Conservation of Tropical Forests

THREE articles which have appeared in the *Empire Forestry Journal* (vol. 12, No. 1, 1933) display the difficulties which exist in conserving and putting to their fullest utilisation the tropical forests of the Empire. To take the second case first, Sir Ralph Pearson, formerly director of the Forest Products Laboratory at Princes Risborough, discusses the problem of creating and developing markets for Empire hardwood timbers at home.

Sir Ralph briefly reviews the reasons why well-known timbers have not found favour amongst markets in Great Britain, ascribing some of the causes to the fact that the consignments sent over were often not carefully chosen ; nor, with the facilities available in the forests, was there much chance of their being so chosen when the short-handed and over-worked forest officer was himself responsible for their dispatch. Sir Ralph deprecates trying to push too many new timbers upon the markets at the same time, and points out the way in which chosen timbers should be forwarded and tested.

A second article, by Mr. J. B. Clements, conservator of forests in Nyasaland, treats of the cultivation of finger millet (*Eleusine coracana*) and its relation to shifting cultivation in Nyasaland. This article, and the practice dealt with, is typical of one of the chief sources of the disappearance of valuable forests in tropical countries, the difficulties facing the administration, not always convinced of the increasing injury supervening, in weaning the people from so wasteful a form of primitive agriculture ; and finally, of the troubles of a forestry department well aware of the evils resulting from the practice.

"It is therefore clear that shifting cultivation in Nyasaland is accelerated to a very considerable extent by the growing of *Eleusine coracana* under prevalent methods. Compared with the growing of other crops, the requisites of the millet make extravagant demands as regards the use of land, and systematic burning of the top soil combined with flat cultivation when carried out on any large scale leads to widespread loss and impoverishment of the soil, particularly in hilly country. Rapid deforestation inevitably takes place in any wooded country where the millet is grown, as conditions are there ideal for providing both new soil for each crop and fuel for heating the soil."

The third article, by N. V. Brasnett, conservator of forests, Uganda, discusses the formation of State forests, and forest rights and privileges of local inhabitants in Uganda. After briefly reviewing the position of the colony from the day, in 1890, when Capt. (now Lord) Lugard signed a treaty on behalf of the British East Africa Co. with the King of Buganda, the declaration of the British protectorate in 1894, and Sir Harry Johnston's arrival in 1899 and subsequent organisation of the administration of the country, the author concentrates upon the various arrangements, regulations and ordinances for the management of the forest areas of the country.

It is impossible to deal with the varying policies to which succeeding administrations subjected the forests after the first and promising lines were laid down. But a perusal furnishes evidence that one of the past flaws in colonial administration has been the refusal or inability of those responsible for the future welfare of their charges to lay down a definite forest policy, based cn wide views, and to adhere to it.

Mr. Brasnett ends his summary of the present position of the forests in Uganda with the sentence : "When formation is completed it is estimated that the State forests of Uganda will constitute just about 2% of the total land area of the Protectorate, and the total forest area, including private woodlands and the valuable savannah, just over 3%, so that it is obviously essential to preserve the whole of this small percentage." Many conversant with the tropical forest and the importance it plays in countries where it exists would consider the percentage dangerously low.

Band Spectrum of PN and its Significance

OF the diatomic emitters of band spectra, few have been more extensively studied than the 14-electron molecules N_2 and CO, which are responsible for many observed band systems and, unlike most emitters, are well known as stable molecules rather than as intermediate products in chemical reactions or equilibrium products at high temperatures. Emitters which are chemically or spectroscopically analogous to these two have, as would be expected, also received considerable attention, the best known examples being the 30-electron molecule P_2 and the 22-electron molecules SiO and CS.

To the latter category the PN molecule becomes an interesting addition as the result of the recent discovery and analysis, by J. Curry, L. Herzberg and G. Herzberg[1], of an ultra-violet band system which is produced by an electrical discharge through a mixture of phosphorus vapour and pure nitrogen. With a heavy discharge (about 6000 v. and $\frac{1}{3}$ amp.) in a water-cooled tube, this PN system has been photographed in the first and second orders of a 3-m. grating, and both the vibrational and rotational structures analysed.

The new bands extend from $\lambda 2375$ to $\lambda 2992$, are degraded towards the red and have a fine structure characteristic of the electronic transition designated as $^1\Pi \rightarrow {}^1\Sigma$. The system is therefore similar to those of the iso-electronic molecules CS and SiO in the same spectral region and to the well-known fourth position system of CO and the Lyman system of N_2.[2] The P_2 ultra-violet system is not analogous to these as it is due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition[3] ; other and less refrangible P_2 bands are known, some of which may, when analysed, prove to belong to the expected $^1\Pi \rightarrow {}^1\Sigma$ system.

From the accompanying table of the more important numerical constants for the electronic states concerned, it is clear that the three 22-electron molecules are similar to one another and intermediate to the 14-electron and the 30-electron molecules in respect of the vibrational coefficients ω_e and $x_e\omega_e$, the rotational coefficient B_0 and the equilibrium internuclear distance r_e. With CO, N_2, SiO and P_2, the band systems under discussion have been observed in absorption as well as in emission, and the lower ($^1\Sigma$) states are therefore stable ground states. The same is expected, though not yet observed, to be true of CS and PN; that is to say, each of these should be

