the lower Tertiary geology of this area. Thus, Brooks[7] described the Kangerdlugssuaq areas as the site of the Icelandic mantle plume in Eocene times, which resulted in major updoming, rifting about a triple point and subsequent crustal separation along fractures parallel to the present coastline.

As it is assumed that both dyke-swarms and the flexuring of the coast are formed in the breaking up of the North Atlantic, the correlation between dyke intrusion and major tectonic events might be explained in the following manner. As stated earlier, both the older dykes and the lavas are flexured and therefore must be older than the collapse of the coast marked by the faulting and shearing. Thus these dykes may well be correlated with the prespreading updoming described by Wager and Deer[5] and Brooks[7].

The younger dykes, which are not sheared and faulted, were probably formed after the initial fracturing event and could be correlated with the active spreading and new crust formation, which opened up the North Atlantic.

Finally, the recognition of intense faulting in the area indicates that extreme caution must be exercised when employing the structural heights in the Skaergård intrusion as estimated by Wager and Brown[8]. Tectonic disturbances of the intrusion would explain some of the irregularities of the Skaergård contact, which can be seen on aerial photographs and the map of Wager and Brown[8]. Such faulting would also be expected to have a profound effect on the magnitude of the hidden layered series in the intrusion, whose size has recently been questioned by geophysical[9] and geochemical[10] investigations and on estimation of the thickness of the basalt succession in the area.

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Interaction between coherent light waves and free electrons with a reflection grating

A NEW effect is proposed for obtaining effective interaction between coherent light waves and free electrons. Potential applications of the effect are optical electron accelerators (linac)[1,2] and optical amplifiers[3].

Smith and Purcell demonstrated[4] that light is emitted when a high voltage electron beam moves parallel and close to a metallic optical diffraction grating in a direction perpendicular to the grating rulings (Fig. 1*a*). The radiation has been explained physically in terms of the oscillations that must be executed by the charge induced on the grating surface by an electron in the beam. The dispersion relationship is

$$\cos\theta_n = (c/v) - (n\lambda/d) \qquad (1)$$

with $n = 1,2,\ldots$, θ_n the angle that the direction of propagation makes with that of the electron beam, d the grating constant, v the velocity of the beam, and λ the free space wavelength of the light.

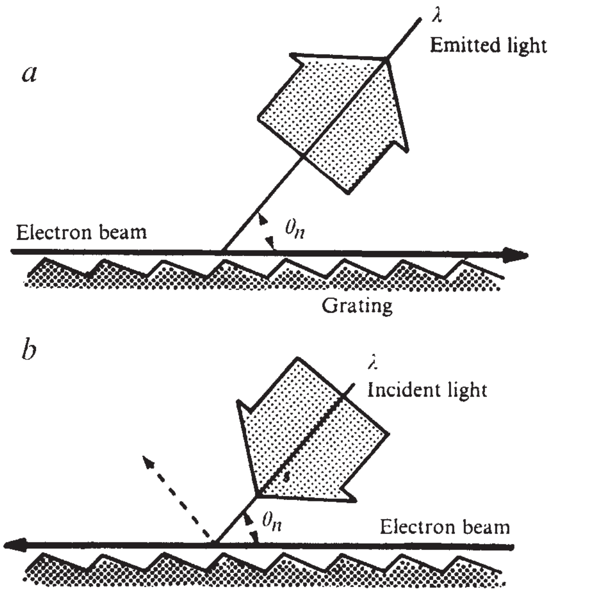

Fig. 1 *a*, Schematics of the Smith–Purcell radiation; *b*, 'inverse Smith–Purcell effect'.

Here we consider the 'inverse Smith–Purcell effect' to obtain extended interaction of an electron beam moving along the grating surface with light incident on the surface. A simple Huygens analysis shows that when the directions of the incident light wave and the electron beam are opposite to those in the case of Fig. 1*a* and satisfy the condition of equation (1), the beam interacts synchronously with the wave; that is, an electron sees the same phase of the wave with the pitch of d (Fig. 1*b*). When the electron beam is opposite in direction to the wave on the grating surface, the synchronous condition becomes

$$\cos\theta_m = (m\lambda/d) - (c/v) \qquad (2)$$

where $m = 1,2,\ldots$.

When the synchronous condition is satisfied, an effective interaction must occur between the electron beam and the light wave in the same manner as the spacial harmonic interaction occurring in microwave travelling-wave tubes, leading to

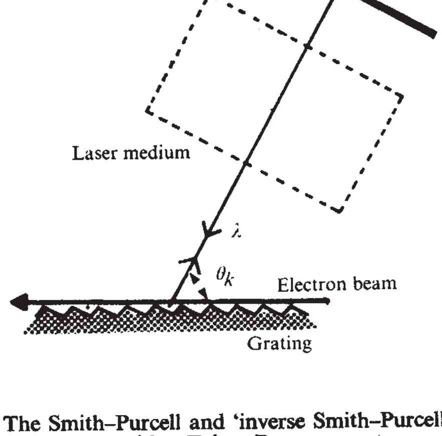

Fig. 2 The Smith–Purcell and 'inverse Smith–Purcell' arrangements with a Fabry–Perot resonator.

electron acceleration or deceleration according to the relative velocities of the electron and the phase of the light wave in the interaction region. If the electron suffers net acceleration over a period of time, then electromagnetic field energy is converted into electron kinetic energy, resulting in an electron accelerator. Optical (laser) accelerators will have the unique property of providing high acceleration gradients because of the intense fields that can be obtained. An acceleration of the order of 1 GeV m^{-1} may be anticipated[3]. In addition, the electrons will be bunched to a dimension which is short compared to the light wavelength, giving current pulses with a time duration of the order of $\sim 10^{-15}$ s. These pulses could be used to study ultra-fast relaxation processes[1,3].

