I am tempted here to add to the address as published what was not sufficiently emphasized in it when delivered. The importance of the study of clinical obstetrics has been almost ignored till recently in the arrangement of the medical curriculum for the student, and it is little short of a scandal that he has been in the past, and is still sometimes, allowed to go out to practise without having taken a training in practical midwifery beyond an often perfunctory attendance on a few cases.

Since the whole art of obstetrics is concerned with, and dependent on, the exercise of the principles of prophylaxis, I have of necessity omitted many points that I might have discussed, but I hope that I have gathered together such as are sufficient to impress the mind with the need for vigilance, with the fact that much has yet to be accomplished, and with the greatness of the ideal to be reached by the true practitioner of our art.

An Address

ON

THE TREATMENT OF HYPERTENSION BASED UPON THE CONSIDERATION OF THE CAUSE.*

By H. BATTY SHAW, M.D., F.R.C.P.,

PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL, AND LECTURER IN THERAPEUTICS, UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL; ASSISTANT PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION AND DISEASES OF THE CHEST, BROMPTON.

INTRODUCTION.

HYPERTENSION, by which is meant an increase of the blood pressure within the arterial system, is no new topic. It was studied most assiduously by Bright and his followers at Guy's Hospital. Interest in its study has been kept up in this country mainly through the efforts of Sir Clifford Allbutt, Dr. Oliver, and Dr. Leonard Hill. Progress was slow because, before a searching study could be made of the subject clinically, it was necessary to devise some means by which its detection could be accurately effected at the bedside. Despite the fact that many clinicians believed they could accurately gauge its existence by means of the finger, suspicion was aroused when it was found that a constant accompaniment of hypertension, namely, cardiac hypertrophy, was found to exist although hypertension was overlooked. The centre of activity in the development of instruments of precision moved from our country to Italy, and we owe to the genius of Riva Rocci the introduction of his sphygmomanometer, by means of which the detection of hypertension was rendered certain. Modifications of his original instrument have been effected, and it is possible for any practitioner now to estimate the presence and degree of hypertension with an exactitude which approaches that given by the thermometer of the temperature of the body. The picture of Dr. C. J. Martin's model of a sphygmomanometer is familiar to us in the advertisement pages of our medical journals, so that it is reasonable to assume that the usefulness of such observation is being appreciated by our profession. No doubt it is a bulky instrument, but it is equally true that there is no pocket substitute which can be trusted to read the degree of arterial tension with as great a degree of accuracy.

THE MODE OF USE OF THE INSTRUMENT.

Single observations must not be trusted, for to establish the existence of permanent hypertension at least three or four observations should be made, if possible daily; if this is not practicable, then on as many occasions as possible at longer intervals. If night and morning observations can be made, so much the better, and the plotting out of the readings on a chart will give a graphic representation of the condition (see Charts A and C, representing normal pressure and hypertension). The pressure may be taken in any position of the body, but, for the sake of comparison with other observations, it is well to take the reading when the patient is recumbent. The patient should,

if nervous, be assured of the harmlessness of the proceeding, for excitement causes a rise of tension for a moment or two. Most readings are taken by compression of the brachial artery, and the return of the pulse at the wrist provides the moment at which the pressure (systolic) should be read off. If there is dropsy of the arm, observations are valueless; fortunately the very conditions in which the instrument is of most use are just those in which dropsy of the upper extremities is exceptional. The limits of normal pressure have been fairly well established; but, owing to the fact that it has been conclusively shown that stiffness of vessels (arterio-sclerosis), which so often accompanies hypertension, causes an error in the readings, it is accepted by most workers that a pressure of 150 mm. of mercury or more, maintained for at least a fortnight, satisfies the observer that pathological arterial hypertension is present; the figures for children are much lower, but it may be said that more use will be found for the sphygmomanometer in adult life than in children; out of observations on about 400 children admitted to University College Hospital during the last four years, not more than one or two showed pathological hypertension; whereas amongst the adults scarcely a week goes by but a case is admitted which gives a pressure chart indicative of this condition.

