in the year to last March, whereas the region's increase was only 12%.

For the last nine years two costing systems have been in force within the hospital service. The returns discussed here are compiled by more than 600 of the bigger hospitals and are based on the more elaborate of the two systems. However, last year the Birmingham Region used a new system, which has been adopted by all hospitals from April 1966. In brief, under the new system each department is costed in the same way as the bigger hospitals have done hitherto, but expenditure will not be reallocated between the departments. Thus, a laundry will be costed for, say, every hundred items laundered, which will show, by comparison with other hospitals, the efficiency of a particular laundry. But it will not apparently be possible, to judge from the Birmingham figures summarized in these returns, to say whether the hospital is using its laundry efficiently—that is, whether the laundry costs are high in relation to the number of patients, which will depend, for instance, on whether their sheets are changed every day, twice a day, or once a week. Presumably, however, the new returns will continue to show details for the direct costs of the wards, of which salaries and wages, particularly nursing salaries, form by far the most important part.

Porphyria and the Genes

Acute intermittent porphyria is a dramatic disease both clinically and biochemically. Its diverse symptoms, including acute pain difficult to relieve and often paralysis, are probably all neurogenic in origin; its prominent chemical manifestation is a relatively vast outpouring of porphobilinogen, the pyrrolic precursor of the porphyrins, and of other intermediate compounds in the biosynthetic pathway for haem.

Various hypotheses have been put forward to explain both the fundamental biochemical disturbance in this disease and its clinical manifestations.[1] Acute porphyria was at one time thought to be a "toxic" process, and suspicion fell upon either the porphyrins or their precursors in spite of the fact that persons with the latent disease can excrete abnormal amounts of porphobilinogen and porphyrins while remaining in apparent good health. Exoneration of these substances came finally from work with carefully purified materials by A. Goldberg, W. D. M. Paton, and J. W. Thompson.[2]

Study of the porphyric state has been helped very greatly by the discovery of a variety of substances which when administered to animals cause disturbances in porphyrin metabolism not unlike those of acute intermittent porphyria. Even so, identification of the fundamental biochemical lesion which results in increased porphyrin production in animals eluded research workers until S. Granick and G. Urata[3] found that after feeding the porphyrinogenic drug dicarbethoxydihydrocollidine to guinea-pigs the level of the enzyme δ-aminolaevulic acid synthetase (A.L.A. synthetase) in their livers became raised as much as 40 times above the normal. This enzyme is the initial and rate-limiting one in the biosynthetic pathway[3 4] for porphyrin and haem; levels of subsequent enzymes in the chain were not much altered. A similar increase of A.L.A. synthetase could be observed by introducing another drug, allylisopropylacetamide, to tissue cultures of chick-embryo liver cells[5] or chick blastoderm.[4] The increase in A.L.A.-synthetase activity was shown to be due to induction of new enzyme by the demonstration that the increase was inhibited by actinomycin D[5 6] and puromycin,[7] which are known to block protein synthesis by interfering with ribonucleic acid formation. It is possible that synthesis of deoxyribonucleic acid is also affected, for K. Narisawa and G. Kikuchi[8] have reported that the induction of A.L.A.-synthetase is blocked by mitomycin C, a specific inhibitor of synthesis of deoxyribonucleic acid.

In 1965 D. P. Tschudy and his colleagues[9] reported that liver tissue from a patient who died from typical acute intermittent porphyria had a level of A.L.A.-synthetase which was raised 7 to 14 times above the normal. A detailed report of the necropsy on this patient has now been published.[10] The liver was assayed for enzyme activity within half an hour of death. Tschudy and his colleagues concluded that the specific rise in A.L.A.-synthetase activity was genetically mediated, and this is supported by their observations[11–13] that in other patients with porphyria, as in animals with the experimentally produced condition, the overproduction of porphyrins and precursors can be blocked by large doses of carbohydrate or protein (the glucose effect).[14] These substances are known to be capable of blocking enzyme induction.

