where

$$f_{A,\psi}(\omega) = \int (A\psi)(t)\tilde{B}(dt, \omega),$$

$\tilde{B}$ being the n-dimensional homogeneous complex Gaussian chaos. The left-hand side of equation (2) is a quantum correlation but the right-hand side is a classical expectation of the product of two complex valued Gaussian random variables. If P is a projection in $L^2(\mathbb{R}^n)$ the probability of the event P in the pure state ψ can be expressed as

$$\langle \psi, P\psi \rangle = P_r\{|f_{P,\psi}| > |f_{I-P,\psi}|\}. \qquad (3)$$

This is alright when ψ is a pure state but Wiener has left the matter open in the case of mixed states. The right-hand side of equation (3) is the probability of a rather artificial classical event in a huge probability space but Masani wonders whether this has something to do with hidden variable theories. Wiener's weakness for looking at everything through his power spectral language of communication theory can be noticed in equations (2) and (3).

During the Second World War Wiener was deeply involved in many defence projects on communication and control systems at the MIT. It was necessary 'to determine the position and direction of flight of an enemy aeroplane and extrapolate over the flight time of a projectile so that the projectile could be aimed so as to reach it'. Wiener formulated the problem as follows: consider a signal function $f(t) = g(t) + n(t)$, where $g(t)$ is the message and $n(t)$ is noise. Predict $g(t+h)$ from a knowledge of $f(s)$ for $s \le t$. To achieve this choose $K(s)$, $s \ge 0$ so that

$$\lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} \left[g(t+h) - \int_{-\infty}^{t} K(t-s) f(s)\, ds \right]^2 dt$$

is minimized. A crude application of the variational technique leads to the equation

$$\int_{-\infty}^{t} K(t-s)\varphi(s)\, ds = \chi(t+h), \qquad (4)$$

where

$$\varphi(t) = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} f(t+\tau) f(\tau)\, d\tau,$$

$$\chi(t) = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} g(t+\tau) g(\tau)\, d\tau.$$

The function φ is the auto-correlation of the signal process f whereas χ is the cross-correlation between signal and message. Imposing suitable hypotheses like stationarity and ergodicity on f, g one can determine φ and χ from past experience via Birkhoff's individual ergodic theorem. Knowing φ and χ one solves the Wiener–Hopf equation (4) for K. This yields the required predictor $\int_{-\infty}^{t} K(t-s) f(s)\, ds$. Here Wiener exploits a whole gamut of machinery developed by him in his generalized harmonic analysis, Fourier transform in the complex domain, causality and analyticity. Based on these ideas Wiener wrote several important monographs, which have now become standard references in the fields of electrical engineering and harmonic analysis.

Right from boyhood days Wiener was interested in languages, philosophy and logic. His doctoral thesis was on philosophy and he went to Cambridge in order to work under the guidance of Russell but, thanks to Russell's advice, took courses in mathematical analysis from Hardy and Littlewood. His work on prediction, filtering and Brownian motion on the one hand and his collaboration with physiologists on the other led him to formulate the ideas of his pet theory which he christened as cybernetics. According to him we live in a chaotic world of ever increasing entropy. 'We are swimming upstream against a great torrent of disorganization, which tends to reduce everything to the heat-death of equilibrium and sameness in the second law of thermodynamics. We live in a chaotic moral universe and our main obligation is to establish arbitrary enclaves of order and system' which again are impermanent. We constantly receive signals and our business is to filter the noise and see or feel good messages. For Michelangelo a marble rock was a signal, his chisel the filter and the hidden message a pieta or David.

During 1955–56 Wiener visited the Indian Statistical Institute at Calcutta and got interested in problems of economic development. I vaguely remember someone at the Institute having told me that when the late Mahalanobis initiated a conversation on economic planning Wiener suggested that it could be done best by an application of harmonic analysis! The study of stochastic processes in India began with Wiener's collaboration with Masani and Kallianpur at Calcutta. Whereas Wiener's work with Masani on multivariate prediction theory was published in the *Acta Mathematica* and received wide recognition, his work with Kallianpur first appeared as an MIT technical report and was later included in his book *Nonlinear Problems in Random Theory* without a reference to Kallianpur.

