ventricles and auricles, owing to their stimulating the inhibitory centres in the medulla oblongata. They have no direct action on the heart except in very large quantities, when they produce an independent ventricular or auricular rhythm and consequent irregularities, which sometimes resemble those following poisonous doses of digitalis. Aconitine is more apt to cause these than veratrine, which, on the other hand, we found to stimulate the inhibitory centre more strongly.

3. CAFFEINE.

Intravenous injections of small quantities of caffeine (0.03 to 0.05 g.) had often little effect on the dog's heart, although distinct acceleration occurred in some experiments after 0.05 g. Larger doses were followed by marked acceleration, for example, from 90 to 117 beats per minute after 0.2 g. This acceleration was not accompanied by any distinct alteration in the strength of contraction or in the extent of relaxation, and only lasted from 10 to 20 minutes. In very large quantities caffeine sometimes elicits an independent ventricular rhythm, which again leads to the rhythmical variations mentioned under digitalis.

4. STRYCHNINE,

even in large quantities, has no direct action on the heart, but often causes some slowing from inhibitory stimulation, which, however, is not nearly so marked as that observed after aconitine and veratrine. The blood pressure is increased by doses which are too small to increase the reflex irritability to any very marked extent.

5. NITROGLYCERINE

does not increase in any way the contraction or efficiency of the heart. In fact it has no effect on that organ save in large doses, which weaken the systole, especially that of the auricle. This effect seems to be due to a direct action on the heart muscle, perhaps aided by the changes in the blood.

6. ALCOHOL

injected intravenously does not in any way increase the efficiency of the heart. The smallest quantity from which any result was observed was equivalent to $\frac{1}{2}$ c.cm. of absolute alcohol, and produced a transient weakness of the auricular systoles. Very much larger quantities (equivalent to $7\frac{1}{2}$ c.cm. absolute alcohol) were required to produce any permanent injury, and even these did not materially affect the rhythm, but only the strength of the contractions. Even 20 c.cm. of 50 per cent. alcohol injected into the vein of a small dog only produced a slight and transient weakness of the ventricle, which recovered itself entirely within three minutes. The strength of the auricular contraction was at first profoundly affected by this quantity, but this rapidly passed off, although no such complete recovery followed as in the ventricle.

Of all the drugs examined, then, the digitalis series and caffeine alone were found to increase the efficiency of the heart, and would be entitled to rank as cardiac stimulants. Caffeine differs from digitalis, however, in its increasing the number and not the strength of the contractions, and would therefore seem to stimulate the rhythm-giving mechanism rather than the auricle and ventricle proper. Digitalis, on the other hand, acts primarily on the strength of the contractions, and only produces noticeable acceleration when administered in poisonous doses. It would therefore seem to act chiefly on those parts of the heart which are endowed more largely with contractile power than with automatic. Caffeine can in no sense be considered a substitute for digitalis, but may have a special sphere of usefulness in cases in which acceleration alone is desired. To induce any increase in the rhythm considerable quantities of the drug would seem to be necessary from our experiments. The essential feature of the digitalis action in therapeutics does not seem to be the inhibitory stimulation and the slowing of the heart, for if this were the case veratrine and aconitine would give equally good results. Its beneficial effects are rather due to the changes which it produces in the heart muscle, and it is to be desired that some drug possessed of this property and devoid of its action on the inhibitory centre were available. The different members of the series vary somewhat in this respect, digitoxin and erythrophloin acting more strongly on the vagus centre and relatively less on the heart muscle than strophanthin.

From our experiments with the digitalis series, the further deduction may be made that the therapeutic effects of these drugs cannot be estimated by the slowness of the pulse. The muscular action may be induced without any marked alteration of the rate of the heart, if from any cause the inhibitory apparatus is weakened, or if one of the series which has but little action on that apparatus has been administered. Much less weight should therefore be laid on the rate of the pulse than on its other characters and on the general symptoms in digitalis treatment. In cases where slowing of the pulse is desired without further alteration, aconite and veratrine would seem to be indicated rather than digitalis. Strychnine and nitroglycerine owe their use in disorders of the circulation not to any changes produced by them directly in the heart, but to their vascular effects. Strychnine increases the resistance to the contraction of the heart by narrowing the calibre of the arterioles through the vasoconstrictor centre; while nitroglycerine dilates the vessels through acting on their coats, and therefore lessens the resistance against which the heart has to work. Both of these may therefore be of value in certain conditions of the circulation; and nitroglycerine would seem to be indicated where the contraction of the vessels induced by digitalis has to be avoided.⁴

Any beneficial effects produced in the heart by alcohol or ether must be attributed to their local irritating properties which may increase the activity of the medullary centres reflexly, or to their general action on the central nervous system and the tissues.

REFERENCES.

¹ *Journ. of Phys.*, xxi, No. 3. ² For details see *Journ. of Exp. Med.*, ii, pp. 233-299. ³ See Matthews, *Journ. of Exp. Med.*, ii, p. 594. ⁴ Cf. Marshall, *Journ. of Phys.*, xii, No. 1.

