if not essential. It is believed from the work so far done with different sulph-hydryl heavy metal complexes that a dissociable compound of enzyme and activator is formed which has an increased affinity to the substrate. The alternative possibility that an active group in the enzyme itself is reduced is not favoured.

Strong evidence for the above theory is afforded by the specific co-glyoxalase action of glutathione, which has been recently followed quantitatively (NATURE, p. 645, October 19, 1935) by comparing lactic acid production with the amount of free –SH group as measured by iodine consumption. It is established that the glutathione first combines by means of this group with the substrate methyl glyoxal and then, as the reaction catalysed by the enzyme develops, enters into further changes which again involve its –SH group. In other words, the amount of free –SH group remains at a minimum during the reaction, but it all reappears when this is finished.

A second and quite different type of enzyme activation is produced by purely physical means. Certain substances which favour the splitting of fats and esters by animal lipase act through the production of colloidal particles which absorb both the enzyme and the substrate and facilitate the reaction between them.

It is established that the purified and recrystallised hæmoglobins of different animals, whilst containing identically the same hæmin, are made up of different globins. There is a quantitative difference between the peroxydase activity of such hæmoglobins of as much as 50 per cent under like conditions, which inasmuch as the active iron-porphyrin group is the same must be due to differences in the structure of the colloidal protein carrier.

It is clear that, for the moment, judgment between the rival carrier and protein theories must be suspended. The assumption of an active group or series of groups at the surface of the enzyme molecule, which definitely combines with the substrate in a normal chemical way, seems well founded. The subsequent hydrolysis of such addition compounds by other recognised groups in the enzyme molecule appears also to be highly probable: it is to be expected that experimental work, for which the way is indicated, will enable such groups to be identified. It remains to establish the structure of the groups in the enzyme which bring about its highly specific activity. This is especially desirable for the carbohydrases where the specificity is so fine; it is to be expected that the progress now being made with the inquiry into the protein splitting enzymes will be continued among the carbohydrases. To-day, however, there is the added complication to face, namely, that the enzyme so often seems to require additional help from some other substance.

Earthquake-proof Buildings

By Dr. Charles Davison

ONCE more, the recent Quetta earthquake has emphasised the importance of erecting none but earthquake-proof buildings in a district subject to destructive shocks. The few houses in Quetta that could lay claim to such a title seem to have survived the earthquake unharmed, not even their chimneys having been thrown down.

How needless the loss of life may be was strikingly shown by Prof. Omori[1]. During the Mino-Owari earthquake of 1891, only 190 persons were killed in Nagoya, a city with a population of 165,000. In the earthquake of 1908, Omori estimated the number of lives lost in Messina as 75,000, the intensity of the shock being nearly the same in both cities. Taking the population of the Messina district as about equal to that of Nagoya, he thus concluded that, out of every thousand persons killed in Messina, 998 lost their lives needlessly, owing to the faulty construction of the houses. Omori's estimate of the number of deaths has been much reduced in later reports on the earthquake. But, even if we take the lowest figure of 25,450, given by Baratta, and the previous population as 90,000, the number 998 is only reduced by 2*.

The influence of site on intensity is shown in every earthquake. In the California earthquake of 1906, the distribution of damage was studied with unusual care in several districts, and especially by Mr. H. O. Wood in San Francisco[2]. The whole of the city lies between about one and nine miles on the north-east side of the San Andreas rift, and thus, if there were no variation in the site, the intensity should have decreased gradually from south-west to north-east. The areas of lowest intensity, in which a few chimneys fell, lay

* It should be remembered, however, that the Messina earthquake occurred at 5.20 a.m., and the Mino-Owari earthquake at 6.37 a.m., both local times.

in the central and south-eastern parts, and were always situated on hard rock exposed at the surface or covered by a thin layer of soil. The next degree of intensity, indicated by the general fall of chimneys and the fissuring of walls, marked the north-eastern portion, on the flanks of hills composed of hard rocks. Areas in which brick-work was seriously cracked and buildings occasionally fell, lay on the flanks of the hills facing the Pacific and in the valley floors in which the alluvial deposits are thick. The highest degree of intensity, marked by the shattering of masonry blocks of good construction, occurred as a rule only on 'made land' in small ravines or lagoons, one area of exceptionally great destruction lying at the north-east corner of the peninsula. Thus, the safest sites are those of level hard rock, and the worst are those of 'made land' filling up former creeks; though, even on the latter, well-constructed houses have been known to escape serious injury.