There is plenty of autobiographical material from the pen of Wiener himself and, furthermore, there is a special issue of the *Bulletin of American Mathematical Society* (1966, vol. 72, no. 1, part II) which contains an analysis of Wiener's contributions to mathematics, communication engineering, biology and philosophy by a team of nine eminent scientists including Masani. Indeed, it is illuminating to read the volume under review along with the special issue of the Bulletin. Here the author has taken great pains 'to present the Wiener message after filtering the Wiener noise from the Wiener signals'. The author's comparative presentation of the personalities of Wiener and von Neumann in the context of matters pertaining to science, defence and the state makes fascinating reading. My only complaint is Masani's temptation to overload his prose with repetitive use of pet phrases like cognate, germane, propadeuctical, prosthesis, phylogenetic and so on. A second reprinting of this volume calls for a thorough proof reading by competent editorial staff.

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Diet, Disease and Development. Wade C. Edmundson, P. V. Sukhatme, Stella A. Edmundson eds. Macmillan India Limited, 2/10 Ansari Road, Daryaganj, New Delhi 110 002. 1992. 324 pp. Price: Rs 145.

The importance of public health has been recognized in the West, but it continues to be one of the less glamorous specialties of medicine. It is now realized that health has a social context and a disease context. Earlier public health specialists depended heavily upon drugs and vaccines to eradicate diseases of public health concern. Now it is realized that it is equally essential to give importance to

social sciences for achieving the desired results. For example, nearly 50% of population in the developing countries are affected with helminthiasis, in spite of the availability of several chemotherapeutic agents for its treatment. As a result, now it is accepted that eradication of helminthic infection is only possible by imparting health education, and improving the environment and socioeconomic standards of the people.

This book on *Diet, Disease and Development* is the outcome of a fruitful collaboration of three leading social scientists who have direct exposure in this field of research. Sukhatme is known for his work in nutrition and statistics. Similarly, Wade Edmundson and Stella Edmundson have done commendable work on undernutrition and work output and are associated with Sukhatme for the last ten years.

The contributions of this book can be grouped into three categories – nutritional deficiency diseases, infective/parasitic diseases and social factors influencing health. Since differences exist between developed and developing countries in disease pattern and aetiological factors, the strategies and preventive steps adopted to control diseases must also vary. The selection of topics is balanced and relevant at the present time as the majority of population of developing countries are suffering from the diseases, covered in this book. The authors, in every chapter, take up one common disease which is of considerable public health importance and systematically highlight the magnitude of the problem, aetiological factors, treatment and its prevention in simple terms. However, the approach is not as in any textbook of medicine or community medicine. Here, the main focus is on the social, economic and public health significance of the disease. For every disease, preventive steps, particularly the constraints, achievements and future requirements in its eradication, are stressed more than the cure of the disease.

The authors analyse the relationship between diet and disease and conclude that it is an extremely complex interaction. They feel that from a statistical point of view, disease is relatively more important than diet since 'death seldom occurs without disease and death seldom occurs from malnutrition alone'. Similarly, they also stress that no single universal theory would be enough to explain development.

It is generally believed that chronic undernutrition, as a result of calorie restriction, retards work output in developing countries. The authors after conducting research, highlight that 'social and physical adaptations occur in people with low energy intakes', and in spite of low food intake, they are 'small and lean, yet they work hard and are extremely efficient at converting food energy into physical work'. Although all nutritionists do not share this view, the authors conclude that low energy intake cannot lead to low work output and slow economic development in the Third World. Therefore, the authors are critical of the supplementary feeding programmes including that of Integrated Child Developing Services (ICDS). They feel that feeding programmes generally are 'expensive in relation to benefit' and conclude that '60% portion of ICDS budget spent on feeding could be better utilized to support education, sanitation and vitamin dissemination and immunization'. Similarly, the myth of protein malnutrition has been dismissed by establishing that if enough food is consumed, it will meet both energy needs and protein needs.

Among nutritional deficiency diseases, apart from protein energy malnutrition, the focus is on the three most common deficiency diseases – vitamin A deficiency, iron deficiency anaemia, and goitre Each disease is covered in simple language without using much medical jargon so that even public health workers can follow it Different approaches in the prevention and treatment of these diseases are emphasized However, current issues such as universal iodination of salt, and effect of massive dose of vitamin A supplementation on morbidity and mortality should have received more coverage.