Acute intermittent porphyria is inherited as a Mendelian dominant character.[1] According to present concepts, a failure of genetic regulation of protein enzyme synthesis could result from alteration in one of two locations, either in the regulator gene or in the operator. A mutation of the first kind should be characterized as a Mendelian recessive. On the other hand, the alternative explanation of a mutation of an operator site so that repressor substance could no longer inhibit replication of the enzyme is compatible with dominant inheritance.[5 10 15]

The most recent publication by Tschudy and his co-workers strongly suggests that the biochemical derangement of acute intermittent porphyria is of this type. Granick[6] has suggested that there may be at least three operons (separate sets of genetic apparatus for enzyme synthesis) for A.L.A.-synthetase, each operon having its own operator, repressor, and structural gene. The first operon would be active in liver parenchymal cells, the second in erythroid cells, and the third in other cells. This could explain the hepatic or erythropoietic manifestations of porphyria and conditions such as griseofulvin intoxication,[16] or some cases of erythropoietic proto-

1 Goldberg, A., and Rimington, C., *Diseases of Porphyrin Metabolism*, 1962. Thomas, Springfield, Ill.
2 —— Paton, W. D. M., and Thompson, J. W., *Brit. J. Pharmacol.*, 1954, **9**, 91.
3 Granick, S., and Urata, G., *J. biol. Chem.*, 1963, **238**, 821.
4 Levere, R. D., and Granick, S., *Proc. nat. Acad. Sci. (Wash.)*, 1965, **54**, 134.
5 Granick, S., *J. biol. Chem.*, 1963, **238**, 2247.
6 —— ibid., 1966, **241**, 1359.
7 Marver, H. S., Tschudy, D. P., Perlroth, M. G., and Collins, A., *Clin. Res.*, 1965, **13**, 278.
8 Narisawa, K., and Kikuchi, G., *Biochim. biophys. Acta (Amst.)*, 1965, **99**, 580.
9 Tschudy, D. P., Perlroth, M. G., Marver, H. S., Collins, A., Hunter, G. W., and Rechcigl, M., *Proc. nat. Acad. Sci. (Wash.)*, 1965, **53**, 841.
10 Perlroth, M. G., Tschudy, D. P., Marver, H. S., Berard, C. W., Zeigel, R. F., Rechcigl, M., and Collins, A., *Amer. J. Med.*, 1966, **41**, 149.
11 Rose, J. A., Hellman, E. S., and Tschudy, D. P., *Metabolism*, 1961, **10**, 514.
12 Welland, F. H., Hellman, E. S., Gaddis, E. M., Collins, A., Hunter, G. W., and Tschudy, D. P., ibid., 1964, **13**, 232.
13 Tschudy, D. P., Welland, F. H., Collins, A., and Hunter, G. W., ibid., 1964, **13**, 396.
14 Neidhardt, F. C., and Magasanik, B., *Nature (Lond.)*, 1956, **178**, 801.
15 Watson, C. J., Runge, W., Taddeini, L., Bossenmaier, I., and Cardinal, R., *Proc. nat. Acad. Sci. (Wash.)*, 1964, **52**, 478.
16 De Matteis, F., and Rimington, C., *Brit. J. Derm.*, 1963, **75**, 91.
17 Gray, C. H., Kulczycka, A., Nicholson, D. C., Magnus, I. A., and Rimington, C., *Clin. Sci.*, 1964, **26**, 7.

porphyria,[17] in which more than one cell system appears to be implicated.

The pathogenesis of the lesions of the nervous system in acute intermittent porphyria is not yet fully understood. Porphobilinogen, δ-aminolaevulic acid, and the porphyrins do not seem to exert any such direct pharmacological action. The necropsy study by Tschudy's group[10] also revealed a histological lesion in the hypothalamus apparently associated with inappropriate secretion of antidiuretic hormone, a disturbance which occurs in some but not all cases of acute intermittent porphyria.

Much remains obscure, but the establishment of a genetically determined error leading to faulty repression of a key enzyme in the porphyrin biosynthetic pathway affords a landmark in the understanding of this baffling but remarkable disease.

Superannuation

It is a source of curious pride to the British that their income-tax laws are the most complicated in the world. Doctors should perhaps take a similar view of the intricacies of the arrangements that exist for their payment in the N.H.S.; certainly their superannuation regulations are in the same tradition of bewildering complexity. New amending regulations come into force next week, and at page 222 of the *Supplement* is printed an account of the main changes and their significance. The amendments are the result of long negotiations between the B.M.A. and the Ministry of Health, and the changes agreed are of real benefit to doctors and their families.

