observation though contrary to that of Bhatia is to be expected since the membrane permeability might have reached the maximum with water presoaking itself and the additional increase in permeability through DMSO might not influence the rate of absorption. Further, it seems that DMSO does not also cause any reduction in mutation frequency.

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LIQUID METAL MAGNETOHYDRODYNAMIC POWER GENERATOR

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THE theoretical aspect of magnetohydrodynamic power generator using a rectangular channel of uniform cross-section is investigated in this article. The experimental arrangements and the results obtained will be presented elsewhere. The physical problem consists of the flow of a conducting, incompressible, heterogeneous and non-viscous fluid bounded by a rectangular channel made of electrodes and insulating walls in the presence of a transverse magnetic field. The purpose of using an heterogeneous conducting fluid is to achieve increased power output.

The required equations following Rudraiah (1964), using

$$u_x = u \left(\frac{\rho}{\rho_0} \right)^{\frac{1}{2}} \tag{1}$$

$$u_y = v \left(\frac{\rho}{\rho_0} \right)^{\frac{1}{2}} \tag{2}$$

and using small perturbation

$$u_x = u' + U$$
$$u_y = v' \tag{3}$$

where u and v are the x and y components of velocity, ρ is the variable density, ρ_0 is some reference density, and U is the free upstream velocity, become

$$\nabla^2 \Phi = N \left[\frac{\partial \Phi}{\partial \xi} + \left(\frac{\rho_0}{\rho} \right)^{\frac{1}{2}} \frac{\partial \Psi}{\partial \xi} \right] \tag{4}$$

$$\nabla^2 \Psi = - N \left[\frac{\partial \Phi}{\partial \xi} + \left(\frac{\rho_0}{\rho} \right)^{\frac{1}{2}} \frac{\partial \Psi}{\partial \xi} \right] \tag{5}$$

with the boundary conditions

$$\Phi = \pm \Phi_w \quad \zeta = \pm \frac{\pi}{2h} \ (\xi > 0) \tag{6}$$

$$\frac{\partial \Phi}{\partial \xi} = 0 \quad \zeta = \pm \frac{\pi}{2h} \ (\xi < 0) \tag{7}$$

$$\Psi = \pm \frac{\pi}{2h} \quad \zeta = \pm \frac{\pi}{2h} \ (-\infty < x < \infty) \tag{8}$$

where

$$\phi = UBh\Phi, \quad \psi' = Uh\Psi, \quad x = h\xi$$

and $y = h\xi$, ϕ is the electric potential and ψ' is the stream function,

$$N = \frac{\sigma B^2 h}{\rho_0 U}$$

is the interaction parameter, which we assume to be small.

To solve equation (4) we use,

$$\Phi = \Phi_0 + N\Phi_1 + \cdots \tag{9}$$
$$\Psi = \Psi_0 + N\Psi_1 + \cdots \tag{10}$$
$$\rho = \rho_0 + N\rho_1 + \cdots \tag{11}$$

We note that Φ_0 is sufficient (Sutton and Carlson, 1961) to calculate the power output. Thus, equation (4) is solved using the technique of conformal mapping, where we use the transformation

$$e^z = \sin w \tag{12}$$

$$\eta_h = \xi + \frac{\pi}{2h} \tag{13}$$

$$z = \xi + i\eta_h \tag{14}$$

$$w = \xi' + i\eta_h', \quad \eta_h = \frac{\eta}{h} \tag{15}$$

The required solution for the potential is

$$\Phi_0 = 2\Phi_w \frac{\xi'h}{\pi} \tag{16}$$

or in terms of dimensional quantities

$$\phi_0 = 2\phi_w \frac{x'}{\pi} \tag{17}$$

where

$$\xi' = \frac{x'}{h} \quad \eta'_h = \frac{\eta'}{h}.$$

The expression for the current, using Ohm's law, will be

$$J_0 = \frac{2\sigma}{\pi} \phi_w \eta' - \left(\frac{\rho_0}{\rho}\right)^{\frac{1}{2}} \sigma\, UBx. \tag{18}$$