With its resurgence, malaria has again emerged as one of the leading causes of debility. The tropics and subtropics continue to be 'the battleground for the war between man, malaria and mosquito'. The reasons for its resurgence have been attributed to premature termination of antimalarial measures, bureaucratic and field worker's lapses. Although malaria has a significant impact on economic development, its eradication also requires enormous economic resources

Respiratory and diarrhoeal diseases account for the highest proportion of deaths in children These two diseases have been covered in two separate chapters. Treatment flow charts are particularly useful in the management of these diseases. Since 40% of all deaths occur in children below the age of four years, that too from the preventable diseases, the expanded or universal programme for immunization will have significant impact on the morbidity and mortality of the population. The authors make a list of recommendations like involvement of all health care personnel, media coverage, ensuring the supply of quality vaccines for successful implementation of immunization programme

Apart from specific diseases, various aspects of primary health care have been explicitly presented. In view of the enormity of the problem of providing health care to all the sick, the concept of 'Selective Primary Health Care' has been stressed. Based on prevalence, morbidity, mortality and ease of control, diseases have been classified into three groups – high, medium and low priority diseases for control. Such prioritization is helpful for optimum utilization of limited resources allotted for the health sector in developing countries.

It is recognized that health problems can be solved to a certain extent by improvement of literacy, particularly among females One chapter exclusively covers the contributions of education to promotion of health care. The authors recommend that all children be provided with at least six years of basic schooling. They also suggest primary syllabus which is community-oriented and practical core syllabus relevant to health, agriculture and social issues. The discussion on obstacles to health care delivery is relevant, as it not only identifies but also suggests remedial measures for effective health care.

It is known that population growth not only affects food availability and health of the people, but also impedes economic development. In a book of this nature, there should have been much more coverage on health implications of population growth, particularly on the reasons for our poor performance on the family-planning front.

This book provides hard data, personal opinion and an interesting interaction of medicine and social sciences. Overall, it reflects the current state-of-the-art in the field. Its single best feature is that the authors have made a real effort to focus on the social aspects of medicine in India and

Indonesia However, the issues discussed are also true of the majority of the Third World countries

The postscript almost summarizes the contents of some of the chapters. At the end of each chapter, a list of scrupulously selected references useful to research workers are given. Bold letters and lucid figures enhance the layout of the book. Public health workers cannot afford to ignore this book However, it is not a book for casual readers but for those genuinely interested in medical sociology, practice of public health and decision making The volume is moderately priced and should find a place on the shelves of libraries in colleges and research institutions.

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HISTORICAL REMINISCENCES

We wanted to start as a part of our Historical Section, articles covering reminiscences by our scientists. With this in view, through a member of our editorial board we approached Prof. G. N. Ramachandran enquiring whether he could write an article on his growing the remarkable Biophysics Department which he established in Madras. We were overjoyed when we heard that he would be willing to write not one but more articles. Unfortunately there seems to be little chance of this happening, although we are keeping our fingers crossed that it would. Meanwhile when the lecture (published below) was given, many suggested that this could well be published in the Historical Reminiscences Section. The article was read by three referees and rewritten twice.

We invite our scientists (especially the senior ones) to write Historical Reminiscences which contain also interesting anecdotes (the articles will of course be refereed!).

— Editor

Four decades in anomalous scattering – Some reminiscences*

S. Ramaseshan

Indian scientists have played a significant role in developing techniques for using anomalous scattering in X-ray crystal structure analysis. This talk is a personal view of one aspect of its history. We were amongst the earliest to establish the multiwavelength method for phase determination. With the coming of the intense X-radiations from tunable synchrotron sources this method has had a remarkable revival in recent years. Many aspects of our forgotten work have been rediscovered and are used routinely for structure determination.