Prof. Milne, in an admirable series of papers[3], urged that the foundations of all buildings should be deeply laid. During his residence in Japan, he made some interesting comparisons of the motion of the ground during an earthquake at the surface and bottom of a pit 10 ft. deep. The experiments were continued by Sekiya and Omori[4], and showed that, in severe earthquakes, the ripples superposed on the large undulations were smoothed away at the bottom of the pit. Thus, Milne suggested that buildings should rise freely from deep foundations. On the other hand, in Japan, a rigid foundation of reinforced concrete has been used, strongly tied together, in the form of a deep solid mat. In Tokyo, buildings on such foundations on soft compact soil were found to withstand shocks better than those with pile foundations.

An entirely different foundation is that recently devised by Mr. R. W. de Montalk[5]. It consists of a slab of reinforced concrete fixed to the ground. A raised rim of the same material contains a layer of shingle a few inches deep, and on this rests a slab of reinforced concrete, the foundation proper of the building. The method is still in an experimental stage, but it is worth noticing that, fifty years earlier, a similar foundation, consisting of quarter-inch iron shot, was used by Prof. Milne in Japan. The small house erected by him stood firmly against storms of wind, and, during a moderately strong earthquake, was practically unmoved.

In plan, buildings should be rectangular and as nearly square as possible, and L or E or U shaped outlines should be avoided. The walls should be uniform in height, without towers or heavy cornices, and they should be braced diagonally. Roofs must always be light, and, above all, the joists of floors and roofs should penetrate at least two-thirds, if not the whole, of the thickness of the walls. The heavy losses at Messina in 1908 were largely due to the neglect of this precaution. In many houses, the roofs and floors fell, while the main walls were left standing.

As to the material to be used, few earthquakes have thrown so much light as the great Japanese earthquake of 1923. Mr. H. M. Hadley[6] spent two months in examining many hundreds of buildings in the ruined cities. The fundamental characteristic of earthquake-proof construction, he concludes, is rigidity of structure. Whatever the material, the undamaged building was one so braced that it moved bodily as a block or unit with its foundations. At the time of the earthquake there were sixteen large steel-framed buildings in Tokyo. Six of these were absolutely undamaged; the others were more or less severely injured. In the former, the common feature was the complete or extensive use of reinforced concrete walls, that stiffened and braced the frames. In the latter, other materials were used that failed to give this support. Of the buildings composed of reinforced concrete in Tokyo, it was found that only 1·3 per cent entirely collapsed, while 78·0 per cent were uninjured. Wooden buildings, the most numerous of all at that time in Tokyo, were undamaged when adequately braced; otherwise, they collapsed; but all suffered greatly from the fires that broke out afterwards. In the reconstructed Tokyo and Yokohama, buildings of every kind are limited in height to 100 ft., and houses of wood or brick to 42 ft.

One other point on which this earthquake has thrown useful light is the effect of the period of oscillation of the buildings. A little more than a year earlier, Prof. Omori investigated the periods of five typical buildings in Tokyo. They ranged from 0·50 sec. to 0·65 sec. After the earthquake, it was found that the building with the shortest period was undamaged and that, as a rule, the amount of damage increased with the period. In great earthquakes, most of the destruction is caused by oscillations with a period of between 1 sec. and 1·5 sec., and thus Japanese architects endeavour to design their buildings so that the period shall not be much in excess of half a second.

Unfortunately, to raise a building that will withstand an acceleration of 0·3 g, or even half this amount, is a costly work. Steel-framed buildings should, of course, be used in all Government offices, in great hotels, and in the principal streets of a city. But, in the smaller houses—the houses that determine whether or no a great earthquake shall be costly to human life—such a form is unattainable. Much, however, can be done by attention to a few points. So far as possible, the bricks and mortar used should be of good quality, and the mortar should be of nearly the same strength as the material that it binds. The safest building is one of a single story, but if, to economise ground space, two or more stories are essential, then the joists should penetrate the walls. Lastly, the thickness of the walls should diminish upwards. The ideal cross-section, as Mr. N. Nasu points out in his interesting report on the Bihar earthquake[7], should be one bounded by parabolic arcs with the vertices downwards. In the seismological observatory at Tokyo, the walls are of brick and so shaped. During the earthquake of 1923, not a fissure appeared in its walls, whereas inside the observatory, a brick column, 15 ft. high and 3 ft. square in section, was fractured and the upper part twisted through an angle of 30°.

