namely, by improvement of the ophthalmic services of the country, by education of the public on ophthalmic matters, and by further research into aetiology and therapeutics.

Improvement of the Ophthalmic Services of the Country

From certain of Marshall and Seiler's figures it would appear that some relation exists between the number of blind, especially in the higher age groups, and the hospital facilities of the district. This is to be expected, and could only be countered by making modern ophthalmic hospital treatment equally available for everyone. This would entail geographical planning and co-ordination on a regional basis, together with the provision of a larger number of ophthalmic surgeons than are at present available. Some more standardized system of training for ophthalmologists at recognized centres and a reconsideration of the requisite examination standards would be advisable, as, at present, postgraduate teaching is somewhat haphazard and there is no uniformity of qualifications demanded by hospitals in various parts of the country. Thus the problem is linked with those of regional planning and of medical education. In addition, the vast questions of ophthalmic benefit and the relations between approved societies, ophthalmic surgeons, hospitals, and opticians would also appear to be involved. There is need, too, for a closer supervision and better facilities for diagnosis and treatment of children under school age and of adolescents leaving school but not yet eligible for ophthalmic benefit. At present no provision is made for these groups, and much preventive work might be done on them.

Education of the Public

This is a basic factor in maintaining the national health. One has only to consider the chaos which exists in the public mind on such subjects as the difference between a refractive error and a disease (and, through this, between an optician and an oculist), the value and nature of orthoptic exercises, and the relation between the condition of the eye and the general health, to realize that much could be done by clearing up misconceptions alone. It is well known that many people with glaucoma postpone medical treatment beyond the limit of safety by buying stronger glasses as a makeshift, and that practically all amblyopic eyes in children are due to the belief of parents that the child will outgrow the squint and that young children should not wear glasses. So little is known of the anatomy and physiology of the eye that it is usually difficult to explain to patients such simple problems as the nature of myopia and of cataract. This ignorance paves the way for the development of ocular neuroses and the accompanying vogue for magical or much-advertised systems of treatment. That these are successful in many cases points to the need for a higher standard of diagnosis among ophthalmologists and a higher level of educated co-operation from the patients. Education is needed at three levels. Some biological and physiological instruction in schools should be obligatory; it should include an understanding of the mechanism of sight and the nature of binocular vision and of errors of refraction. In adult life authoritative information should be available on such subjects as the care of the eyes (such as the futility of constant eye baths) and the nature of presbyopia. Most especially, however, instruction is needed on protection of the eyes in industry, since most minor injuries are due to the prevalent attitude towards safety-first measures and to ignorance of the possible effects of such injuries.

Research

The trend of medical research at the present time is towards greater collaboration between experts in different branches of science. Since medicine is largely an art there must be, for progress, close contact with the basic sciences underlying it. Advances in ophthalmology of recent years owe practically everything to basic discoveries in the realms of physics and chemistry—pharmacology and physiology also co-operating. We have only to mention the practical application of the diathermic current and of the cathode ray, the improvement in optical glass and plastics, the synthesis of the sulphonamides, the discovery of the nature of vitamins and their biochemical action, and the researches of psychologists into

the visual function to show how closely interlocked with advances in ophthalmology are discoveries in other fields. Too often, however, the ophthalmologist, overburdened with the mass of clinical work confronting him, lacks the requisite contact with the experimental sciences. The establishment of research teams in association with laboratories where physicists, physiologists, biochemists, and pathologists, among others, could unite with ophthalmologists for the solving of given problems would seem to be desirable. For example, to return to Marshall and Seiler's report and the seven most common causes of blindness, we can foresee that the problems of cataract and glaucoma will require the help of biochemistry for their solution and that uveitis must invoke experimentation in pathology, bacteriology, and immunology. Venereal disease is already yielding to chemotherapy, and myopia and the abiotrophies probably require genetical research for their unravelment. The question of injury includes experiments in the design of protective goggles and work on the best psychological approach to ensure their use.

If these desiderata be kept in mind it is possible that when the next survey of the statistical position can be undertaken a distinct improvement may be manifest.