For large η' along $x = \pi/2$, equation (12) becomes

$$e^x = \frac{1}{2} e^{\eta'} \tag{19}$$

and hence

$$\eta' = x + \log 2. \tag{20}$$

If the channel length is L, the total current to the electrodes per unit length in the direction of the magnetic field is

$$J_L = \sigma \left[\frac{2\phi_w}{h} - \left(\frac{\rho_0}{\rho}\right)^{\frac{1}{2}} UB\right] L + \frac{4}{\pi} \sigma \phi_w \log 2. \tag{21}$$

The efficiency of the power generator is given by

$$\epsilon_g = \frac{\text{Power output}}{\text{Flow work}}$$

$$= \frac{2\phi_w \left[L \left\{\frac{2\phi_w}{h} - \left(\frac{\rho_0}{\rho}\right)^{\frac{1}{2}} UB\right\} + \frac{4}{\pi} \log 2\right]}{UBLh \left(\frac{\rho_0}{\rho}\right)^{\frac{1}{2}} \left[\frac{2\phi_w}{h} - UB \left(\frac{\rho_0}{\rho}\right)^{\frac{1}{2}}\right]}. \tag{22}$$

If $L \to \infty$, the end losses become negligible and the efficiency becomes

$$\epsilon_g = \frac{2\phi_w}{UBh} \left(\frac{\rho}{\rho_0}\right)^{\frac{1}{2}}. \tag{23}$$

We conclude that using an heterogeneous conducting fluid, the total current per unit length in the direction of the magnetic field, the power output and efficiency are increased.

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OCCURRENCE OF BIVALVE GASTROPODS (MOLLUSCA) IN VISAKHAPATNAM SHORE

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THE bertheliniids were considered to be an extinct group of bivalve molluscs until Kawaguti and Baba[1] discovered the first living representative of the group *Tamanovalva limax* from Bison Seto, Inland Sea of Japan. The above authors established the true identity of this group as 'bivalve gastropods' with a protoconch and a typical Opisthobranch Sacoglossan radula. Ever since the description of this genus *Tamanovalva* by Kawaguti and Baba there has been a growing interest and an intensive search for the occurrence of these forms in other parts of the world. In recent years as many as eleven species of bivalve gastropods belonging to two families and four genera have been reported from different parts of the world, Australia, California, Hawaii, Jamaica and Puerto Rico. As many as 8 of these belong to the genus *Tamanovalva*. The only previous report of a bertheliniid from Indian waters was by Prabhakara Rao[2] who obtained four specimens of *Tamanovalva limax* from the green alga *Caulerpa racemosa* from Mandapam, Gulf of Mannar on the east coast of India. In the present communication the authors report the occurrence of three species of *Tamanovalva* of undetermined identity, one from *Caulerpa taxifolia* and two from *Caulerpa racemosa*. The specimens were discovered in the course of our studies on the systematics and ecology of invertebrate animals associated with the algal vegetation on our foreshore.

A single specimen of *Tamanovalva* sp. was found on the fronds of the siphonous green alga, *Caulerpa taxifolia* collected from the low watermark. The shell is fragile and leaf-green in colour and measured 2·5 mm. in length and 1·95 mm. in height. Faint growth lines were visible on the shell and the periostracum was transparent (Fig. 1). The adductor muscle impression is circular and subcentral. The protoconch or nucleus on the left valve is one and one-half whorls, sharply set of from the rest of the body by its pearly white colour (Fig. 2).

Five more specimens of *Tamanovalva* were recovered from the fronds of *Caulerpa racemosa* of which one was alive. The live specimen (Fig. 3) which measured 8·5 mm. in length, when fully extended, was found attached to the fronds of the alga which it resembled closely in shape and colour. The shell is semicircular and measured 6·6 mm in length and 5·0 mm. in height. The shell is obese with a subcentral bluish-yellow large circular adductor muscle impression. The protoconch was not present and it is presumed to have been lost accidentally. Above the adductor muscle impression are two bright