THE CLINICAL ASSOCIATIONS OF HYPERTENSION.

Hypertension of a maintained course is met with in the cases of what is known as essential cardiac hypertrophy—that is, hypertrophy which exists independently of valvular lesions—and may be found to be associated clinically with no other pathological sign but tortuosity of the accessible arteries such as the brachial, hence the diagnosis of hypertension dependent upon arterio-sclerosis. In other cases, with or without clinical signs of cardiac hypertrophy and tortuous arteries, there may be albuminuria, and casts may be found in the urine. There is little hesitation then in diagnosing "renal" hypertension, and it is generally admitted that the form of renal disease most commonly associated with the hypertension is sclerosis of the kidney, either the granular or regularly contracted kidney, or the irregularly contracted or scarred kidney, which by some is known as the arterio-sclerotic or infarcted or scarred kidney. It is a familiar experience that the only clinical accompaniment may be retinitis, and it has been the practice to affix the term "albumin-urica" if albuminuria exist; if it does not exist, it is reasonably anticipated that sooner or later albumen will appear in the urine. Not a few cases of hypertension are found associated only with "asthmatic signs," and if the heart shows signs of hypertrophy such asthma is said to be "cardiac," if albumen is present "renal," and if these signs and others which connote pathological conditions which are capable of producing asthma are non-existent, the diagnosis of primary or bronchial asthma is made. If the hypertension is accompanied by the existence of tophi, or pains in the big toe, or if the patient is a painter or addicted to alcohol, then gouty, plumbic, or alcoholic hypertension may be the diagnosis. In a certain proportion of the cases of exophthalmic goitre high tension is observed not for a few, but, as in the above cases, for many days. Not a few cases present evidence of hypertension and of dropsy, or of monoplegia or hemiplegia, or of coma or of convulsions, and even of cirrhosis of the liver, and finally nothing but hypertension may be found. It is alleged that hypertension is an accompaniment of age, and is a purely degenerative phenomenon. Quite apart from the difficulty of understanding how involutionary changes could cause hypertension, the statement is not true, for octogenarians, and even centenarians, may have no hypertension and yet it may be present in quite young people.

This list of the clinical associations is long and varied enough, but it is possible to add to the number. Enough, however, has been said to show an extremely perplexing problem when the question is asked, How can a solution be found which shall clear up the connexion, if any, between raised arterial tension and such extremely varied associations?

THEORIES OF THE CAUSATION OF HYPERTENSION.

It has been said that their name is "legion," but of this large number a certain list of alleged causes must be

* Delivered at a meeting of the St. Pancras and Islington Division of the British Medical Association, October 27th, 1910.

mentioned which from their popularity and currency, if for no other reason, deserve recognition and consideration on this occasion. They fall into one of two categories, mechanical or chemical.