RISE IN POTASSIUM CONCENTRATION IN THE BLOOD STREAM FOLLOWING ISCHAEMIA OF MUSCLE MASSES

BY

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It is well known that the concentration of potassium is much greater in cells than in tissue fluids. Thus Eichelberger (1941) found 25 times as much by weight in dog's muscle (corrected for blood and fat content) as in the serum. This great difference in potassium concentration on the two sides of the cell membrane is maintained only so long as this structure remains undamaged. Prolonged asphyxia is one method of causing such damage. Baetjer (1935) found, by measuring its concentration in the perfusate, that loss of potassium from cat's muscle increased as the rate of blood-flow was reduced, but that the actual excitability of the muscle remained unaltered. Fenn *et al.* (1939) found that there was a limit to the potassium reduction in cat's muscle that could be brought about by perfusion. Later, Fenn, Koenemann, and Sheridan (1940) observed that no increased loss of potassium or production of lactic acid followed periods of asphyxia in perfused frog's legs.

Method of Investigation

The present investigation was undertaken to determine whether or not any appreciable loss of potassium followed periods of asphyxia in the larger muscle masses of human beings. The subjects were patients to whose limbs tourniquets had been applied for periods ranging from 35 to 100 minutes in the course of orthopaedic operations. They were all muscular young adults, mostly men. Blood samples were taken from the antecubital vein just before and at seven minutes after the removal of the tourniquet. From the first few patients additional samples were taken—one at the start of the operation and another one hour after its conclusion; but since the former revealed only the usual slight fall in the concentration of potassium that occurs during the administration of an anaesthetic, and the latter a subsequent return to normal, they were soon discontinued. The clot and serum were separated as soon as possible, and any specimen with a trace of haemolysis was discarded. The potassium was estimated by the cobaltinitrite method of Tisdall and Kramer (1921), using duplicate samples and putting through a standard with each batch. In the later cases inorganic phosphate was determined

as well, applying the phosphomolybdate method of Denigès (1921) to the usual trichloroacetic acid filtrate. The results are shown in the accompanying table. The significance of the differences observed was calculated by the method of Fisher (1938), and a value for *P* of less than 0.01 was found. The rise in the serum potassium is thus statistically significant. Although marked and consistent, the observations upon the serum phosphate are too few for statistical methods to be applied.

Table of Results

Case No.	Duration of Ischaemia (Mins.)	Position of Tourniquet	Serum Potassium			Serum Phosphate		
			Before Removal	7 Mins. Later	Rise	Before Removal	7 Mins. Later	Rise
1	90	Top of thigh	19.5	22.6	3.1	—	—	—
2	50	Below knee	22.2	23.6	1.4	—	—	—
3	80	Half up thigh	21.2	27.6	6.4	—	—	—
4	50	Top of thigh	18.6	21.2	2.6	4.5	5.2	0.7
5	70	Above knee	20.3	20.2	-0.1	—	—	—
6	70	Above knee	18.6	19.2	0.6	—	—	—
7	70	Right arm	16.7	16.5	-0.2	—	—	—
8	45	Below knee	17.4	18.7	1.3	—	—	—
9	100	Above knee	17.1	19.2	2.1	5.4	7.4	2.0
10	90	Half up thigh	19.5	20.0	0.5	3.3	4.0	0.7
11	35	Top of thigh	16.9	18.5	1.6	3.2	3.8	0.6
12	60	Top of thigh	19.7	21.4	1.7	4.3	4.8	0.5

The values for the serum potassium and phosphate are in mg. per 100 c.cm.

Discussion

Houssay *et al.* (1937) found that in chloralosed dogs general asphyxia for from two to four minutes led to an increase in the serum potassium, but that this did not occur after removal of the liver or suprarenal cortex or section of the splanchnic nerves. It is to be assumed, therefore, that the potassium was released from the liver by parasympathetic stimulation. Thus in the present series there are two possible sources of the extra potassium found in the serum. It might have come either from the asphyxiated cells, presumably those of the muscles, or from the liver by the action of a hypothetical substance present in the ischaemic limb and suddenly released into the circulation—such a substance as Blalock (1930) postulated in his experiments on the production of shock. It should be noticed that in only three cases—Nos. 5, 7, and 9—was severe trauma applied to the limb during its period of ischaemia, and that these showed no exceptional rise in serum potassium. The other operations were for the removal of semilunar cartilages, or manipulations of similar severity.