Molecule	$^1\Pi \rightarrow {}^1\Sigma$	Upper State, $^1\Pi$				Lower State, $^1\Sigma$			
	ν_0 (0, 0) cm.$^{-1}$	ω_e cm.$^{-1}$	$x_e\omega_e$ cm.$^{-1}$	B_0 cm.$^{-1}$	r_e A.U.	ω_e cm.$^{-1}$	$x_e\omega_e$ cm.$^{-1}$	B_0 cm.$^{-1}$	r_e A.U.
(14) CO	64765	1516·7	17·24	1·600	1·232	2167·4	12·70	1·85	(1·15)
(14) N_2	68962·7	1692·28	13·318	(1·52)	(1·26)	2359·60	14·445	1·992	1·094
(22) SiO	42690·0	851·51	6·143	0·6270	1·62	1242·03	6·047	0·7238	1·51
(22) CS	38796·3	1072·2	10·05	0·74	1·61	1282·5	6·00	0·79	1·56
(22) PN	39688·5	1103·09	7·222	0·7274	1·542	1337·24	6·983	0·7834	1·487
(30) P_2						780·43	2·812	0·3133	1·856

capable of existence as gaseous substances in the absence of an electric discharge; J. Curry and L. and G. Herzberg are further investigating the PN system from this point of view.

The heat of dissociation of the $^1\Sigma$ state of PN is estimated as 7·8 volts from a Birge-Sponer linear extrapolation of vibrational energies, and as 6·3 volts from a consideration of probable products of dissociation. It is thus somewhat less than that of N_2 (recently given as about 7·9 volts[4] rather than the hitherto accepted value of about 9·0 volts[2]) and greater than that of P_2 (5·0 volts[3]). Similarly the heats of dissociation of CS and SiO (each roughly 8 volts) are less than that of CO (about 10 volts).

The molecules discussed here are all composed of nitrogen, phosphorus and their immediate neighbours in the periodic table. From the atoms preceding and following these we have other 22-electron molecules about which, however, nothing can yet be stated, namely BCl (bands observed in the same spectral region but not systematised[5]) and AlF (expected band system not yet recorded).

W. JEVONS.

[1] *J. Chem. Phys.*, **1**, 749; 1933 (preliminary report). *Z. Phys.*, **86**, 348; 1933.

[2] Particulars of these band-systems and of the notation used in the PN paper and in the present article are given in the writer's "Report on Band Spectra of Diatomic Molecules" (*Phys. Soc.*, 1932). The more recent analysis of SiO bands is by Saper (*Phys. Rev.*, **42**, 498; 1932) and that of CS bands is by Crawford and Shurcliff (*Phys. Rev.*, **43**, 766; 1933).

[3] G. Herzberg, *Ann. Phys.*, **15**, 677; 1932.

[4] Lozier, *Phys. Rev.*, **44**, 575; 1933.

[5] Lochte-Holtgreven and van der Vleugel, *Z. Phys.*, **70**, 188; 1931.

Biology of Heavy Water

IN *Science* of February 16, 1934, Prof. Gilbert N. Lewis summarises the results of certain sporadic attempts to observe the effect of water containing heavy hydrogen, H^2, upon living organisms. Experiments have necessarily been confined to small organisms, though some preliminary observations on mice are included. The first experiments were upon tobacco seeds, the germination of which was completely retarded by pure H^2_2O and slowed up some 50 per cent by water containing 50 per cent H^2_2O. Seeds transferred to normal water after three weeks in pure H^2_2O sprouted in about half the cases but gave unhealthy seedlings. Yeast cultures in an appropriate nutrient medium dissolved in pure heavy water failed to grow, and Pacsu has also shown that the evolution of carbon dioxide by yeast from sugar solution made up with heavy water is much diminished.

In an experiment that was expensive if preparatory in nature, a mouse was supplied in three doses with some 0·66 gm. of pure H^2_2O. The mouse survived, though during the experiment it showed "marked signs of intoxication". The symptoms of distress seemed more marked after each dose but not cumulative, which led Prof. Lewis to conclude that the heavy water was being voided, but no preparation had been made to test this point. Prof. Lewis concludes that H^2 is not toxic in any high degree but that its complete substitution for H^1 leads probably to a complete inhibition of growth, an effect which is to be traced to "the greatly reduced rate of all physicochemical processes when H^2 is substituted for H^1."

Mr. S. L. Meyer of the Vanderbilt University Biology Department describes in *Science* of March 2 culture experiments with a blue mould, in which those grown on media made up with one out of every 214 hydrogen atoms H^2 gave sixteen times the yield of fungus as those grown on control solutions free from H^2.

The late Dr. Edward W. Washburn and Dr. Edgar R. Smith have been carrying on experiments at the Bureau of Standards at Washington in which they have studied the proportion of H^2 atoms present in the tissues after plants have grown in normal soil solutions. So far as could be judged, rooted willow cuttings absorbed H^1 and H^2 in the proportions in which they were present in the original water supply, but apparently the heavy hydrogen was selectively accumulated in the tissues as the expressed sap contained water 2·8 parts per million heavier than normal water, whilst the water obtained from the destructive distillation of the willows was 5·4 parts per million heavier than the normal supply. Dr. Washburn died suddenly on February 6; his report with Dr. Smith has been published since, in *Science* of February 23.

Universe and Atom

THE issue of *Die Naturwissenschaften* of March 9 contains the address on this subject which Prof. Wehl of Göttingen gave at the opening of the holiday course on mathematical sciences given at Göttingen in July 1933. His object was to put before his audience only such conclusions as are at the present time reasonably certain and to avoid any fantastic speculations.

By representing space in the space time continuum as the abscissa and time as the ordinate of a point on a curved surface, Prof. Wehl shows how the Einstein continuum with its mass distribution is represented by a cylindrical surface with its axis vertical and its radius determined by the density of distribution of mass. Stars at rest are represented by generating lines and the movement of light