## High Frequency Fatigue.[1]

MESSRS. G. F. Jenkin and G. D. Lehmann have prepared an important report on the subject of high frequency fatigue. These researches, the object of which was to determine the effect of the frequency of alternation of stress on the fatigue limits of various metals, were carried out in the Engineering Laboratories of the University of Oxford, and tests were made on rolled, normalised, and hardened steel; rolled aluminium, annealed copper, and normalised armco iron. The ordinary frequency employed in fatigue tests is 50 periods per second, though in 1924 Jenkin [2] carried out work up to 2000 periods per second, and in the research described in this paper frequencies up to 20,000 periods per second were used. In all the higher frequency tests the specimen consisted of a bar supported at the nodes, and vibrating freely.

Jenkin had previously used an electromagnetic method to produce the vibrations, but this will not work for very high frequencies and a new method had to be designed. On the experiments now described fluctuations of air pressure acting directly on the specimens were used to make them vibrate. The apparatus was essentially two blowers, each blower consisting of a small adjustable resonating chamber, into which air was admitted by a throttle valve in the back, while the front was closed by one face of the specimen. The position of the specimen was so arranged that as it vibrated to and fro it alternately released the air pressure or allowed it to mount up in the chamber.

The strains were calculated on the assumption that the bar vibrated freely and the only measurement necessary was the amplitude of vibration at the centre of the bar. Lord Rayleigh has shown how the strains may be calculated for a long, thin vibrating bar, but using the method of vibrating by air, the bars had to have a moderate width and, for the highest speeds, had to be short, with the result that Lord Rayleigh's theory was no longer sufficiently accurate. Prof. Love, however, has explained how the theory could be applied to bars of moderate width, such as were used in this apparatus.

The results obtained are of very great interest. In Jenkin's earlier experiments the largest increase of the fatigue limit observed was only 15 per cent, but, as he pointed out, much larger rises were to be expected at higher frequencies. In the present tests, the fatigue limit in all cases increases as the frequency of vibration is raised, and increases of fatigue limit up to 60 per cent have been recorded. It has also been found that the fatigue limit does not increase indefinitely with the frequency, but apparently reaches a maximum value at a certain critical frequency. In some tests it was actually shown to fall at the highest frequencies, the greatest drop obtained beyond the maximum fatigue limit being about 9 per cent of the maximum. This fall would probably have occurred for the other metals also, if they had been tested at still higher frequencies. The results obtained are summarised in the following table:

| Material. | Critical Frequency (Approx.). | Maximum Fatigue Limit (Tons/sq. in.). | Ratio Maximum F.L. to Ultimate Tensile Stress. | Ratio F.L. at 50 ~ to Ultimate Tensile Stress. | Maximum Increase above F.L. at 50 ~ (Per cent). |
|---|---|---|---|---|---|
| Normalised 0·11 per cent carbon steel | 20,000 | >17·99 | >0·799 | 0·631 | >26·7 |
| Rolled 0·11 per cent carbon steel | >20,000 | >25·25 | >0·588 | 0·528 | >11·5 |
| Annealed copper | 10,000 | 5·59 | 0·385 | 0·324 | 18·8 |
| Rolled aluminium | 20,000 | 5·02 | 0·785 | 0·586 | 33·9 |
| Normalised armco iron | 10,000 | 18·1 | 0·903 | 0·685 | 31·6 |
| Hardened 0·86 per cent carbon steel | 10,000 | 32·4 | 0·658 | 0·400 | 62 |

[1] Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1222 (M. 62): High Frequency Fatigue. By G. F. Jenkin and G. D. Lehmann. (E.F. 219.) Pp. 34. (London: H.M. Stationery Office, 1930.) 1*s.* 6*d.* net.

[2] *Proc. Roy. Soc.*, A, vol. 109; 1925.

## South African Vegetation.

DURING the recent meeting of the British Association in South Africa, the South African Association for the Advancement of Science may be said to have acted as scientific hosts to their visitors, and in that capacity they certainly spared no effort to provide information as to South African scientific activities which would interest their visitors from the northern hemisphere. As a result, the number of the *South African Journal of Science* issued in December 1929, which contains some of the papers read at the 1929 meeting, provides an exceptionally favourable means of gaining a comprehensive impression of South African science. The president, Dr. Jan H. Hofmeyr, in an eloquent address pointed out that, since the first visit of the British Association in 1905, there has been a great increase in the facilities for higher education throughout South Africa, and the 27 graduates of 1905 had increased to 314 in 1928. There has naturally, therefore, been a great amount of valuable scientific work carried out throughout the country since 1905, and Dr. Hofmeyr emphasises, as the outstanding feature of this period, that the bulk of this work is due to the activities of South Africans. Scientific data are no longer the result of the sporadic activity of visitors from older communities with a longer academic history; they result from the continuous labours of a number of South African investigators, many of whom have received their training in South Africa.

Biologically, South Africa is the product of its climate, its sunshine, its clear dry air, and its dependence upon rainfall. The remarkable vegetation of this great continent is very much influenced by the very characteristic physical and climatic features of the country, and this report, describing pioneer work in many fields, naturally has to give great space to the tentative generalisations that emerge as to the natural vegetation of the country and as to economic possibilities in agriculture and forestry. Prof. J. H. Wellington points out, however, that the three characteristic South African regions, as determined by seasonal precipitation, are equally important in determining human activities. These regions are:

(1) The western part of Cape Province, with a winter rainfall associated with westerly and north-westerly winds from the South Atlantic anticyclone. The visiting botanists obtained a slight impression of the possibilities of this type of weather on the occasion of their excursion to the Kirstenbosch Botanic Garden.

(2) The vast central and eastern area of the sub-



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