The only feature in common between this series and cases of the "crush syndrome" is the period of ischaemia undergone by the muscles. Recent observations on that condition—e.g., those by Beall, Bywaters, Belsey, and Miles (1941) and by Bywaters and Beall (1941)—have shown that a steady and prolonged rise in the serum potassium occurs. This is possibly due to the concomitant renal failure, and would certainly mask the small and transient change noted here, as also would any marked release of potassium by direct trauma to the muscle cells.

No attempt has been made to find any correlation between the duration of the asphyxia, the weight of muscle involved, and the amount of potassium released. This might shed light on the origin of the potassium, but it cannot be attempted without a larger series than the present. In this connexion it should be noted that if it could be assumed that equilibrium between the blood and the intracellular fluids of the tissues had been reached, every rise of 1 mg. % in the serum potassium would mean that 0.19 g. of the ion had been released into the circulation. The weight of the muscles of the calf and foot is about 1,300 g. (Roessle and Roulet, 1932), while the potassium content is about 0.3% (Gamble *et al.*, 1923; *Tabulae Biologicae*, 1926), so that in Case 9 of the present series the ischaemic muscle would have to give up about 10% of its potassium to account for the whole of the rise observed in the serum.

Summary

A series of observations is reported in which the serum potassium showed a significant rise after the removal of a tourniquet applied to a limb during the course of orthopaedic operations.

The extra potassium in the circulation might have come from the cells in the ischaemic area or from the liver by the action of a hypothetical substance released in the limb.

I have to thank Mr. E. S. Jamieson for the opportunity of making these observations on his cases.

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Medical Memoranda

Manual Dilatation of the Pelvis: Four Further Cases

In 1936 I reported (*British Medical Journal*, **2**, 282) a case in which the pelvic girdle was dilated to avoid the death of a patient in parturition. On that occasion the measure was adopted as one of desperation. The result was gratifying. Since then we have made considerable use of the method as one of election, and experience has been progressively encouraging. I am now able to single out four definite cases in which we feel justified in ascribing to its use the getting of a live undamaged child from an undamaged mother. (We acknowledge its valuable help on other occasions.)

Three cases do not need a separate description. All three (a) were primiparae; (b) had a minor degree of pelvic contraction which ante-natally justified an expectation of successful delivery (perhaps assisted), given normal opportunity for natural dilatation of the passages and moulding of the head; (c) were complicated by early rupture of the membranes; (d) required intervention on account of signs of foetal distress; and (e) required this intervention at a stage when, although labour was already more or less protracted, the size-relation of the head and passages was unfavourable.

The fourth case was that of a 1-para with marked general contraction, and properly a hospital case; she was a new-comer to the district, and an unexpected call. The membranes ruptured at the onset of labour. A good degree of moulding was allowed. When delivery was undertaken it was necessary to make full use of manipulation.

PURPOSE AND INDICATIONS

The purpose is to minimize damage to the mother, and damage, especially cerebral damage, to the child. It is not meant to replace any current practice, except forceful dragging of a child through unnecessarily narrow passages. It is indicated in proportion to the expectation of difficulty. It would appear to be indicated whenever forceps are used to overcome resistance by the bony passages to the transit of the head, and to be as rational on behalf of the child as completing the dilatation of the soft passages is on behalf of the mother.

In at least some cases of disproportion (particularly with early rupture of the membranes), when the head gets an unfavourable entry at the brim, the disproportion tends up to a certain stage to become worse. Although confident that this can occur, I feel that an attempt to analyse the mechanics of the process might bring me into one-sided conflict with the anatomist. The labour may survive this phase successfully; but if for any reason delivery has to be undertaken before the head has become adjusted to the passage, corrective measures should be addressed to the bony as to the soft passages. In the first degree this correction is, in the jargon of the moment, a "de-worsening," but some further stretching of ligaments and easing of joints are almost always attainable with comparative ease and with safety.

TECHNIQUE

The technique is essentially elastic. Leverage must be from bone to bone, and may be done with the finger-tips on one and the knuckles or the back of the hand against another, or with the knuckles on one and the back of the hand against the other. Much depends on the size of the operator's hand and other local conditions. One must ensure that bone is underneath the finger-tips, as there is usually some degree of oedema of the soft tissues, and these are easily damaged. Leverage