TO REMIND.

A biological Essay by SIR WILLIAM BATE HARDY, F.R.S., D.Sc., LL.D. Published for Vanderbilt University by the Williams and Wilkins Company, Baltimore, 1934. Agents, Baillière Tindall and Cox, London. Pp. x+45. Price 4/6.

This is a small book but it contains a very great deal of matter for thought. Its title, which was the late author's own, tells us nothing of what it deals with. It consists of two lectures (the Abraham Flexner) on the specificity of the physico-chemical constitution of those substances which are characteristic of living matter. It thus deals with the essentials of vitality.

The late Sir William Hardy's researches had been into such subjects as the physico-chemical constitution of protoplasm, colloidal systems, blood plasma, and the behaviour of colloids in an electric field; so that he was peculiarly well fitted to discuss the problem fundamental for bio-chemists—how does living matter differ essentially from non-living? Hardy would reply that as far back as 1860, Pasteur himself had stated it—the presence of optically active, isomeric, organic substances.

The chemical essence of protoplasm is protein, that is amino-acids, and all naturally occurring amino-acids are lævo-rotatory.

"Protoplasm is not merely asymmetric, its asymmetry is specific. It grows and reproduces generation after generation, and its proteins remain lævo-rotatory." A few vital animal products are dextro-rotatory, e.g., dextrose, lactic acid and bile-acids. The specificity exhibited by plants is no less remarkable: yeast ferments only dextro-hexoses, not the left-handed varieties. "Living matter is still the sole source of optically active compounds" (p. 12).

Like many other philosophical biologists Hardy was impressed with the mystery of life. Here are his own words (p. 8).

"Have I exaggerated the mystery? If any one doubt, let him consider the hepatic cell. . . . any or every cell (of the liver) seems capable of synthesizing glycogen from sugar or from lactic acid, of solving the chemical conundrum:—how to pass directly from carbohydrates to fats and back, or (from) proteins to fats, of dealing with metallic poisons, of controlling the chemical cycle of hæmoglobin, of synthesizing uric acid, so on and so on. Has the biologist any picture even of the vaguest kind of how so diverse a chemical factory can operate in a fluid mass, say $\frac{1}{10^{-8}}$ cubic millimetres in volume? . . . It will be necessary to realize there is some master process, some integrating principle."

Biochemistry has discovered much, but it has not yet resolved the central characteristic mystery of life. When Hardy was a young man, the physiologists were rightly impressed with the molecular instability of protoplasm expressed in its affectability or capacity for responding to a stimulus. But there is another aspect of living matter, its "extraordinary stability" (p. 19), as Hardy phrased it. "Generation after generation through untold repetitions in the form of successive generations these small structural chemical differences are reproduced, and that in spite of the complex cycle from ovum to the completed type" (p. 19). In other words, this is the complementary property of *dis*regarding a stimulus, the state of physiological insusceptibility, the power to remain in the metabolic status quo ante. Hardy called it "stability"; Fraser-Harris in 1900 called it the "Functional Inertia of living matter" which includes the functional momentum of protoplasm.

In these two lectures Hardy shows himself to have had the truly philosophical outlook. Living matter, he tells us, has intervened directly or indirectly in the production of every optically active compound. Every artificial *i.e.*, synthesized-in-the-laboratory organic substance is optically