Acta Physiologica Scandinavica, 44, 255; Conway, 1963, Circulation, 27, 520) and in the hand (Silvertsson, 1970, Acta Physiologica Scandinavica, Suppl. 343) is increased in hypertension. Secondly, the vasodilatation produced by exercise results in approximately the same change in resistance in hypertensives as in normals but as resistance falls, the difference between the normal and the hypertensives is unchanged. Finally, the peripheral resistance in dogs varies inversely with the cardiac output from one day to the next. The production of hypertension does not alter this relationship but shifts the resistance curve to a higher level. Again resistance varies spontaneously but the difference from the normal is fixed.

The findings, taken together, indicate that in hypertension the process leading to an increased resistance does not interact with the vascular smooth muscle activity but remains relatively fixed despite wide fluctuations in vascular tone.

D. A QUANTITATIVE APPROACH TO THE STUDY OF CIRCULATORY ABNORMALITY, ESPECIALLY OF HYPERTENSION

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The control mechanisms of the circulation have been studied systematically using engineering principles of control system analysis. Mechanisms that have received special attention are the following:

1. Renal ischaemia gives (a) increased secretion of renin and formation of angiotensin; (b) peripheral vasoconstriction; (c) elevated arterial pressure; (d) elimination of the renal ischaemia.
2. Increased arterial pressure gives (a) baroreceptor excitation; (b) sympathetic inhibition; (c) reduced arterial pressure back toward normal.
3. Decreased arterial pressure gives (a) increased aldosterone secretion; (b) salt and water retention; (c) enhanced blood volume; (d) elevation of arterial pressure back toward normal.
4. Increased arterial pressure gives (a) increased loss of water and salt through the kidneys; (b) decreased body fluid volume; (c) decrease of arterial pressure back toward normal.

The gains of the first three of these mechanisms varied from 1-6 to 8, all relatively low values. However, the gain of the fourth mechanism, the kidney mechanism for pressure and fluid volume regulation, approached infinity over a period of several days. Therefore, this last control system completely overshadowed all the others for long-term control of arterial pressure. A major conclusion of this study is that the functional relationship between arterial pressure and output of salt and water by the kidneys must be changed from normal if chronic hypertension is to be sustained, regardless of the initiating cause of the hypertension.

E. CIRCULATORY CHANGES IN EXPERIMENTAL HYPERTENSION

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Early observations in both renal and renoprival hypertension indicated that the major factor responsible for the raised blood pressure was an increase in peripheral resistance. Subsequent work has confirmed this, but has revealed the cardiac output to be elevated in certain forms and at certain phases of hypertension. In renal hypertension resulting from constriction to the artery to a sole remaining kidney, the cardiac output may fall acutely (Olsted & Page, 1965, Circulation Research, 16, 134; Ledingham & Pelling, 1967, Circulation Research, Suppl. II, 20–21, 187) but later rises and exceeds the level observed in control animals (Ledingham & Pelling, 1967; Bianchi, Tenconi & Lucca, 1970, