It is evident that long-continued experiments may be necessary, and in the case of specific mixtures of gases requiring the complete absence of the rare gases or their presence in definite proportions, the apparatus may become complicated and the technique very exacting, especially when any record is to be kept of metabolic changes. For some purposes a closed circuit is a necessity, and I am not sure but that such a system introduces some complicating conditions, possibly by gas adsorption upon walls or materials or by the cutting down of radiant energy from without. In my own efforts,[10] for example, results soon led from experiments with nitrogen-oxygen mixtures to a closer examination of what happened to animals when confined in a circuit of ordinary air. Frogs were the most convenient animals to use, and there was disclosed a peculiar fluctuation in the nitrogen-rare gas fraction of air which was apparently correlated with light and darkness.

It is the relative proportions of the various gases in an atmosphere that seems to me to be a matter of prime importance, and this is clearly indicated in Professor Hershey's experiments. The necessity for accurate gas analysis led me to discontinue respiration experiments in 1924 in order to develop an apparatus for the analysis of air samples in which the "inert" fraction could also be determined. As soon as attempts were made to increase accuracy, irregularities began to appear with such persistence that it seems possible that differences as low as .01 per cent. in oxygen estimations may have some significance other than technical error. The associated gases may, perhaps, play some part, for irregularities tended to be greater when using oxygen made by the liquid air process where the argon impurity was about 1.9 per cent. Results are still very confusing, but an anomaly seems to be developing which must be more clearly defined before reporting. That these irregularities are due to an isotope may be possible. The magnitude of change is such as to be perhaps too frequently ascribed to experimental error and on that account keeps the observer in a harassed state of mind.

The main object of this note is to give a word of praise and encouragement for these experiments of Professor Hershey. One of the chief difficulties in arousing interest in and support for such work is to present any reasonable mechanism by which the "inactive" gases may act upon the body. The possibility of finding a mechanism in the field of gas analysis has kept me away from the more physiological type of respiration experiment. While medical men may understand little concerning the rare gases, as Professor Hershey suggests, I have a suspicion that the chemist and physicist are likewise ignorant of some important relation between these noble gases and the commoner constituents of the atmosphere.

EDWARD FIDLAR

[10] Univ. Toronto Studies, Physiol. Series No. 98.

SCIENTIFIC BOOKS

Manual of Meteorology, Vol. III. *The Physical Processes of Weather.* By SIR NAPIER SHAW, F.R.S., sometime director of the Meteorological Office, London, and president of the International Meteorological Committee. With the assistance of Elaine Austin, formerly of Newnham College, Cambridge. Cambridge University Press. American agent, Macmillan. 445 pages, 149 figures. Price $9.00.

THIS being an air-minded (not *aero*-minded) age with airports (not *aero*ports) and aviation instruction schools advertised by every ambitious town, we would expect to find airgraphics (not *aero*graphics) holding a prominent place in the curricula of our colleges and universities. Such is far from reality. Worse yet, no one feels responsible. Physicists are indifferent; engineers, not excluding aeronautical engineers, feel it is not up to them; chemists, biologists, geologists and even economists give themselves no concern, content perhaps with a daily weather map. Yet in every field of scientific endeavor, varying atmospheric conditions have direct and noticeable effects. We do not see how precise measurements, for example, can be made when only casual uncorrected readings of pressure and temperature are made.

By airgraphics we mean just what the word says, the science of the air, the description in full of atmospheric phenomena. It is more than the physics of meteorology, or the statistical methods of climatology, being in brief the detailed study of the earth's gas envelope, regarded as a tremendous thermal engine, with energy transformations of heat and motion. Sir Napier Shaw, retiring from a long and proved leadership of the Meteorological Office, set himself the heavy task of collating all that had been done in atmospheric physics and dynamics by divers workers in many lands, and seen from different angles. This has long been miscalled meteorology. (In the present volume [III] meteors are mentioned twice. In Vol. II there are two scant references, and in Vol. I, one.)

Vol. I, it will be recalled, gave a general survey of the atmosphere; Vol. II dealt with the physics of the air. The present volume (III) sets forth the dynamics and thermodynamics of circulation. Vol. IV has had a curious history, illustrating that the last shall be first, for it was issued in 1919 and dealt with the wind as connected with pressure distribution. We are given to understand that a new Vol. IV is on the stocks, for the double reason that the first issue is already out of print and that there is so much to be added.

