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Pointers

Enterocyte in Coeliac Disease: Professor C. C. Booth explains the concept of enteropoiesis and its study by electron microscopy in the Oliver-Sharpey lecture (p. 725).

β-adrenergic Blockade: Estimation of plasma propranolol levels shows that an active metabolite is formed when drug is taken orally. Some therapeutic effects seem unrelated to β-adrenergic blocking action (p. 731).

Heparin in Cardiac Infarction: Intravenous heparin produces a rise in the serum free-fatty-acids but has no consistent effect on plasma catecholamines. The plasma level of noradrenaline may be a predictive guide to patients likely to develop arrythmias (p. 735).

Digitoxin Intoxication: Symptoms described in 179 patients who took overdosages of digitoxin because of a manufacturing error by a drug firm (p. 737).

Peruvoside: Haemodynamic studies on patients taking a cardiac glycoside obtained from an Indian plant (p. 740).

Hypertension in the Young: Investigation of 127 hypertensive patients attending a Singapore clinic revealed an underlying cause in 57%. Primary arteritis of the aorta was an important cause (p. 744).

Diabetic Ketoacidosis: Cerebral oedema described as potentially fatal complication (p. 746).

Fetal Metabolism: Free amino-acid levels found to be higher in fetal than maternal plasma, suggesting that fetal kidney can conserve amino-acids (p. 747).

Case Reports: Macroglobulinaemia and poisoning with glutethimide and phenformin (p. 750-2).

Urinary Infections: First article in new "Current Practice" series on renal disorders (p. 753).

Today's Drugs: Vasopressors (p. 756).

Medicines Legislation: The Medicines Act explained by Sir Derrick Dunlop (p. 760).

Disability in Community: Lambeth survey shows chest diseases most common disabling complaint (p. 762).

Liver Conference: Report of fifth annual meeting of the European Association for the Study of the Liver (p. 765).

Personal View: Dr. John Apley proposes medical rock-bottom club (p. 766).

Public Health: Report of the Public Health Committee's recent meeting (*Supplement* p. 97).

Water Fit to Drink

Though European Conservation Year has aroused considerable attention, it was in the second quarter of the nineteenth century that Edwin Chadwick was the first to appreciate the problems arising from pollution of water supplies by sewage wastes. His efforts brought the dawn of public health. The last serious outbreak of cholera in this country was in 1866, and no cases have occurred since 1893. Other waterborne diseases have likewise largely disappeared, and a case of typhoid fever makes headline news nowadays.

But close vigilance is still needed. Public health protection has produced a susceptible population with little natural or acquired immunity. Apart from the now well-known risk of disease being introduced by travellers there are the dangers, among others, of accidental pollution of our watercourses and ground water supplies from temporary camping sites and floods. The River Authorities set up by the Water Resources Act of 1963 have been made responsible for the functions of the superseded River Boards. These River Authorities have powers and duties in their catchment areas embodied in the Rivers (Prevention of Pollution) Acts of 1951 and 1961. It is an offence to cause, or knowingly to permit, to enter a stream any "poisonous, noxious or polluting matter." The consent of the River Authority is also required for bringing into use any new or altered outlet for the discharge of sewage effluent or trade effluent, or for making a new discharge of effluent. The River Authority may grant consent subject to conditions governing volume and quality, but provision is made for appeal to the Minister of Housing and Local Government against refusal of consent or against conditions.

Conventional water treatment as practised by water undertakings was developed to deal with pollution by bacteria and other organisms that cause disease, and with pollution from organic matter, including decaying animal and vegetable matter, and agricultural wastes. In the course of time new forms of pollution have emerged which cannot entirely be dealt with by conventional methods of sewage treatment and water purification—for example, industrial wastes, detergents, radioactivity, oil, pesticides, and other synthetic organic chemicals. Industrial effluents containing specific toxic agents as well as being harmful to man and to fishes in the rivers may impair the treatment of sewage. Control has therefore to be exerted at the factory, and there are powers for this under the Public Health Acts of 1937 and 1961. Local sewage authorities can refuse to accept industrial effluents unless preliminary treatment is carried out on the factory site, and limits can be set down for the amounts of toxic substances permitted before discharge to the sewer. Pollution from radioactivity is being strictly controlled at Government level so far as the use and disposal of radioactive isotopes in research, medicine, and industry are concerned. Radioactivity from fallout has now fortunately reached a low level.

Perhaps the greatest pollution problems now are those due to the

increasing use and accidental spillage of oil, pesticides, and other synthetic organic chemicals. As well as damaging watercourses they are difficult to remove by treatment. Furthermore, we know little of their long-term effects if ingested over many years even in infinitesimal amounts. Some of these substances, such as detergents, are easily degraded by bacterial action. They are said to be "biodegradable" and are soon rendered harmless. Others are not susceptible to biodegradation. New methods of chemical analysis of water are being introduced to identify these substances even when present in minute dilution, and with this knowledge long-term toxicity tests can be undertaken to assess their significance to health.

