LETTERS TO THE EDITORS

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Investigation of the Cœlacanth

IT was my privilege to carry out detailed investigations on the first Cœlacanth, and to have discovered what appears to be the area where those fishes still live.

The recent Comoran Cœlacanth, while mutilated more than was at first realized, nevertheless retains most of the soft parts, including the abdominal viscera. This extends enormously the scope of the investigational work that may be carried out on the specimen. There will be still more that can be done only on parts, exudates, and secretions from an untreated fresh specimen, which it is hoped to seek before very long.

It is in keeping with the importance and scope of the investigations on all parts of this fish that they should be assigned to leading experts in the field in which they fall. I have advised the South African Council for Scientific and Industrial Research, and have requested the Council's approval of and co-operation in this matter.

Application to be included in this scheme should be sent either to the South African Council for Scientific and Industrial Research, P.O. Box 395, Pretoria, or to me personally at Rhodes University, Grahamstown. While every possible facility will be granted to selected visiting specialists, it should be noted that there is no possibility of financial aid from this end.

The ownership of the next specimen or specimens is of less importance than their proper preservation for scientific purposes. As certain organs and body fluids require special treatment and preservation, it is intended to compile a set of special instructions to be issued to those in areas where it is possible that a fresh Cœlacanth may be obtained. It will be appreciated if those interested will kindly furnish detailed special instructions composed in language as simple as possible, giving full directions and not only the names, but also the actual composition of any materials to be employed.

Since there is a hope that more Cœlacanths may be found at the Comoro Islands, it is desirable that all such materials should be available there.

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Feb. 8.

Plastic Properties of Coking Coals

THE processes which take place when a coking coal is turned into coke by heating in the absence of air are very complex and only partly understood, though they have been studied for many years[1,2]. We have made a renewed approach to the problem, and have evolved for guidance an elementary theory applicable in the temperature-range within which coking coals show plastic properties. Supporting experimental evidence is described below.

It is widely accepted[1] that a coking coal at temperatures of the order of 300° C. and higher shows plastic properties, the word 'plastic' being used here in a general sense; and there is evidence that it behaves as a liquid having a normal viscosity–temperature relationship[3]. At temperatures approaching 400° C., this liquid is subject to thermal decomposition and changes into a gas and an infusible solid. We assume this change to take place according to the laws governing first-order chemical reactions, so that if at time $T = 0$ there exists a mass m_0 of coal in the liquid state, at a later time $T = \tau$ there will remain a mass:

$$m_\tau = m_0 \exp -k\tau,$$

where k is the velocity constant of the decomposition reaction at the temperature of the decomposition; and at any later time $T = \tau + t$, there will be:

$$m_{\tau+t} = m_0 \exp -k(\tau+t) = m_\tau \exp -kt. \qquad (1)$$

The time $T = 0$ can never be experimentally realized, as some decomposition must take place in the period of heating to the required temperature, which for reasons of fundamental and experimental limitation cannot be made infinitely short. The time $T = \tau$ is taken to be the time when the predetermined temperature has been reached.

As the solid product of decomposition accumulates, the viscosity of the liquid/solid mixture will rise. We assume a relationship of the form:

$$\bar{\eta} = \eta(1 + \lambda c),$$

where λ is a constant later shown to be equal to, or not far from, unity, η is the viscosity of the mixture before the concentration of solid matter is inc eased by c, after which it becomes $\bar{\eta}$. (A fixed value of λ cannot be assumed, *a priori*, to apply over a long period of time, but it can be shown that it approaches constancy over periods which are not infinitesimal. Idealized extreme cases of solid suspensions and analogous systems have been studied by G. I. Taylor[4] and A. Einstein[5].) It follows that

$$\eta_{\tau+t} = \eta_\tau \left(1 + \lambda \frac{m_\tau - m_{\tau+t}}{m_{\tau+t}}\right); \qquad (2)$$

and substituting from equation (1), we have:

$$\eta_{\tau+t} = \eta_\tau (1 + \lambda \exp kt - \lambda),$$

so that:

$$\frac{d}{dt}(\log \eta_{\tau+t}) = \frac{\lambda k \exp kt}{1 + \lambda \exp kt - \lambda} = \frac{\lambda k}{(1-\lambda)\exp(-kt) + \lambda}. \qquad (3)$$

This equation makes the following statements concerning the slope of the graph of $\log \eta$ against t: (i) for $t \to 0$, the slope tends to λk; (ii) for $t \to \infty$, the slope tends to k. Thus, as t increases, the slope changes from λk to k.

The predictions of the theory were checked by measuring the viscosity of four different coals at various temperatures using an apparatus developed by Gieseler[6] and other workers[7]. A stirrer is embedded in compressed powdered coal in a crucible. A torque is applied to the stirrer which makes it rotate when the coal softens on heating. The viscosity of the coal is inversely proportional to the rate of revolution of the stirrer. In the past, the apparatus has been used for observing the viscosity changes with rising temperature, but there is no difficulty in adapting it to work at constant temperature.

The graph shows the result of a typical experiment. A linear relationship between $\log \eta$ and t is clearly shown. The precision of the experiment is such that a slight curvature would not be detected. Exact linearity would imply $\lambda = 1$ (see equation 3), so that the slopes give the reaction velocity directly. The graphs obtained permit the statement that λ is a