distillation. Subsequent recrystallization of such materials from a solvent led to a considerable reduction in the loss factor, accompanied by an even larger decrease in the D.C. conductivity. The following results were obtained, at about 15° C., with the long-chain ketone, palmitone :

| | $\sigma$ D.C. ($\times 10^{-15}$ mho-cm.$^{-1}$) | Dielectric loss factor at 3·9 c./s. | 1·3 c./s. | 0·44 c./s. |
|---|---|---|---|---|
| Vacuum-distilled | 8 | 0·10 | 0·22 | 0·41 |
| Recryst. from alcohol | 0·1 | 0·002 | 0·004 | 0·005 |

Since the vacuum fractionation of these compounds involved heating at high temperatures in a restricted supply of oxygen, it seemed probable that the observed effect on the electrical properties was related to the presence of oxidation products in the material. In support of this, the ketone laurone gave the following results, before and after heating for two hours at 100° C., with restricted access to the atmosphere :

| | $\sigma$ D.C. ($\times 10^{-15}$ mho-cm.$^{-1}$) | Dielectric loss factor at 3·9 c./s. | 1·3 c./s. | 0·44 c./s. |
|---|---|---|---|---|
| Before heating | <0·05 | 0·002 | 0·002 | 0·003 |
| After heating | 1·5 | 0·068 | 0·12 | 0·21 |

Paraffin wax was more stable and required heating for two hours at 330° to give an increase similar to that shown above for laurone.

The autoxidation of long-chain compounds is known to proceed through the formation of hydroperoxides which are unstable and decompose to give alcohols, ketones, acids and aldehydes (see, for example, ref. 5). To determine whether any of these impurities are responsible for the dielectric absorption and high conductivity of oxidized long-chain compounds, electrical measurements were made with paraffin wax to which small proportions of compounds of the above-mentioned types had been added. The addition of 1 per cent of methyl hexyl ketone, *n*-heptaldehyde or caprylic acid gave comparatively little change ; but a large effect was obtained with *n*-octyl alcohol ($C_8H_{18}O$), as shown by the following results :

| Paraffin wax | $\sigma$ D.C. ($\times 10^{-15}$ mho-cm.$^{-1}$) | Dielectric loss factor at 3·9 c./s. |
|---|---|---|
| 1. Untreated | <0·004 | 0·000 |
| 2. + 1 per cent of *n*-octyl alcohol | 4000 | 4·0 |

Large increases in D.C. conductivity and dielectric loss factor also resulted from 1 per cent additions of *n*-hexyl, *n*-heptyl and secondary octyl alcohols ; but cetyl alcohol ($C_{16}H_{34}O$) produced only a small change.

It thus seems probable that the high dielectric absorption at low frequencies and high D.C. conductivity observed with oxidized long-chain compounds are due to the presence of small proportions of alcohols of comparatively short chain-length. The alcohol molecules may be adsorbed at crystal interfaces in such a manner as to enable the formation of hydrogen-bonded chains of hydroxyl groups, which have previously been suggested as a cause of high dielectric absorption in solid secondary alcohols at low frequencies[6].

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## Fundamental Lengths and Masses of Fundamental Particles

CERTAIN considerations based on the principles of quantum mechanics lead to the view that the process of localization of a particle in space and time is subject to quantization. Thus if the world line of a particle of rest mass $m_0$ is considered, it has no physical meaning to subdivide it into elements of length less than $h/m_0c$, or, what is the same thing, to associate with the particle intervals of proper time less than $h/m_0c^2$ [1]. This has been expressed as a principle of elementary indeterminacy by Ruark[2] and by Fürth[3].

In the case of the proton, of rest mass $M_0$, the length $h/M_0c$ might be regarded as the fundamental length of the order of $10^{-13}$ cm., which has come to be described as the range of nuclear forces. In a recent paper, Fürth[4] has identified this length with Yukawa's expression $h/2\pi\mu_0c$ for this range, $\mu_0$ denoting the mass of the $\pi$-meson associated with the nuclear field.

The range of nuclear forces might also be identified with the expression $ke^2/m_0c^2$, where $m_0$ is the rest mass of the electron. Unlike the other expressions, this contains a numerical constant $k$ which is not well defined theoretically. Such values as $\frac{1}{2}$ and $\frac{2}{3}$ have been ascribed to it in the classical theory of the electron, and Fürth[5] by a rather different consideration deduced the value 15/32. The constant is evidently of fundamental importance, and if $ke^2/m_0c^2$ is regarded as a fundamental unit of length, it ought to be derived without any considerations of electron structure or charge distribution. The identification with the other expressions for the range of nuclear forces makes it possible to deduce the value of $k_0$ with a high degree of accuracy.

Thus, making use of recent data[6], $2\pi e^2/hc = 7{\cdot}2978 \times 10^{-3}$, $M_0/m_0 = 1836{\cdot}57$ (with a certain margin of error), the relation $h/M_0c = ke^2/m_0c^2$ gives $k = 0{\cdot}4688$. Fürth's value, namely, $15/32 = 0{\cdot}46875$, is in remarkable agreement with this.

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