Technical skills are available, but much greater financial resources are essential to halt worsening conditions in the rivers. Lack of money is the main stumbling block to the prevention and alleviation of pollution, and to this end Mr. Eldon Griffiths, Parliamentary Secretary to the Ministry of Housing and Local Government, spoke on environmental pollution in the House of Commons[1] on 21 July, saying: "In the face of restraint on capital expenditure, river authorities in recent years have felt inhibited from pressing upon local authorities their duty to spend money to bring their effluents up to standard, at least to raise their standards." There is no reason why the water in the River Trent should not be brought up to the quality of the water in the Rivers Thames and Lee if time and money are devoted to it.

The Central Advisory Water Committee should be greatly assisted by the recently published report of the Working Party on Sewage Disposal[2] under the chairmanship of Mrs. Lena Jeger, M.P. The report recommends close control of industrial effluents into rivers used as a source of drinking water, particularly effluents likely to contain synthetic organic chemicals, because these materials, sometimes of unknown composition, tend to be stable and biologically potent at very low concentrations. Discharge of crude sewage from boats and other floating craft into fresh water used for recreation and as sources of domestic water supplies should be prohibited, it says, and the law should be amended to require better safety precautions against accidental pollution of water by oil or toxic substances. When a local authority provides a new sewerage scheme in fringe and rural areas where cesspools and septic tanks are the means of disposal of domestic sewage, the premises near the line of the sewer should be connected to it at the local authority's expense. Meanwhile the report suggests that local authorities should provide a free and sufficiently frequent service for the clearance of cesspools and septic tanks to avoid local pollution of ground water and to avoid nuisance. The working party received little evidence of ill health from sewage pollution of bathing beaches but was very much aware of the aesthetic aspects. It recommended that crude sewage should be discharged to the sea only after screening, comminution, and passage through diffusers on long, carefully sited outfalls.

Control of the water cycle has always been an urgent matter in this small country of ours, but as the demand for water increases and the volume of our waste does likewise the more exact must be the control if we are to maintain healthy and attractive water supplies.

[1] *Hansard*, 22 July 1970, col. 375
[2] Working Party on Sewage Disposal, *Taken for Granted*. London, H.M.S.O., 1970.

Control of Breathing

Acute lack of oxygen immediately stimulates breathing in mammals through the aortic and carotid chemoreceptors. The carotid body, which weighs only 15 mg. in man,[1] is composed of islands of sustentacular cells enclosing glomus cells (possibly the actual chemoreceptors[2]). The islands are separated by wide blood sinusoids. Afferent nerves pass to the lateral reticular formation in the medulla,[3] and in addition the carotid body has a sympathetic supply tonically controlling both its blood flow[4] and oxygen consumption.[5] The glomus cells also have an efferent innervation of intracranial origin,[6] which can modulate the afferent discharge to a constant hypoxic stimulus[7 8] and thus provide for feedback control at chemoreceptor level. The afferent discharge increases hyperbolically as the arterial oxygen tension (Po_2) drops below 100 mm. Hg,[9] but the chemoreceptor also responds to independent increases in both Pco_2 and hydrogen ion activity[9]. The discharge from the chemoreceptor fluctuates with respiration in vivo,[10] probably as a result of oscillations of arterial Po_2[11] and Pco_2 and pH[12] throughout the breathing cycle. These phase relationships may be important: afferent stimulation during inspiration has been shown to potentiate breathing but to have little effect if applied during expiration.[13] This finding could explain the potentiation of the hypoxic ventilatory drive by a large external dead space in one study,[14] though the mean levels of arterial Po_2 and Pco_2 found were comparable with studies without the dead space. The phase relationships between breathing and carotid arterial blood gas tensions depend on both cardiac output and the mixing volume of the left heart.[15] Changes in these relationships are therefore to be expected in exercise or in cardiopulmonary disease.

Birth at high altitude blunts the ventilatory drive from acute hypoxia in man,[16] and this is not corrected by subsequent years spent at sea level.[17] Conversely prolonged residence at high altitude leaves the acute hypoxic drive intact in subjects born at sea level,[18] which suggests the drive is irreversibly determined early in life. This view was supported by the failure of surgical correction of the central cyanosis of congenital heart disease to restore the acute hypoxic drive to normal,[19] but this observation has recently been challenged.[20] The site of any damage from congenital hypoxia to the mechanism serving the acute hypoxic drive in man has not been determined. This drive remains normal in the llama,[21] goat,[22] or cat[23] born at high altitude; indeed no animal has yet been found which could be used to study this variation in the hypoxic drive. Surgical damage to the human chemoreceptors causes acute hypoxia to depress ventilation,[24] and the same effect ensues when the sympathetic nervous system is impaired by drugs or disease,[25] as severe falls in cerebral blood flow then aggravate brain hypoxia.

In contrast to these effects of acute lack of oxygen, long-standing hypoxia induces a gradual increase in ventilation and fall in arterial Pco_2 over several days.[26] This slow ventilatory acclimatization can develop despite the absence of peripheral chemoreceptors,[27] for it appears to depend on anaerobic brain metabolism in chronic hypoxia, with a reduction in