ACETYLENE, THE NEW ILLUMINANT, AND THE DANGERS ARISING FROM ITS INHALATION.

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IN the BRITISH MEDICAL JOURNAL of March 12th, p. 713, attention was drawn to this new illuminant. As the subject is at present attracting public attention owing to the ease with which the gas can be generated and the likelihood of its being used pretty widely throughout the country, it may be well to point out to your readers certain facts connected with the medical side of the question. In the article referred to allusion is made to the greater explosibility of acetylene compared to ordinary coal gas. A mixture of air and acetylene commences to be explosive when it contains 5 per cent. of acetylene, whereas it requires the presence of 8 per cent. of coal gas to make a similar mixture explosible. This, therefore, is one of the dangers attending the use of the new illuminant, and its excessively pungent and disagreeable odour, though a warning to the individual of its presence, is one of its disadvantages. Experimenting with calcium carbide from which the gas is obtained on the addition of water, my colleague, Dr. R. A. Bolam, and myself had ample evidence in the Physiological Laboratory of the unpleasant and penetrating odour of acetylene, the rapidity with which the gas is evolved immediately, and of the great heat which is generated. This latter circumstance would point to the absolute necessity of having acetylene, if being made for private mansions, generated in the open air or in a covered shed open at the sides.

Our experiments were directed rather towards an investigation of the poisonous properties of the illuminant when inhaled compared with coal gas. In the case of coal and water gas, death supervenes by asphyxia owing to the carbon monoxide, so largely present in these gases, entering into extremely stable combinations with the hæmoglobin of the blood, from which it is with difficulty dissociated. It is the absence of odour in water gas that renders it so dangerous; its influence is so subtle because of its presence being unperceived. Under ordinary circumstances a short period is sufficient to asphyxiate an animal by coal gas. With the assistance of Dr. Bolam I have tested the effects of acetylene. If a rabbit, for example, is placed in a bell jar into which ordinary air and acetylene are pumped, the animal seems for a very

long period to experience very little inconvenience. It is not until ordinary atmospheric air is excluded and only acetylene admitted that symptoms gradually and slowly develop. This circumstance shows that so long as there is any oxygen in the aerial medium by which the animal is surrounded, it is the oxygen which is absorbed into the blood and very little acetylene. After a more lengthened exposure to acetylene than that which is necessary for coal gas the animal becomes intoxicated, it falls over on its side apparently profoundly asleep, and while all through the experiment its breathing has been somewhat short and rapid, stupor steals over the animal apparently painlessly, for there is not exhibited anything of the excitement, nervous or respiratory, which is seen in the narcosis produced by such poisonous vapours as bisulphide of carbon or benzole, or even in ordinary asphyxia. Where somnolence has been induced and asphyxia not pushed too far the rabbit, when removed from the bell jar and placed in ordinary atmospheric air, begins to move about in a few seconds in as lively a manner as if it had not been interfered with, there being neither weakness nor paralysis of its limbs. In a word, a few inhalations of atmospheric air are sufficient to restore to the animal all its faculties.

Should the inhalation have been pushed further and the animal have been very deeply asphyxiated, death may ensue, the cyanosis hitherto observed being rapidly replaced by extreme pallor. In the minor and easily recoverable stages of asphyxia the vascular tension is still maintained, and there is no difficulty in obtaining a drop of blood for examination; but when the deeper stages are reached so extremely contracted are all the vessels that it is almost impossible to obtain even a trace of blood. When this stage has been reached recovery is difficult. It is interesting at this point to mention that when we examined the blood of a rabbit at different stages of intoxication from acetylene, and especially in the deepest asphyxia, this fluid on spectroscopic examination always exhibited two well-marked bands of oxyhæmoglobin; also that unlike the blood in coal-gas poisoning, although resembling it in the cherry-red colour which it presented, it was readily reduced on the application of ammonium sulphide and gentle heat. To that extent, therefore, if the asphyxia caused by acetylene is not too profound—and under ordinary domestic circumstances it would not be a pure acetylene atmosphere that would be inhaled by an individual, but one mixed with a large proportion of ordinary air—the danger to life seems to be less than it would be in coal-gas poisoning, and the prospect of recovery by removal to atmospheric air greater. Death may supervene, however, if the inhalation has been lengthened and atmospheric air excluded.

A rabbit which was profoundly asphyxiated by acetylene, whose lips were extremely pale, its arteries, comparatively speaking, empty, pupils widely dilated, breathing short and irregular, and muscles completely paretic, died after removal from the bell jar, death being preceded as in anæmia of the brain by opisthotonos and convulsions first of the fore limbs, then of the hind, and subsequently the tremors became general. At the necropsy the heart felt hard to the touch, and was firmly contracted, both auricles and ventricles were filled with dark clot; the lungs were pale; the liver not unduly filled with blood; the kidneys showed a dark venous coloration at the junction of cortex and medulla, while the vessels on the surface of the brain were pale and empty, and on section the brain tissue was extremely pale. The bladder was distended; the urine was quite free from albumen and sugar. The general pallor throughout was striking.

