the atomic weight of potassium would be 0.002 of a unit higher than it is to-day. Should they lack other methods, chemists of the very distant future will be able, by redetermining its atomic weight, to calculate the lapse of time since the first modern atomic weight determination of potassium.

If we assume that the emission of β -particles effects an alteration in the nuclear charge, the product of transformation of potassium will be a calcium isotope of atomic weight 41. We have seen that since the consolidation of the earth's crust about 2 per cent. of potassium of mass 41 will have decayed, so that the maximum amount of calcium 41 which has accumulated in potassium minerals during the whole of geological time will amount to only 0.1 per cent. of their potassium content. This should be capable of detection in determinations of the atomic weight of calcium which has been extracted from old potassium minerals.

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A Theory of the Upper Atmosphere and Meteors.

It has been clearly recognised that the force of gravity acting on the atmosphere of the earth will cause the heavier gases to settle downward by diffusion and the lighter gases to rise to the higher altitude, and that winds, if they exist, would by convection keep the composition of the air uniform at all elevations. The classical ideas of atmospheric pressures (for example, Humphreys, Jeans, Chapman, and Milne, etc.) have been based on the assumption that convection is negligible, at least above a 50 km. level, and that diffusion is the important factor in determining the partial pressures of the gases. In this note are presented some conclusions, to be published in detail later, which have resulted from taking into account convection and diurnal temperature variations in the high atmosphere.

The ordinary equations of diffusion show at once that if the air were uniformly mixed at all altitudes and then left free from all convection currents, there would be a constant flow of lighter molecules upward and of heavier molecules downward, which would be independent of the altitude until a level was reached where the diffusing gas would be in gravity equilibrium. This 'diffusion' level for hydrogen would move from infinity down to 142 km. in one day, at the end of five days it would be at a height of 127 km., and in 50 days it would be at 113 km. The corresponding levels for helium would be at 137, 120, and 106 km. respectively. The new calculations give hydrogen and helium contents above 150 km. roughly 1/100,000 of the values previously calculated.

Absorption of solar and terrestrial radiation must be taken into account in any discussion of radiation equilibrium in the upper atmosphere. Numerous writers have recognised this fact, but apparently none of them has made an attempt to calculate absorption coefficients or to estimate a difference of temperature for day and night, or winter and summer conditions. Water vapour above 11 km. absorbs a little more than 20 per cent. of black body radiation from below at earth temperatures, while carbon dioxide absorbs nearly 40 per cent. Ozone absorbs only about 2 per cent., but its presence is important because it absorbs about 4 per cent. of the solar radiation at an altitude where most of the re-radiation must be by the ozone itself. Temperature calculations based on these ab-

sorption coefficients show that for a 50° latitude above a height of 60 km. we should expect a temperature of about 250° K. during a winter day with a drop to 220° during the night, and a temperature of 370° during a summer day with a corresponding drop to 230° during the night.

The atmosphere at the base of the stratosphere cannot be in radiation equilibrium, but must receive more radiant energy than it loses both from above and below during a 24-hour day. The temperature condition of the earth's surface is in very unstable equilibrium. The loss in heat by radiation from the warm equator is much less than from the cooler polar regions. An increase in temperature at sea-level near the equator would not result in an increase in the energy lost by radiation from these regions, but would actually result in a decrease. Loss of heat by radiation from the earth depends not on the condition of the surface, but on the temperature at the base of the stratosphere and absorption in the stratosphere. A slight change in the carbon dioxide of the air would have a tremendous influence on the climate of the earth. If the carbon dioxide content of the air were increased from the present 0.03 per cent. to 0.1 per cent., tropical plants would probably grow in the polar regions. On the other hand, if this protecting sheet decreased from 0.03 per cent. to 0.01 per cent., ice would probably be found near the equator.

Since the present theory leads to low densities of the atmosphere above heights of 100 km. or so, densities much lower than those of classical tables, the facts about the appearances of meteors require explanation. It seems possible to do this following to a certain extent the ideas of Sparrow and departing from those of Lindemann. When a high-speed meteor strikes an air molecule, it is assumed that the energy of the impact violently ejects atoms, molecules, and possibly small particles of molecular dimensions from the body of the meteor. This ejected material, by virtue of its velocity, carries into the air the energy which eventually gives the light of the meteor trail. For example, when a nitrogen molecule strikes an iron meteor which has a velocity of 40 km. per second, the energy of the impact is sufficient to raise the temperature of 1800 molecules 1000° C., or to evaporate 56 molecules of iron, or to evaporate and ionise 24 molecules of iron. As a result of this impact, a mass roughly thirty times that of the nitrogen molecule is ejected from the meteor principally in the form of highly energised iron atoms which have velocities slightly greater than that of the meteor itself. The inelastic collisions of these iron atoms with the molecules of the air result in the visible trail.

The excitation energy of these collisions may be as high as 155 volts for nitrogen or 280 volts for argon. Much of this energy may be radiated in the ultra-violet or even soft X-ray region, and it is probable that not more than one-tenth of the total radiation is in the visible part of the spectrum. Therefore, the total mass of the meteor must be much more than that derived by Lindemann and Dobson from their considerations of the relation between the mass of a meteor and its light. The temperature changes in the upper atmosphere from evening to morning, and from winter to summer, given by the present theory, lead one to expect appearance of meteors at heights which are greater by, say, 5 km. in the evening than in the morning, and in the summer than in the winter. It would be interesting to know whether this difference has been observed.

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