This apparently monoclinic simple lattice is no other than a rhombic B^*-centred lattice with $a^* = 0{\cdot}25720$, $b^* = 0{\cdot}15556$, $c^* = 0{\cdot}13096$. These give finally $a = 3{\cdot}888$ A., $b = 6{\cdot}428$ A., $c = 7{\cdot}636$ A., which compare favourably with $a = 3{\cdot}889$ A., $b = 6{\cdot}428$ A., $c = 7{\cdot}633$ A. as given by Byström. The (direct) lattice is again B-centred. The rhombic indices hkl are related to the triclinic indices $h'k'l'$ as follows: $h = k'$, $k = l'$, $l = 2h' + k' + 2l'$. The details of the calculation will be published elsewhere.

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Specific Ionization of Extensive Shower Particles

In using ionization chambers to study extensive showers, it is necessary to assume some value for the specific ionization of shower particles in order to convert the number of ions collected (which is the quantity measured by the chamber) to the number of particles passing through the chamber, and hence the shower density. There seems to be no general agreement between different workers as to the best figure to assume for this purpose. A survey of the literature reveals that values range from 50 to 100 ion pairs/cm. for air. Many are in the vicinity of 85 ion pairs/cm. for argon, or its equivalent of about 65 ion pairs/cm. for air or nitrogen. This figure corresponds to the specific ionization averaged over electrons of all energies, including those near the minimum of the ionization loss – energy curve. The average energy of extensive shower particles is in the region of 100 MeV., and it therefore seems reasonable to take a larger value for the specific ionization of such particles. Carmichael[1] has, in fact, suggested that discrepancies between the extensive shower spectrum obtained by Geiger-counter methods and that found from the size distribution of large bursts could be partly due to an under-estimation of the sizes of bursts in the latter case for the above reason. Carmichael suggests that a value of specific ionization at least 1·4 times greater is necessary to obtain agreement.

In connexion with ionization-chamber experiments conducted in this laboratory, an estimate (based on published data) was made of the specific ionization of electrons of 100 MeV., and is published in the belief that it will be of use to other workers in this field.

Direct measurements for electrons in this energy region have been made by Corson and Brode[2], Sen Gupta[3] and Hazen[4]. In all cases the method employed was that of drop-counting in a cloud chamber filled with nitrogen. From their results we obtain an average value of 59 ± 5 ion pairs/cm. for the probable specific ionization in dry nitrogen at N.T.P. for electrons of energy 100 MeV. Corson and Brode do not state whether their results were corrected for the ionization of the water and alcohol vapour in the chamber. If not, the average would be reduced to 58, but this is well within the probable error.

Cloud-chamber techniques measure only the 'probable' ionization, that is, the primary ionization plus ionization from secondaries of energy less than a certain critical value, which is about 10^4 eV. At 100 MeV. the *total* ionization for electrons (which includes that from all secondaries) is 1·4 times greater than the probable ionization as measured in cloud chambers[5]. The total ionization for extensive shower electrons is thus 83 ion pairs per cm. for nitrogen, corresponding to 107 for argon. It may be noted that this value of specific ionization, although 1·3 times greater than values commonly used, is still not sufficient to bring ionization-chamber and Geiger-counter measurements into agreement.

Ionization chambers, at least for high pressures, measure a quantity which is close to the total ionization. For any given ionization chamber there will be an average upper limit η to the energy of secondaries that expend all their energy in producing ions in the chamber. Secondaries of higher energy will escape from the chamber without losing all their energy in the production of ions. The actual value of η differs from chamber to chamber, being dependent upon the geometry of the chamber and the nature and pressure of the gas. The accompanying table shows the calculated probable ionization for ionization chambers as a percentage of the total ionization for electrons of 100 MeV., on the assumption that ionization from secondaries of all energies less than η eV. is completely collected. Secondaries of energy greater than η will lose some part of their energy in the chamber, the amount lost by a secondary the energy of which lies between E' and $E' + dE'$ being approximately:

$$\frac{\eta^2}{E'} \cdot dE' \text{ eV. } (E' > \eta).$$

The amount of energy *not* expended within the chamber can be calculated by appropriately modifying the relation 1·8 of Rossi and Greisen[5]. The percentage of the total energy of the secondaries detected by the chamber follows at once.

Percentage total ionization for secondaries of energy less than η eV. Primary energy, 100 MeV.

η (eV.)	Percentage total ionization
10^4	74
2×10^4	76·3
5×10^4	79
10^5	81
2×10^5	83·3
5×10^5	86
10^6	88

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