The rabbit died long after its removal from the acetylene atmosphere, after it had been breathing for twenty minutes ordinary air superficially and irregularly. The condition of the heart found at the necropsy is scarcely that observed in asphyxia; some other factor, therefore, contributed to the death of the animal, a point to which I may allude in a subsequent communication.

A CASE OF CONGENITAL HYPERTROPHY OF THE PYLORUS.

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THE rarity of congenital hypertrophy of the pylorus serves as a sufficient excuse for placing the following case on record:

A male child, between 7 and 8 weeks old was recently brought for treat-

ment to the Victoria Hospital for Children in a state of extreme emaciation. The previous history elicited was as follows: At birth the child was apparently healthy; from the first, however, he vomited the breast milk. After a fortnight, owing to the inability of the mother (who had to go out to work) to nurse him any longer, he was fed by hand on condensed milk, and later on cow's milk; the vomiting, which occurred about half an hour after meals, however continued. Accompanying this there was progressive wasting and constipation of the bowels.

When the child first came under observation there was emaciation to an extreme degree, and kerato-malacia, most marked in the left eye. No tumour was felt in the region of the pylorus. Death ensued four days later, the vomiting being rather less during the last week of life. The age of the child at death was 8 weeks. A *post-mortem* examination was made five days after death. The weight of the child was 4 lbs. 13 ozs., the average weight according to Galton's life-history album being 15 lbs. Nothing abnormal was noted in any of the organs excepting the stomach. The pyloric end of the viscus was at once seen to be markedly thickened; it was about three quarters of an inch long, and the lumen was about the capacity of a No. 4 male catheter. The stomach was a little dilated, and its walls were distinctly thickened in the neighbourhood of the pylorus. The duodenum was normal. The intestines generally were collapsed and empty. No dilatation of the œsophagus was noticed.

Microscopically the mucous membrane was thrown into folds and showed some catarrh. The submucosa was much condensed. Both the muscular coats, but more especially the circular, were hypertrophied. There was no small-cell infiltration or fibrosis of the muscular coats, and there seemed to be no change beyond hypertrophy.

REMARKS.

This case is one of the group of cases of congenital hypertrophy of the pylorus, of which at least 17 have been recorded with *post-mortem* examination. Thomson¹ has done much to establish the recognition of this disease, and Finkelstein² has collected 10 cases, including 2 recorded by Herschsprung,³ 4 by Henschel,³ and 3 by Gran;⁴ other cases have been described by Thomson (3), Schwyzer (2)⁵ Pedden,⁶ Pitt,⁷ and De Bruyn Kops,⁸ while Soltan Fenwick⁹ briefly refers to two cases that he has seen. Thomson recognises as belonging to this class cases recorded by Williamson in 1841 and Dawosky in 1842.

Age.—The average age in 17 cases was 5 months, but this was largely due to the inclusion of 2 cases of Henschel's, aged 16 and 24 months; excluding these 2, the average age for the 15 cases was 3 months, the extremes being 7 months and 3 weeks. These cases, therefore, form a distinct group, and are evidently very different from R. Maier's¹⁰ 31 cases of congenital stenosis of the pylorus, 21 of which were collected by himself and 10 by Landerer. The ages in this series varied between 12 and 80 years; the youngest were in girls aged 12 and 16 years respectively, the cases being equally distributed over the subsequent decades. These cases, which are often referred to as cases of congenital origin, are, it would seem, of a different nature from those we are now discussing and are rather allied to chronic pyloric fibrosis.

Sex.—In 15 of the cases in which the sex is recorded, 8 were females and 7 males, so that including our own case the incidence of the disease appears to fall equally on the two sexes.

Influence of Heredity.—Henschel met with 3 cases in the same family, thus showing that, like some other congenital conditions, especially congenital obliteration of the bile ducts, the lesions may repeat itself in the offspring of the same mother. There is no evidence that congenital syphilis plays a part, and though, on the view that it is a disturbance of nerve co-ordination, it might naturally be thought that the parents would be found to be nervously unstable, this is only definitely stated to be so in a small minority of cases. (Thomson,¹¹ Schwyzer.¹²) This, among other points, requires further investigation.

The cause of this muscular hypertrophy has been ably discussed by Thomson, who has proposed the name of "congenital gastric spasm" for this condition. He believes it to be due to nervous inco-ordination, which leads to simultaneous contraction of the stomach and the pyloric sphincter, and so to overwork of both. There is no evidence of any gross cause such as ulceration, and he dismisses the suggestion, which he himself raises, of the pyloric spasm being due to any irritating property of the liquor amnii swallowed in the later months of intrauterine life by the foetus, on the ground that there is no evidence of irritation on the mucosa. However, the mucous membrane is described in some of the recorded cases (Thomson, Pedden, Schwyzer, Finkelstein) as being inflamed, and, though this may quite conceivably be a secondary result of the spasm, it prevents this ingenious suggestion being put entirely aside, though whether the foetus swallows the liquor