1. Mechanical.

It has been argued that hypertension is due to an occlusive disease, such as endarteritis, which blocks partially or completely all the arteries of the body, or a great number of them. The heart meeting with this resistance hypertrophies and the blood pressure rises. As proof of this position the frequency with which arterio-sclerosis is manifested in such cases is quoted. Several objections may be raised at once, and more especially as the pressure charts now shown will give an opportunity of clinically checking the behaviour of the heart in changes of the degree of the hypertension. It will be seen that in certain of the cases, after prolonged rest in bed, the pressure falls, *but rises again* (see Chart C); that even some cases have been admitted with a normal or slightly elevated pressure and during rest in bed the pressure has risen (see Chart B); during these variations the heart has not resumed its normal condition. If endarteritis were the primary cause of hypertension, the blood-pressure chart should show a persistent elevation, it should never fall to normal, and certainly should not rise. But a more fatal objection is that endarteritis may be absent entirely when histological observations are made of these cases. A variant of this theory is that it is not endarteritis which is the cause of hypertension, but arterio-sclerosis; the heart, owing to the loss of dilatability and contractibility of the vessels, has more work to do to meet the requirements of the tissues. This argument would be a good one were we seeking for an explanation of the maintenance of normal pressure in the presence of arterio-sclerosis, but it is difficult to see why the heart by hypertrophying should not only meet extra demands to supply blood at normal pressure, *but should actually produce greatly elevated pressure*. Last of all, a great objection to the theory of occlusive disease of the peripheral vessels being the cause of hypertension is that fibrosis should under this condition be a common feature of the organs of the body, but, as the careful observation of 29 fatal cases of hypertension has shown, fibrosis, though met with in the kidneys in each of these cases, has not occurred in the liver in a single case. In one case, used as a control, in which there was no hypertension and no cardiac hypertrophy, the kidney was normal, but the liver intensely cirrhotic. Still one final objection may be raised—namely, that it is well established that hypertension may exist before the blood vessels become sclerosed and before the heart hypertrophies. This is only a clinical observation, and must be taken for what it is worth. When an appeal is made to the pathological histology of cases of hypertension, the theory that occlusive disease of the blood vessels, or arterio-sclerosis, is the cause of hypertension falls to the ground completely.

Still other views centre around the idea that occlusion of blood vessels is responsible for the hypertension. Capital is made of the accepted fact that it may be found that the renal arteries are occluded in cases of hypertension. But hypertension is found to exist when occlusion disease of the kidney vessels is absent, and, moreover, ligation of one renal artery or both, excision of one kidney or both, is not followed by hypertension, nor is amputation of a lower extremity followed by hypertension. The same objections hold for the theory that the vessels of the splanchnic area, by being occluded, cause hypertension; the vasomotor system is too beautifully balanced to allow of hypertension when a part of the arterial bed is obliterated. It has also been argued that stiffness of the vessel walls, as in arterio-sclerosis or atheroma of the large vessels above the diaphragm, like the aorta, is responsible for hypertension; accepting, for argument's sake, that such an association is a constant one, it does not appear to be an adequate explanation for the reason already given—namely, that though it would be reasonable to expect in such a case that the heart assisted with greater effort to maintain a normal pressure, it would be unreasonable to expect the heart to assist still more to produce a much higher pressure than normal. And, lastly, the variability of the high tension, as shown by the charts now exhibited, requires a variability in the

arterio-sclerosis, or atheroma, or endarteritis of the vessels suggested—a view which is alien to the permanency of such changes when once established.

Another explanation which has been popular, and still is, is that part of the kidney substance is rendered inoperative by occlusion or arterio-sclerosis of branches of the renal artery, and cardiac hypertrophy and hypertension come into play in order to pass through the surviving kidney substance all the blood of the body for depuration purposes. This view is untenable for the same reason that occlusion of any district of arteries is incapable of causing hypertension (*vide supra*). An amplification of this doctrine hypothecates the influence of chemical agents, and will be discussed later. In the same way the view that hypertension is due to a reflex action, dependent upon afferent impulses from the cellular tissues, efferent stimuli to the blood vessels and central control by the vasomotor centre, must be considered later under the heading of chemical causes, for there are no facts pointing in hypertension cases to the existence of vasomotor storms of contraction entirely spontaneous in origin and capable of lasting, as tension cases last, for many years. Still another view is that the heart undergoes an essential, that is a spontaneous, hypertrophy in these cases—a view which has only to be mentioned to be dismissed, for it has so frequently been observed that hypertension precedes and does not begin to develop at the time of the inception of cardiac hypertrophy. It is stated that great muscular exertion causes the so-called essential cardiac hypertrophy, but this idea is negated by recent experimental evidence, which shows that muscular effort in animals does not cause cardiac hypertrophy; and clinically we know that people who have led sedentary lives develop this form of cardiac hypertrophy.