Individual effort could hardly accomplish such monumental work and Sir Napier acknowledges fully the ready cooperation of many former official associates, and others, not forgetting proof-readers, pressmen, binders and the manager of the University Press. We take it that all felt a measure of pride in the making of these volumes.

There is not space here to discuss at length new material. One matter of great moment is the practical application of entropy—that elusive something connected with the degradation of heat which college instructors despair of ever explaining lucidly to their classes. It is here regarded as "an index of the dilution of the energy of the working air." In fact, the whole of Chapter VI, treating of "Air as Worker," is a piece of straight thinking on a difficult subject. His tephigram (a combination of temperature and entropy) enables one to plot the heights of successive isentropic surfaces. We are given tables for calculating the entropy of the air, when temperature and pressure are available. We can now regard "an *isentropic surface* as a practical alternative for sea-level or some other *horizontal* surface on which to place the facts about the weather."

Sir Napier of course is a master hand at good English. The nine-page comment on the analogy of medicine and meteorology could well be reprinted as a separate, making a delightful little essay requiring only fifteen minutes to read, but inspiring hours of thinking over. A few lines will make this clear.

> We might indeed have profited by the analogy to which we have drawn attention by giving to this volume the title "The Physiology of Weather," as defining the attitude which meteorologists have to adopt towards experimental physics. We have felt however that to do so might convey the impression that we were proposing to regard weather as the expression of a living organism. Although the weather has many characteristics that are suggestive of vitality, we have thought it best to avoid that impression.

Any forecaster of long experience will appreciate the implication that the weather has a will of its own and like old Joey is deep and devilish sly!

And acknowledging the impeachment that he is not a text-book writer, *i.e.,* one who saves students the trouble of thinking, it is suggested that comprised within the almost unpronounceable name of meteorology there are a large number of subjects quite worth while thinking about. It is in a way unfortunate that the science has been to some extent accepted as a responsibility of government, and this perhaps accounts for much of the indifference of universities, as mentioned above.

It only remains to say that we wonder why a Nobel prize has not come to Sir Napier Shaw. We hope that such recognition will not be much longer withheld.

ALEXANDER MCADIE

BLUE HILL OBSERVATORY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE RATE OF GROWTH OF STALACTITES[1]

IN the summer of 1929 the writer observed stalactites suspended from the roof of the inspection tunnel in the Wilson Dam at Muscle Shoals, Alabama, and later a series of specimens was collected for him by Captain H. D. W. Riley, of the Corps of Engineers. These stalactites are of more than ordinary interest, as their age is known and their rate of growth can be approximately determined.

Fig. 1 is a generalized sketch section of the Wilson Dam. The inspection tunnel is near the base of the dam on the upstream side, its floor 90 feet below the surface of the impounded pool. It is 6 by 9 feet in section and 4,600 feet long. In it are located the valves of the wells for the relief of accumulated hydrostatic pressure in the bedrock beneath the dam. The stalactites hang from the roof of the tunnel along the lines of junction of adjacent concrete segments.

[1] Published by permission of the director of the U. S. Geological Survey.

Most of the stalactites ranged between 5 and 9 inches in length (12.7 and 22.8 centimeters) and the

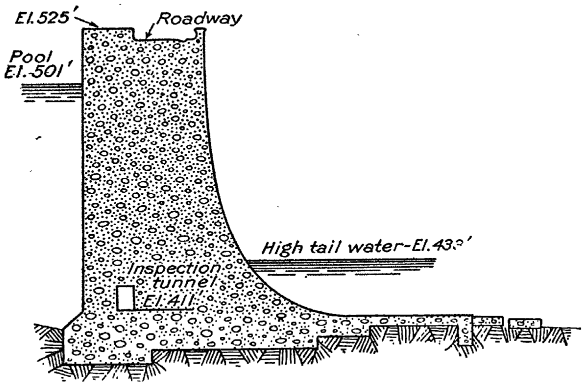

FIG. 1. Cross-section of Wilson Dam at Muscle Shoals, Alabama. The stalactites hang from the roof of the inspection tunnel, eighty-one feet below the surface of the pool.