$$\frac{V^2}{gd} = \alpha_9 \cdot \frac{(XVs)^{1/2}}{(g\nu)^{1/6}} \quad (9) \quad \frac{V^2}{R} = \frac{4}{3} f$$

(Froude No.)

$$\frac{Vd}{\nu} = \alpha_{10} \cdot Q^{1/2} \cdot \frac{g^{1/3}}{\nu^{11/12}} \cdot \left(\frac{m}{XVs}\right)^{1/4} \quad (10) \quad \frac{VR}{\nu} = 0\cdot375\ Q^{1/2}$$

(Reynolds No.)

Where b = breadth ; A = area ; V = velocity ; d = mean depth ; b/d = shape factor ; S = slope ; M_l = meander length ; $(S.V)^{1/2}$ = Lacey's new silt factor ; R = hydraulic mean depth ; P = wetted perimeter ; $f = 0\cdot75\ V^2/R$ = Lacey's original silt factor, and (SV) = Lacey's new sand factor.

By reducing Mr. Lacey's (A) and (B) formulæ, we obtain

$$P/R = \tfrac{1}{2}\ (V^2/gR)^{1/3}\ .\ (RV/\nu)^{1/3}, \qquad (A)$$

which reduces to

$$P = \tfrac{1}{2}\ \frac{VR}{(g\nu)^{1/3}} \qquad (A1)$$

$$\text{or } P = \sqrt{\frac{Q}{2(g\nu)^{1/3}}} = 2\cdot78\ Q^{1/2}\ \text{(at 30° C.)}, \qquad (A2)$$

$$\text{and} \quad V^2/gRS = \tfrac{1}{4}\ (V^2/gR)^{-2/3}\ .\ (RV/\nu)^{1/3} \qquad (B)$$

$$\text{or } V = g^{5/9}/\nu^{1/9}\ .\ R^{2/3}S^{1/3} \qquad (B1)$$

$$= 15\cdot8\ R^{2/3}\ S^{1/3}\ \text{(at 30° C.)}. \qquad (B2)$$

$(B2)$ is what Lacey has called his "general regime formula"[3].

Though dimensionally homogeneous, these two formulæ omit the effect of charge and grade, whereas grade and charge are included in formulæ (1) and (3).

When $R^{2/3}$ and $S^{1/3}$ in Lacey's (B) formula are rewritten in terms of the new equations we obtain

$$V \propto \frac{\nu^{1/36}}{g^{1/18}}\ .\ Q^{1/6}\ .\ \frac{m^{1/4}}{(XVs)^{1/12}}. \qquad (3a)$$

This differs from equation (3), which is not directly deducible from $(B1)$ because, as I pointed out in 1936 [4], this formula should be in the form

$$V = 16\cdot0\ R^{2/3}\ S^{1/3}\ (f_{Vd}/f_{dS})^{1/2}, \qquad (9)$$

where the silt factors $f_{Vd} = 0\cdot75\ V^2/d$ and $f_{dS} = 192\ d^{1/3}\ S^{2/3}$.

Equation $(3a)$ should, therefore, be rewritten in the form

$$V \propto \frac{\nu^{1/36}}{g^{1/18}} \cdot Q^{1/6} \cdot \frac{m^{1/4}}{(XVs)^{1/12}} \cdot \frac{g^{4/9}}{\nu^{1/18}} \cdot \left(\frac{XVs}{m}\right)^{1/6}$$

or $V \propto g^{7/18}/\nu^{1/36}\ .\ Q^{1/6}\ (m\ .\ XVs)^{1/12}$, which is identical with equation (3).

Thus grade and charge should not be omitted in this equation, though they come in to such a low power that they have a negligible effect in the sand region, where $Vs \propto m$, and not much effect even in the regions where $Vs \propto m^{1/2}$, or m^2.

The above formulæ are for quartz sand in water ; if any other material or liquid is used, $m(\sigma - \rho)/\rho$ is involved, where σ is specific gravity of material and ρ of liquid.

CLAUDE INGLIS

c/o Institution of Civil Engineers,
London, S.W.1.
May 9.

[1] Central Irrigation and Hydrodynamic Research Station, Poona. Annual Reports (Technical), 1940–41, p. 50 ; 1941–42, p. 33.

[2] "The Behaviour and Control of Rivers and Canals (with the aid of Models)", chapter 3, by the Author (in the press).

[3] Paper 5518, Inst. Civ. Eng., "A General Theory of Flow in Alluvium", p. 20.

[4] Discussion on Dr. N. K. Bose's Punjab Engineering Congress Paper 192, "Silt Movement and Design of Channels".

Turbulent Flow in Alluvium

MY communication dated December 9, 1946, published in the issue of *Nature* of March 22, 1947, pp. 407–8, contains an error, due to hasty transcription, for which I owe an apology to those who have attempted to follow the derivation of the dimensionless equations. The seventh essential variable, the energy gradient i, should have been given as ρgS, and not as gRS. The kinematic viscosity ν has also on p. 408 been replaced by μ the viscosity. The Reynolds number should appear as (RV/ν) throughout.

The correct equations were quoted by me[1] in 1937 in the more general form

$$iR/\rho V^2 = gRS/V^2 \propto (RV/\nu)^{-1/3}\ (V^2/gR)^{2/3},$$

and

$$P/R \propto (RV/\nu)^{1/3}\ (V^2/gR)^{1/3}.$$

No attempt was made at that time to assign numerical values to the constants, or to eliminate the Reynolds number, a step which in retrospect appears sufficiently obvious.

I should have stated finally in respect of the equations that they can apply rigidly only to an ideal self-generating channel flowing in an unlimited medium of incoherent alluvium identical with the alluvium transported.

GERALD LACEY

c/o Institution of Civil Engineers,
London, S.W.1.
May 4.

[1] *Trans. Amer. Soc. Civ. Eng.*, **102**, 159 (1937).

Role of Dendritic Cells in the Infective Colour Transformation of Guinea Pig's Skin

WHITE skin from a spotted black and white guinea pig may be caused to turn black by grafting it to a pigmented area. Conversely, black skin grafted to a white area slowly blackens the white skin that surrounds it[1,2]. Recent experiments by Billingham and Medawar[2] have set aside the possibility that the blackening reaction is the outcome of a mere diffusive process, or of a mass replacement of white epidermal epithelium by black. We have now examined the possibility, for various reasons unfairly belittled in our earlier communication, that the blackening reaction is due to the differential migration of melanoblasts from pigmented into unpigmented skin.

Examined in living black epidermis, melanoblasts (pigmentary dendritic cells) appear clearly as nucleated cells occupying the lower reaches of the epidermis and sometimes just abutting into the underlying dermis. Dendrites originating from them —most commonly four to six primary stalks with distal dichotomizing branches often 100 μ in length —weave horizontally and upwards between the ordinary basal layer cells, which they supply with melanin granules in a manner to be described in detail elsewhere[3]. Black dendritic cells are strongly 'Dopa'-positive, that is, they cause the rapid intracellular oxidation of 3 : 4 dioxyphenylalanine[4], a