According to the Delhi correspondent of *The Times* (December 24, 1935), the Government of India has decided that the official Quetta shall be rebuilt so far as possible on the existing site, and that earthquake-proof buildings should be provided for the permanent employees of the Government living there. On account of the strategic importance of Quetta, it is necessary that the military garrison should remain there in about the same strength as before, and desirable that the headquarters of the civil administration should also be placed there. Though it is recognised that, for many years to come, Quetta will probably be free from destructive earthquakes, it has also been decided that, if the civil population wish to return to the city, they must be prepared to adopt a safer and more expensive standard of building.

1 *Bull. Imp. Earthq. Inv. Com.*, **3**, 39–40 (1909).
2 A. C. Lawson, "The California Earthquake of April 18, 1906", 1, 220–242, 335–346 (1908).
3 "Construction in Earthquake Countries", *Trans. Japan Seis. Soc.*, **14**, 1–246 (1890). The experience gained in recent earthquakes, especially in that of Japan in 1923, is embodied in Mr. J. R. Freeman's valuable work, "Earthquake Damage and Earthquake Insurance" (New York, pp. 904 (1932).)
4 *Trans. Japan Seis. Soc.*, **16**, 19–45 (1892).
5 NATURE, **130**, 41–42 (1934).
6 *Bull. Amer. Seis. Soc.*, **14**, 6–8 (1924).
7 *Bull. Earthq. Res. Inst.*, **13**, 417–432 (1935).

Obituary

Sir Alfred Sharpe, K.C.M.G., C.B.

FORTY years ago, when exploration in Central Africa was beginning to give place to settlement, pioneers of many nations frequented the rooms of the Royal Geographical Society in Savile Row and passed within the sphere of hospitality of Sir John Keltie at his club or his home. There one was in the habit of meeting Sir John Kirk and the Rev. Horace Waller, friends of Livingstone, F. C. Selous the hunter-settler in Matabele Land, H. H. Johnston the artist-administrator of British Central Africa, O'Neill the typical exploring consul, and many more. Of these Sir Alfred Sharpe was, until a few weeks ago, almost the last survivor, and his passing ends a period in which science was enriched by men of adventurous spirit, keen even if unspecialised observing power, honesty of purpose and a determined aversion from every form of spectacular publicity.

Alfred Sharpe was born in Lancaster on May 19, 1852, trained to the law and at thirty-three years of age became a stipendiary magistrate in Fiji. In 1887 he found a wider sphere in a consular post in the Shire Highlands east of Lake Nyasa. At that time, Scottish missionaries were establishing stations on the Lake, and the Moir brothers, working in association with them, were opening up honest trade. Arab slave raiders were a perpetual danger both to the natives and to the pioneers, and Sharpe found himself in a congenial atmosphere, hunting the big game and fighting the slave-traders under the direction of Sir Harry Johnston. He was a man of unbounded courage, and danger, whether from man or beast or from natural difficulties of any kind, was a piquant incentive to his work. He had the responsibility of extending British influence to the westward of Lake Nyasa and thus laid the foundations of Northern Rhodesia.

Sharpe succeeded Sir Harry Johnston as Commissioner and later as Governor of British Central Africa, which he left in 1910 as perhaps the best organised and most prosperous tropical colony in Africa. He was a great hunter, and his shooting expeditions added many new species to zoology. He encouraged all branches of scientific work and took an understanding interest in the researches of naturalists.

On laying down his official duties, Sir Alfred Sharpe continued to make journeys of exploration in other parts of Africa, especially in the northern section of the Great Rift Valley on the east and in the almost unknown interior of Liberia on the west. He published the results of his geographical studies in an important work, "The Backbone of Africa", in 1921. His mind, vigorous to the end, was constantly at work on problems associated with his geographical achievements, and it is understood that in the last week of his life he completed a paper for publication. He was struck down by sudden illness when on the eve of embarking for a Christmas holiday in a milder climate. His death took place at the age of eighty-three years on December 10.

H. R. M.