force... the problem of establishing science as a live and vital force in society is an inseparable part of the problem of transforming an industrially underdeveloped to a developed country."

Growth Of Science

Admittedly, many writings and speeches of Bhabha on aspects of public policy in science and on his philosophy and methodology in the growth of science in the country could not be included in this volume. For historians of science and builders of scientific institutions, not to speak of administrators of science, this collection would be



CREATIVE SCIENTIST: Dr. Homi Bhabha and his colleagues discussing the design of the first Indian reactor, Apsara.

Homi Jehangir Bhabha: Collected Scientific Papers: Edited by B. V. Sreekantan, Virendra Singh And B. M. Udgaonkar (TIFR, Bombay)

effects of the interaction of an electron and positron, which is a positively charged electron.

Incidentally, Bhabha was highly satisfied with the papers written in India compared to some of the celebrated works done by him abroad.

what is relevant to a nation on the march towards the 21st century: "An important question we must consider is whether it is possible to transform the economy of a country to one based on modern technology developed elsewhere without at the same

invaluable. Modern students of science get the feel of the environment in which Bhabha the physicist worked through his scientific papers, which make pleasurable reading even for the lay reader who can do well to skip the numerous mathematical equations in the book.

At least the general articles in the hefty volume are bound to stimulate aspirants interested in science. It also serves as a study in contrast between the times of Bhabha and those of today.

A Perfect Spy is less a novel than a bizarre probing into the fracturing lives of the ultimate

Le Carre