2. Chemical.

This term must be used in a broad sense. By chemical agencies we mean soluble bodies which can permeate the whole vascular system, operating either on the ends of afferent nerves, on the vasomotor centre, or on the termination of motor nerves distributed to the muscular coats of blood vessels or to the muscular elements of the heart. In quite early times the view was advanced that such chemical elements were to be found in retained metabolites, such as urea, uric acid, xanthin, etc., which could no longer, owing to the inefficiency of damaged kidneys, be extruded from the body, or they were to be found in such elements which, owing to the disorganized state of the kidneys, were formed, and, not being excreted, accumulated in the body to its undoing, producing as some of their harmful effects hypertension, cardiac hypertrophy, etc. The one answer which must negative this ingenious theory is that not a single metabolite of either order has been discovered which, operating on the elements of the vasomotor reflex, could cause hypertension—that is, not one of these bodies is "pressor"; indeed, those that can be separated are "depressors." A further unsatisfactory point is that such view does not trouble itself with the explanation of why the kidneys have reached such an unsatisfactory condition as to be imperfect eliminators of the toxic substances. Indeed, the whole theory is negated by observations which show that, despite the defect in the kidneys, various metabolites, such as urea, may be excreted quite effectively in these cases. Decent sepulture should therefore be accorded to the views that the heart hypertrophies and hypertension is established in the effort of the heart and vessels to drive through surviving renal tissue all the blood of the body for depuration purposes. Such a happy result could only be effected through the reflex vasomotor control, and the stimulant to such action must be *de facto* a pressor body; metabolic changes in the body have not, so far as actual demonstration is concerned, produced such pressor substances.

Then a more modern conception has arisen which looks to the suprarenal bodies and the pressor part of the pituitary body as a source of a pressor substance which, operating on the vessels at the neuro-muscular junction, provokes contraction, hypertension and cardiac hypertrophy. Despite the energy of our French *confrères* it is difficult to be convinced that any constant change has been found in the suprarenal bodies (or of the pituitary bodies) which could explain cases of hypertension. The same may be said of the efforts of those who look to

Blood pressure charts (taken during sixteen days, night and morning).

A.—William P., aged 35, clerk. Admitted for debility associated with old anterior poliomyelitis. This chart serves as a type of normal pressure chart, showing the variations possible during rest in bed.

B.—Charlotte E., aged 48, housewife. When the patient was admitted she suffered from albuminuria and dropsy. The heart was hypertrophied and the vessels tortuous. She developed anaemic symptoms, but these with the dropsy yielded to treatment, and she was allowed to return home; a few days later she died suddenly and unexpectedly. It will be noted that in eight days the pressure rose through 56 mm.

C.—Isabella B., aged 20, unmarried. The patient was admitted for severe headaches, puffiness of the eyes, and vomiting; eyesight defective owing to "albuminuric retinitis." Heart hypertrophied and vessels tortuous. Haematemesis and melaena. Latterly dropsy developed. Pericarditis developed seventeen days after last record here charted, and the pressure had fallen then to 170 mm. Death occurred twenty-seven days after the detection of pericarditis, the last pressure registered being 124 mm. At the necropsy the heart, free from valvular lesion, showed pericarditis, and weighed 13 oz.; each kidney was small and tough and weighed 3 oz. It will be seen that the pressure fell 40 mm. and rose 30 mm. in the sixteen days.

D.—Eliza W., aged 37, housewife. Admitted to the Brompton Hospital for Diseases of the Chest with signs of cardiac hypertrophy, dropsy, and albuminuria. Death occurred within a week of the last record in this chart, the last pressure reading being 130 mm. At the autopsy the heart was greatly enlarged; the kidneys were less than normal size, and showed well-marked old infarct scars, which were

numerous in each organ. This is an example of hypertension being associated not with general but with localized sclerosis of the kidneys.

E.—William C., aged 56, painter. Admitted for dropsy, shortness of breath, and albuminuria; heart enlarged; vessels tortuous. The chart (thick line) shows the degree of high pressure towards the end of illness. At the date marked by X, dry pleural and pericardial friction sounds were heard. Death occurred eleven days later. At the autopsy both kidneys were found to be granular; the right weighed 5½ oz., the left 6 oz., and the heart 24 oz. The chart shows the "depressor" effect upon the circulation of a terminal infection (pericarditis) occurring in a hypertension case.

