and practically in the spring breeding condition. In the control the testes were found to be quite minute. The birds have been exposed to the severest winter weather on record in northern Alberta for at least the last twelve years, involving long spells with below-zero temperatures with a minimum of − 35° F. Two canaries (one control, one experimental) which lived with the Juncos under identical conditions and were killed at the end of November 1926, possessed testes in precisely the same condition as those of the Juncos referred to above.

Juncos have been released at intervals. Out of 51 controls liberated between November and March (in two winters), 48 have been retaken alive at the point of liberation. Of the three remaining, one was killed by a cat, one by a shrike, and the last by a blizzard. In other words, it is evident that, regardless of temperature, barometric pressure, weather conditions in general, etc., birds released with their gonads at their resting minimum, stay where they are even though given their freedom hundreds of miles north of their normal wintering grounds. They will not migrate while in this condition.

Out of 36 experimentals released this winter after the first samples, taken at random from the aviary, showed the organs to be developing, 14 have been retaken. The other 22 departed upon release. All the ones retaken have been killed for examination. Without exception their gonads have been in the condition of one or other of the two Juncos referred to above. None with organs in an intermediate stage of development have stayed here upon release. Returns from liberated birds would probably be too much to hope for in the circumstances, but each is ringed with a U.S. Biological Survey band.

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Carbon Monoxide Poisoning in the Absence of Hæmoglobin.

WARBURG (*Biochem. Zeit.*, 177, p. 471; 1926) has shown that carbon monoxide depresses the rate of oxygen consumption by yeasts and a micrococcus, and that the amount of carbon monoxide required to produce a given effect increases with the partial pressure of oxygen. He concluded that carbon monoxide competes with oxygen for a catalyst concerned in respiration, as it does for hæmoglobin in vertebrates. He also showed that the affinity of oxygen for this substance is 7-14 times that of carbon monoxide, instead of 1/150 to 1/550 as in the case of hæmoglobin at 15° C., and that, like carbon monoxide hæmoglobin, the compound formed with carbon monoxide is dissociated by light.

I have extended these observations to two higher organisms, namely, the wax-moth *Galleria mellonella* and the cress plant *Lepidium sativum*. The moths behave normally in so little as 2·0 per cent. oxygen at atmospheric pressure provided this gas is diluted with 'nitrogen,' but become motionless in 0·8 per cent. In intermediate concentrations they are feeble and ataxic. When, however, the oxygen is diluted with carbon monoxide, about 16 per cent. of an atmosphere of oxygen is needed for normal behaviour, and in 8·8 per cent. oxygen + 91 per cent. carbon monoxide they are completely immobile. With intermediate amounts of oxygen, smaller amounts of carbon monoxide are poisonous. On admitting air, recovery is rapid and complete.

Cress seeds would not germinate at all in atmospheres containing less than 1·7 per cent. oxygen when diluted with nitrogen, and even in 5 per cent. oxygen growth was poor, though it was almost normal in 10 per cent. When the oxygen was diluted with carbon monoxide there was no germination whatever under 3 per cent. oxygen, and only a few seeds opened in 7 per cent., while in 14 per cent. growth was slow. A comparison of different cultures showed that for a given amount of growth 2-3 times as much oxygen was needed in the presence of large quantities of carbon monoxide as in its absence. Carbon monoxide is therefore relatively less poisonous for cress than for moths or yeast.

The most probable conclusion from these experiments is that oxygen, before it can be utilised for some at least of the oxidative processes in the cell, must combine with a substance possessing a lesser but well-marked affinity for carbon monoxide, these two gases combining with the same group in its molecule. As this substance is found in higher animals and plants as well as bacteria and fungi, it is probably a nearly universal cell constituent. The apparently different ratio of its affinities for carbon monoxide and oxygen in cress as compared with yeast and moths, is of course paralleled in the case of hæmoglobins from different animals.

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Persistent Lines of Hafnium.

A NUMBER of spectra of zirconium ores and oxides have been examined for persistent lines of hafnium, using the wave-lengths for this latter element given by Hansen and Werner (NATURE, 112, 618; 1923). The most persistent lines observed—three of which were found in all spectra examined—are at wave-lengths

2773·40, 2866·35, and 2919·55 angstroms,

of which the first is the most persistent. Other lines slightly less persistent are 2516·85, 2887·15, 2898·25, 2904·40, (2904·80), 2940·80, 2964·85, 3194·20. (The line 2904·80 is uncertain on account of a strong zirconium line nearby. The hafnium line and its neighbour 2904·40 are possibly a pair like those at 2513·00 and 2512·70. The line 2904·40 is very persistent, but the shorter pair are not.)

On account of the shortness of the range of Hansen and Werner's wave-lengths, none of these lines may safely be considered to be true *raies ultimes*, but their persistence may have some practical utility. In this regard it may be remarked that the crude ores are but slightly more difficult of examination than are fairly pure oxides, in spite of the richness of the preponderant spectra involved. With moderate dispersion (λλ 7000-2100 on a 10-inch plate) and good focus, the number of blends involving strong hafnium lines in the region studied is small and for analytical purposes probably of little moment. In using the ores and oxides of zirconium in a carbon arc, satisfactory spectra were not frequently obtained unless the arc carried enough current to be noisy. When satisfactory zirconium spectra were got there was no uncertainty about the hafnium traces, repeated exposures giving concordant results. Of the ores at hand the richest was of Wisconsin origin, being surpassed only by concentrates from a Carolina ore which was not available in crude state. In addition to the commoner elements in the ores, scandium appeared strongly in several cases.

Regularities in the spectrum of hafnium, to which the persistent lines should be a guide, have not yet appeared satisfactorily. The arc spectrum should be of odd multiplicity; McLennan, McLay, and Smith (*Proc. Roy. Soc. London*, 112, 76; 1926), applying Hund's principles, make the lowest arc term a triplet *F*. Inspection of Hansen and Werner's wave numbers beginning with the differences between the most per-