suggested that the effect was due to irregular reabsorption of the fluorescent light. The irregularity of the reabsorption was explained by enhanced predissociation in the upper electronic state. A similar explanation could apply just as well to nitrogen, since enhanced predissociation is produced in the upper electronic state of the first positive bands in the presence of rare gases. In both iodine and nitrogen the phenomenon of variation of intensity in a 'v' progression would have to be interpreted as an apparent violation of the Franck-Condon rule.

The connexion between the phenomenon which has been discussed above and the identification of the 7883 radiation in the aurora as the first positive nitrogen band (7, 6) is obvious. If (7, 6) is observed in the aurora, then why are (7, 3), (7, 4), and (7, 5) missing? According to the Franck-Condon rule, these bands should be stronger than (7, 6), and yet they have never been reported in any auroral displays. The 6323 radiation which was identified as the band (10, 7) presents a similar problem. The observation in laboratory experiments of violations of the Franck-Condon rule, be they real or apparent, enable us to identify such bands as 7883 and 6323 as nitrogen bands.

JOSEPH KAPLAN.

Department of Physics,
University of California at Los Angeles,
June 6.

[1] NATURE, **129**, 759, May 21, 1932.
[2] *Phys. Rev.*, **36**, 778; 1930.
[3] *Proc. Roy. Soc.*, A, **102**, 453; 1922.
[4] Loomis and Fuller, *Phys. Rev.*, **39**, 180; 1932.

Chain Reactions in Enzymatic Catalysis

I MUST thank Dr. Richter[1] for raising the fascinating problem of whether enzymes act by initiating chain reactions. If this is correct, the value which I calculated[2] for the number of hydrogen peroxide molecules destroyed by a catalase molecule per second, namely, about 10^5, retains its biological significance, but the enzyme surface is far less active than I supposed. The view that oxidative enzymes in general initiate chain reactions was put forward by Haber and Willstätter.[3] I propose to examine this view, but only some of the arguments which I shall bring against it would be valid if catalase were unique among enzymes in starting a chain reaction. This is, however, very unlikely. Peroxidase was shown by Kuhn, Hand, and Florkin[4] to have the same degree of activity per molecule per second, and a very similar active hæmatin grouping.

The chain theory renders the proportionality observed in many cases between enzyme concentration and reaction velocity unintelligible. If the chains end when two free radicals meet, as Haber and Willstätter assume, their length should be shorter the greater the concentration of radicals, and the reaction velocity should be about proportional to the square root of the enzyme concentration, as Allmand and Style[5] found it proportional to the square root of the illumination when hydrogen peroxide was photolysed. If the chains end on the walls or other foreign substances, the velocity should be appreciably reduced by some of the very miscellaneous impurities found in catalase preparations. Zeile and Hellström,[6] among others, found that neither of these conditions was fulfilled in the case of catalase.

Again, the chain theory does not account for specificity. Thus Haber and Willstätter postulate free OH radicals not only in the catalase reaction, but also in the actions of acetaldehyde oxidase and alcohol oxidase. If this were the case, catalase would catalyse the oxidation of acetaldehyde and alcohol by hydrogen peroxide. Similarly, they postulate meriquinoid radicals as links in the chain produced when a dehydrogenase catalyses the reduction of a quinone by a hydrogen donator such as succinic acid. If this were so, dehydrogenases would not be specific, for a meriquinoid radical produced by the dehydrogenation of succinic acid could proceed to remove a hydrogen atom from a different hydrogen donator, for example, glucose or lactic acid.

Finally, the theory does not explain the fundamental fact that most intracellular oxidations do not yield heat directly, but the energy of oxidation is mainly transferred to other molecules. For example, the energy of oxidation in muscle is largely used to resynthesise glycogen from lactic acid. These coupled reactions, involving as they do the interaction of at least four molecules, can only occur at a specific surface where the various reactants are held simultaneously. It is extremely difficult to see how such a reaction could occur in a homogeneous medium, especially when the molecular concentrations of some of the reactants are very low. For example, the oxygen concentration in tissues is less than 10^{-4} M, and it can fall below 10^{-7} M without slowing down bacterial respiration.

For the above and other reasons, I think that the majority of biochemists will demand very strong experimental evidence before they accept the chain theory of enzyme action.

J. B. S. HALDANE.

Biochemical Laboratory,
Cambridge.

[1] NATURE, **129**, 870, June 11, 1932.
[2] *Proc. Roy. Soc.*, B, **108**, 559; 1931.
[3] *Ber.*, **64**, 2844; 1931.
[4] *Z. physiol. Chem.*, **201**, 255; 1931.
[5] *J.C.S.*, 606; 1930.
[6] *Z. physiol. Chem.*, **192**, 171; 1930.

Occurrence of *Bathynella* in England

IN 1927 I happened to visit the well-known Bath Stone Quarries at Corsham, near Bath, for the purpose of collecting *Cyclops* from the underground water of the district.

Looking through the material on my return to Marlborough, I came across two specimens of a small crustacean that I was unable to identify and they were put on one side, as I was working at the time exclusively on the distribution of *Cyclops* and hydrogen ion concentration.

In 1931, quite by accident, I again examined these two specimens, and found them to belong to the very remarkable group, the Syncarida. Both specimens were immature and not well preserved, but they were evidently *Bathynella* or *Parabathynella* and were sent to Dr. W. T. Calman, keeper of zoology at the British Museum (Natural History), who identified them provisionally as *Bathynella chappuisi*, Delachaux.

The Bath Stone Quarries are very extensive, comprising some sixty miles of trolley lines and containing a number of underground wells. In addition, one has to work entirely in the dark except for an electric torch, since the galleries are about 100 feet below the surface, and it seemed as if the rediscovery of these minute animals might be a very long task.

On June 15 of the present year I came across twenty to thirty living specimens and there is reasonable evidence that the piece of water in which they occurred is a remarkably permanent one, so that now, knowing the exact spot, one can go there with a reasonable amount of confidence.

Dr. Calman and Dr. Isabella Gordon have now examined some fresh specimens and are apparently satisfied that the original diagnosis was correct. The species is therefore *Bathynella chappuisi*, Delachaux.