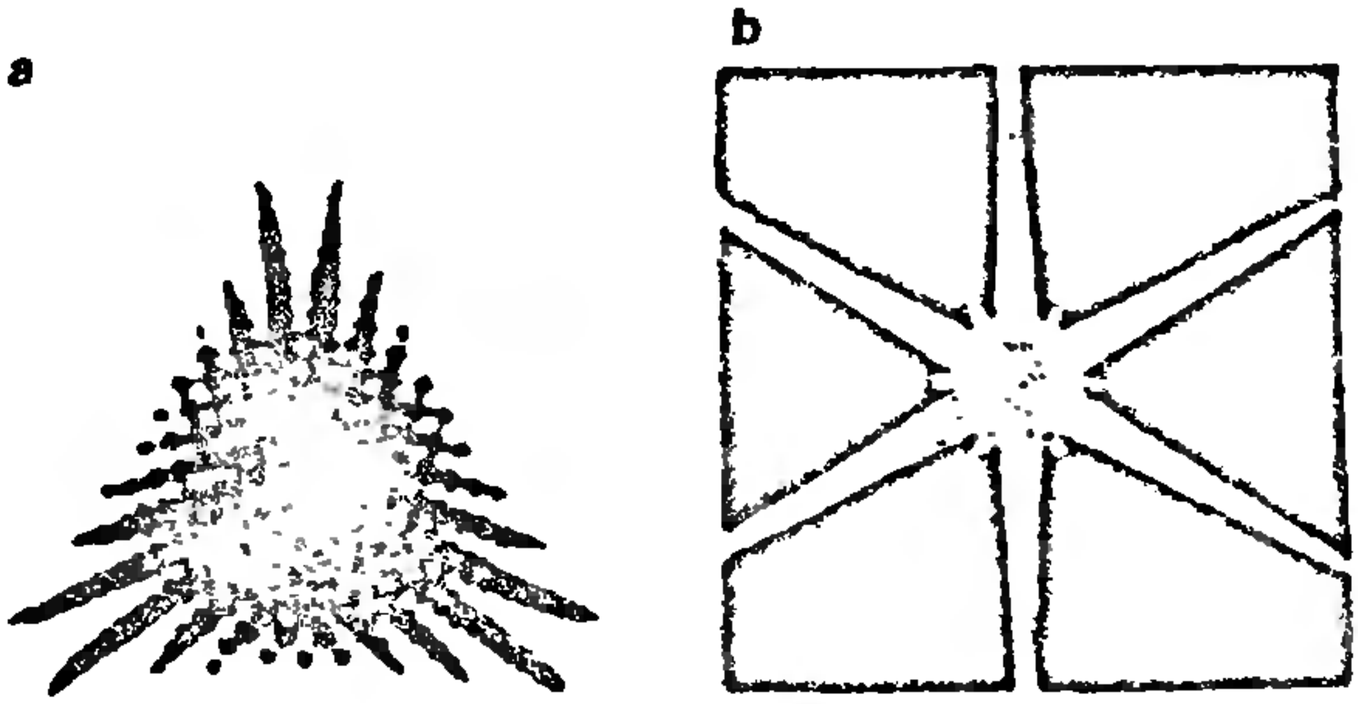

Figure 1. Diffraction patterns of a *triangular aperture* (ref 29): (*a*) Fresnel, (*b*) Fraunhofer

Friedel's law and its violation

X-ray diffraction takes place in the Fraunhofer regime which introduces a centre of symmetry into the diffraction pattern. This is strikingly illustrated in the case of optics (Figure 1) which shows that while the Fresnel diffraction of a triangular aperture has a threefold axis of symmetry, its Fraunhofer pattern displays sixfold symmetry The implication of this for X-ray diffraction is that a non-centrosymmetric (hemihedral) crystal will display a (holohedral) centrosymmetry in its X-ray pattern. This is the Friedel law and is expressed as by $I(hkl) = I(\bar{h}\bar{k}\bar{l})$. The Argand diagram of the scattering vectors (Figure 2*a*) shows how the modulus of the resultant amplitude for the two inverse reflections is the same while their phases are opposite ($\alpha(hkl) = -\alpha(\bar{h}\bar{k}\bar{l})$).

In 1928 S. Nishikawa and K. Matukawa demonstrated for the first time that Friedel's law can fail under some

*Talk delivered at the seminar held on the retirement of Prof K. Venkatesan (19 July 1992)