General practitioners' pensions are based on their total superannuable earnings in the N.H.S. The annual pension is calculated as a percentage of this total. The new scheme introduces a rising scale of percentages, ranging from 1½% in the first 10 years to 2½% after 40 years' service. This change has two advantages ; it goes some way towards coping with inflation, and it takes into account that practitioners often reduce their incomes in the later years before they retire. Examples of the working of the scale are given in the *Supplement*.

Under the old regulations some part-time consultants had pensions calculated in the same way as general practitioners. The earnings of consultants do not usually show a tendency to level off or decline as retirement approaches ; so the rising formula will not be applied. All part-time consultants will be treated in a comparable way to full-time hospital staff, and their pensions will be calculated on the basis of their average net earnings over the last three years and their years of service. The number of sessions worked per week will be used to calculate an equivalent period of whole-time service, and the appropriate whole-time remuneration calculated for the last three years. This allows a consultant to give up some sessions in the period before retirement without greatly reducing his pension. All fees for domiciliary visits are now to be pensionable.

Changes have also been made in family benefits. When a doctor dies before retirement his widow will be offered the choice of a half-rate pension with no gratuity or a pension of one-third the full rate plus the death gratuity. On retirement the option will be exercised by the husband. The choice may be difficult, and some advice from an expert is given in the *Supplement* as a guide. Allowances have been introduced for children of doctors who die when the children are under 16 or are still being educated These range up to a half-rate pension where three or more children are orphaned.

There are many other changes in the new regulations, but nothing in them will affect doctors who are already retired, though the B.M.A. has for years pressed for some means of linking pensions to changing values of money. Necessarily complex, the changes are nevertheless to be welcomed as showing real improvements. Doctors would be wise to seek expert advice if they have any doubts.

Anxiety and the Pulse

The classical physical signs of an anxiety state include tachycardia and excessive sweating. A recent paper by E. D. Frohlich, H. P. Dustan, and I. H. Page[1] draws attention to the possibility that in some cases the anxiety may be the result of these physical abnormalities and not the cause. The two patients described by Frohlich and his colleagues were found to have sinus tachycardia, palpitations, and anxiety, and the authors suggest that the cause was an abnormal sensitivity of the beta-receptor mechanism to circulating adrenergic substances.

Studies of the pharmacology of adrenaline in man have shown that it has a wide range of actions, and it is not possible to block all of these with any one antagonist. In 1948 R. P. Ahlquist[2] introduced the concept of alpha- and beta-receptors to explain this finding. Alpha-receptors are concerned with smooth-muscle excitation. Among the effects of stimulation of beta-receptors are an increase in the heart rate, an increase in the force of the heart beat, vasodilatation in some vascular beds, and relaxation of smooth muscle in the bronchi. All beta-receptor activity can be blocked by propranolol.

Frohlich and his co-workers showed that their patients responded to stimulation with isoprenaline or to tilting or to anxiety by an increase in their symptoms, but that this response could be overcome by adrenergic blockade. On the other hand, the patients responded normally to atropine and to pressure on the carotid sinus, thus suggesting that the tachycardia was not due to a reduction in parasympathetic tone. All the symptoms, including the anxiety, were abolished by treatment with propranolol.

Sinus tachycardia occurs as a comparatively minor feature of many diseases : in heart failure and febrile conditions, in shock and anaemia, with arteriovenous shunts, and in anoxic pulmonary disease. In thyrotoxicosis, in some anxiety states, and with a phaeochromocytoma it may be a major manifestation. In thyrotoxicosis, as in Frohlich's patients, the tachycardia is produced by an increased sensitivity of the adrenergic receptor system, which is independent of the elevated basal metabolic rate. This was the basis of the Goetsch test, now abandoned because of its lack of specificity, in which an exaggerated response to infusion of noradrenaline was elicited in patients with clinical hyperthyroidism. In anxiety states it is possible that a similar mechanism operates, and propranolol will control the tachycardia in both these situations.

[1] Frohlich, E. D., Dustan, H. P., and Page, I. H., *Arch. intern. Med.*, 1966, **117**, 614.
[2] Ahlquist, R. P., *Amer. J. Physiol.*, 1948, **153**, 586.
[3] Brill, I. C., Welch, J. D., Condon, R. J., and Jones, F. C., *Arch. intern. Med.*, 1965, **115**, 674.
[4] Gorlin, R., *J. Amer. med. Ass.*, 1962, **182**, 823.