On the other hand, when the electrons are faster than the phase velocity of the light wave and suffer a net deceleration, light amplification may be obtained.

If the incident angle θ_k of the light satisfies the following condition,

$$\cos \theta_k = k\lambda/2d \tag{3}$$

where $k = 1,2,\ldots$, the diffracted ray direction is the same as the incident one. In this case we can adopt the configuration shown in Fig. 2. A Fabry–Perot resonator is formed with the grating and a mirror[5]. Using this configuration as a laser cavity, high intensity electric field in the laser cavity can be used to accelerate the electrons. This configuration involves the one proposed by Takeda and Matsui[2] as the special case of $\theta_k = \pi/2$.

The same configuration can be used to obtain 'stimulated Smith–Purcell radiation', that is, the Smith–Purcell radiation with internal feedback by the Fabry–Perot resonator. We have observed[6] the millimetre and submillimetre wave oscillation in an electron tube called the Ledatron when $\theta_k = \pi/2$.

With recent progress in the development of high power lasers in the optical and infrared regions, it should be possible to miniaturise linacs by using the 'inverse Smith–Purcell effect' proposed here.

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Alteration of structures of sublayer flow in dilute polymer solutions

The Toms effect may be assumed to be based on a phenomenon which occurs in the immediate wall layer. Models proposed to explain the effect are, therefore, mostly aimed either at producing an interaction of the molecules with the flow structure (that is, the eddies), or at attributing new rheological properties to the liquid on the basis of the molecules released, which should lead to new forms of flow.

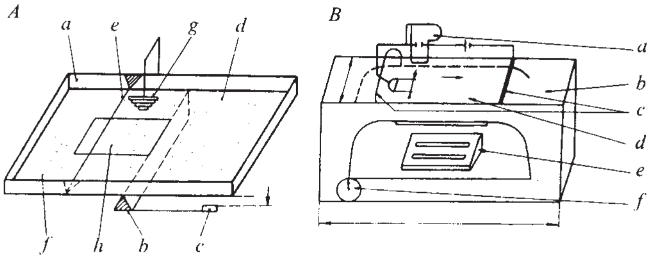

Fig. 1 Experimental apparatus. *A* : *a*, Tub; *b*, wedge; *c*, washer; *d*, base; *e*, trip-wire; *f*, fine sand; *g*, camera; *h*, section. *B* : *a*, Camera; *b*, small channel; *c*, electrodes; *d*, glass plate; *e*, stroboscope; *f*, pump.

Marked boundary layers exhibit a clearly defined reproducible pattern of streamwise streaks in their sublayers[1-3] and regions with higher colour concentrations are identical to those areas where liquid flow is retarded.

Observations by Fales[4] allowed this flow structure to be explained by means of a longitudinal eddy model. As the question of this eddy structure, or its alteration in the existing models is of decisive importance[2,5,6] in explaining the Toms effect we endeavoured to explain this problem by observation.

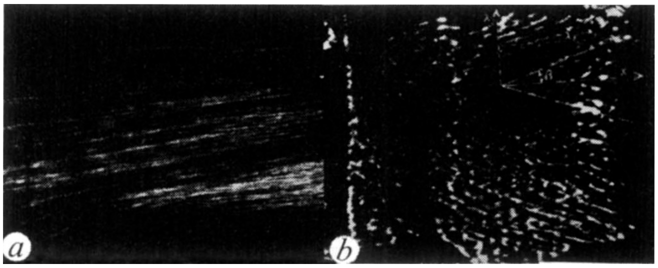

Fig. 2 Sand pattern experiments. *a*, With tap water; *b*, with 50 p.p.m. polyacrylamide solution.

We investigated the structures using fine sand to make the flow visible, though in fact it is not the flow itself which is observed, but the trace it leaves on the bed. As a second step we investigated the sublayer by means of the hydrogen bubbles visualisation technique.

Fine quartz sand settles evenly on the bottom of the experimental tank, and when the liquid is set in motion, the individual grains can be photographed easily, particularly when a smooth surface is used, as in this case. When we investigated integral structures, we used continuous illumination; short term movements were followed under stroboscopic lighting.

As a test device (Fig. 1*a*) we chose a shallow, rectangular sheetmetal trough with a smooth, black plastic foil attached to the bottom. The trough could be tipped steeply about a pivot by means of exchangeable washers, so that we could regulate the velocity of flow as a result of the tipping motion. The flow itself was also brought to a turbulent state with a trip-wire and made visible by means of fine sand. We recorded the movement of the quartz grains with a camera mounted perpendicular to the water surface. The second test was carried out in a small closed-circuit channel (Fig. 1*b*). The camera, or film unit, stood perpendicular to the two-dimensional flow, which was illuminated from below by a stroboscope through a glass plate.