F.—Horace R., aged 42, carman. Admitted December 30th, 1909, for dyspnoea and cough and oedema of the lower extremities. Albumen was found on admission, but was absent during the rest of his stay in hospital till January 22nd, 1910, when he was discharged, greatly improved. The curve, indicated by doubled lines including dots, was taken immediately before his discharge.

G.—The same patient, Horace R., was readmitted on March 3rd, 1910, suffering from exacerbations of tophaceous gout, dropsy, and dyspnoea. Albuminuria was constant. He died on June 26th, 1910, and this chart shows the pressure during sixteen days immediately before death. Curve again indicated by doubled lines including dots. At the autopsy an empyema of 5 pints (thought during life to be a serous effusion) was discovered. The heart weighed 23 oz., and each kidney 4½ oz.; both were sclerosed. Charts F and G again show how the signs of hypertension may be altered when a terminal infection (empyema).

an internal secretion of the kidneys as a means of explaining hypertension. No one has advanced any suggestive evidences of such a condition; the blood issuing from the renal veins of a healthy animal has no pressor effects.

Interesting discoveries have recently been made that proteid substances undergoing putrefactive changes may develop pressor bodies. Knowing, as we do, that substances elaborated in the intestines are eliminated in the kidneys—for example, the ethereal sulphates—it is an inviting theory to regard the intestines as a factory for the development of such pressor bodies from the proteid of the food, to believe that such bodies are absorbed through the intestinal mucosa, and, owing to the faulty condition of the kidneys met with in hypertension cases, accumulate in the system and lead to hypertension. The beneficent effects of purgation, diuretics, and diaphoretics lend ample support to this doctrine, but an ugly hiatus is still present—namely, the absence of an explanation why the kidneys show such constant changes in hypertension cases; so far as I am aware, it has not been shown that in the cases of sclerosis of the kidneys with hypertension such products of proteid putrefaction have *caused* the kidney change.

It is not to be wondered at that workers, from the time of Bright himself, have been found who sought to prove a close relationship between the development of hypertension and changes in the kidney. Many years ago two Swedish workers advanced the view that we must look to the kidneys for the possession of a pressor substance, and they demonstrated that kidney substance was pressor. With the knowledge we possess (1) that in hypertension cases the kidney shows so frequently a loss of substance as shown by the development of fibrous tissue leading to the familiar picture of a granular kidney; (2) that in the remaining cases the fibrous tissue is still there, indicating loss of kidney parenchyma at some time or another, although the kidney bulk may be equal to or greater than a normal individual's, owing, as may be reasonably supposed to be the case, to the compensatory development of new parenchyma, it is reasonable to argue that at last a step forward has been made and hypertension has been explained. When once hypertension is established by the pressor effects of the loosened kidney substance entering the circulation, cardiac hypertrophy occurs, and the familiar picture of arterio-sclerosis is developed, neither as *cause* of hypertension, but as *result*, or better as accompaniment.

It is no use blinking one's eyes to the fact that even accepting such an hypothesis, we are still at a loss to explain why the kidney parenchyma is loosened from its bed. That problem must be left for the future, which, thanks to the study of cytology, is promising. Substances which can dissolve cells, even of the kidney—nephrolysins—have been demonstrated as a result of the introduction of the kidney of one animal into the tissues of another of a different species. But so far facts are wanting to show, on parallel lines, how nephrolysins can be developed in an animal which can lead to the undoing of its own kidneys. It is possible that the future will show that bacterial invasion of the body is also capable of yielding nephrolysins, and that the task of clearing up the pathology of kidney disease will have advanced nearer to the stage of causal treatment.

