

Frank Yang and physics

P.T. Matthews

Selected Papers 1945–1980 With Commentary. By Chen Ning Yang.
W. H. Freeman: 1983. Pp. 596. Hbk \$43.95, £41.50; pbk \$21.95, £18.95.

WHEN distinguished physicists reach the age of sixty — or some similar milestone — it is not unusual to celebrate the occasion by bringing out a festschrift made up of papers written on request by friends and colleagues. These volumes must be a source of satisfaction to the person so honoured but are seldom of much significance in the scientific literature. Good papers are not often written to order in this way.

Professor Yang — Frank Yang as he is known in the West, Yang Chen Ning to his fellow Chinese physicists with whom he has re-established contact — has wisely chosen a different course. This book celebrates his sixtieth birthday by reprinting a selection of his papers with his own commentary. The commentary is partly autobiographical but also serves to set his own work within the context of the advances being made in the relevant fields at the time and to show the interplay between the development of his own thinking and this general background. The commentary is totally unpretentious, straightforward and unassuming. Some seventy papers are reproduced out of a total of over two hundred published by Yang between 1945 and 1980.

Yang's two main fields of interest have been in statistical mechanics and in symmetry principles in relation to elementary particles. He has remained active at the frontiers in both these areas and this collection of papers also provides, from his own viewpoint, a history of the main developments in these fields.

In the years immediately following the Second World War very rapid advances were made in elementary particle physics, exploiting the theoretical ideas of Yukawa and Kemmer and the flood of new experimental information which became available with the increasing energy of particle accelerators. Simultaneously, theoretical physicists were fascinated by the remarkable properties of superconductors and superfluids and the question of whether these phenomena could be understood in terms of quantum statistical mechanics or if they pointed to new fundamental effects outside the conventional framework. Under the early influence of Fermi, Yang has maintained an active interest in both these areas. He has contributed over the years to the general problem of phase transitions and the insights which can be gained from simplified systems more amenable to mathematical analysis, such as the Ising model, the one-dimensional problem and the hard sphere gas. But the main thrust of his collected work is in elementary particle theory.

Historically the most fascinating aspect of this record of achievement is the account of the establishment of parity violation in weak interactions and the subsequent recognition of the fundamental role of the

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Heads together — C.N. Yang (left) and T. D. Lee at the Nobel prize ceremony, December 1957.

CTP theorem during 1956 and 1957. For the part which he played in this Yang was awarded the Nobel Prize. His other major contribution, which took much longer to mature, but in the end has had possibly an even greater influence on the development of the subject is his work completed in 1954 in collaboration with R.L. Mills, on isotopic spin conservation and generalized gauge invariance. This is the first example of a quantum field theory which is gauge invariant with respect to a non-Abelian group. The subsequent developments, particularly those of renormalization by G. 't Hooft and the electroweak theory of Glashow, Salam and Weinberg, have made

this the central basic concept in our understanding of all the fundamental forces in nature, according to current thinking. The Yang–Mills paper started the chain of ideas which led to the recent discovery at CERN of the W and Z intermediate bosons.

These two outstanding pieces of Yang's work are not isolated achievements, but stand out as high points against a background of significant contributions to physics over a period of nearly forty years. The published papers speak for themselves, but combined with Yang's own commentary in this book, the net effect is a fascinating insight into the workings of a first rate scientific mind. It also gives a vivid impression of a very able, very sincere and a very likable person who has obviously derived immense satisfaction from his work. This impression is enhanced by a number of photographs in many of which Yang himself appears with a succession of other physicists with whom he has collaborated over the years. One is reminded of W.B. Yeats' phrase describing two anonymous Chinese from an earlier epoch. His "ancient glittering eyes are gay". They have good reason to be.

I can recommend this book strongly to anyone seriously concerned with the development of fundamental physics since the Second World War. With the help of the commentary, it should also be of interest to a wider public, who can get a very clear impression of what it is like to devote one's life successfully to what at one time was somewhat denigratingly classified as "curiosity based" research, warts and all, including the strains on personal relationships which can easily follow from public recognition of collaborative work. □

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Low profiles

Peter Liss

Trace Metals in Sea Water.

Edited by C.S. Wong, E. Boyle,
K.W. Bruland, J.D. Burton and
E.D. Goldberg.

Plenum: 1983. Pp. 920. \$115, £80.50.

IN his Presidential Address to the Geochemical Society in 1976, Karl Turekian said "... one has the feeling that the whole field of trace metal marine geochemistry would have been a completely dull one over the past fifty years if it weren't for analytical errors! The startling conclusion, as the sources of errors become better understood and the quality of the analyses improve, is that most trace metals are at extremely low concentrations in the oceans and have

rather unspectacular variations in their concentrations".

Measurements made since then have added weight to Turekian's judgement which, at the time of his address, was made on the basis of very few reliable results. We now know that much of the earlier trace metal data for seawater was plagued with errors due to sample contamination during collection, storage and laboratory processing. With the adoption of "clean" sampling and analytical techniques, pioneered by Clair Patterson for lead, reliable data are now appearing. Consequently, although reports of abrupt and spectacular changes in seawater trace metal concentrations have declined, trace metal distributions are not homogeneous and hence are still of great interest. It is becoming clear that trace metal distributions are closely related to other oceanographic phenomena.

For example, the metals cadmium, zinc