The above views have been stated by me four years ago in the Goulstonian Lectures, and I should not have presumed to repeat them on the present occasion were I not able to give you more facts supporting them. During the last four years, owing to the generosity of my colleagues in the hospital, I have had access to all the cases which have revealed hypertension. Of this number, which was very large, 29 cases have proved fatal. In every case the heart was shown *post mortem* to be hypertrophied; in every case there was general arterio-sclerosis; *in every case there was fibrosis of the kidneys*, some were smaller than normal, some were of normal size, some were larger than normal. Sections of every kidney have been mounted, and under the same cover-slip a section of normal kidney taken from a surgical case dying from chloroform poisoning has been placed; the kidneys of every case are on view, and I invite your criticism of the deductions I have drawn from these 29 complete inquiries.

It will interest you to note one instance in particular of a case which died at the Brompton Hospital last week. You will see that there is a typical hypertension as shown by Chart D; the heart was hypertrophied, and the vessels clinically were tortuous. The kidneys present the appearance of old multiple infarction, probably from local thrombosis of blood vessels; the evidence is that they are scarred deeply in many places, showing a loss of kidney substance; the right lung showed three recent infarcts, but the valves of the heart were free from signs of recent or old endocarditis. Presumably the infarction of the kidneys and possibly of the lung is due to local occlusions. We do not know the origin of this local occlusion, possibly it was bacterial, but the sign complex must not escape you (1) loss of kidney substance, (2) hypertension, and (3) arterio-sclerosis and cardiac hypertrophy. I believe this to be the sequence of the events.

TREATMENT.

It seems hardly fair to give this paper the title it has received; no doubt you anticipated something new in the treatment of this curious condition. I must dispel this delusion and confess to you that the only treatment I can advise is that in which you are probably more expert than I—namely, symptomatic treatment, and first amongst them I would venture to suggest that all such patients should be made to rest recumbent during a much longer period than is usual with them, the diet should be easily digestible, and purgatives should be freely used. I say unhesitatingly that when the patient arrives—as he or she most surely will, provided other maladies such as pericarditis do not cause the closing scenes—at the stage of what we still persist in speaking of as uraemia, do not hesitate to bleed your patients and use sedatives when the symptoms are convulsive in character, a condition in which lumbar puncture appears in some cases to give relief.

If this address is taken in the right spirit, I venture to think that, after all, you will have gained, for your diagnosis will in the future be more correct and consequently your treatment more natural and less haphazard; it is to be hoped you will not endeavour to treat the hypertension by drugs, any more than you treat temperature by such means; you will rather preserve both as a means at least of estimating the condition of your patient. For instance, if the pressure has been known to be raised for weeks and with conditions indicative that your patient is growing worse, even though there be no rise of temperature, you will suspect with a steady fall of the pressure the onset of some infection such as pleurisy, pericarditis, and even peritonitis, a disorder which we all have learnt to our cost develops so easily without our knowledge (see Chart E). Moreover, with the deepening toxæmia, you will with an elevated pressure be more chary in your use of digitalis and other powerful cardiac tonics, drugs which in such cases are so often used on the pretext that there is cardiac degeneration, dilatation, etc., when forsooth the heart and vessels are so efficient that between them they are maintaining maybe a pressure twice as great as your own.

It is necessary to warn you that, even by use of the sphygmomanometer, you will not be able to find hypertension in every case of kidney sclerosis; as the charts will show, one observer might be called in to see the patient when the tension is high and make a correct diagnosis, another called at a later period, when infection has occurred, will find it low, and so miss the true diagnosis (see Charts F and G).

Lastly, the question may be raised of causal treatment. Has investigation revealed any agent akin to the diphtheria antitoxin which is capable of neutralizing the poisonous substances circulating in the blood of patients suffering from this dire complaint? Unfortunately the answer is a negative one. No one has so far been able to show the presence in the serum of these patients of a substance which is pressor in action, much less of a substance of the complex constitution of toxin or amboceptor, whether bacterial or cellular in origin. That such bodies exist is a piece of pure speculation based upon our knowledge of cytological studies in which toxins have been developed when an organ of one animal has been injected into another animal of different species.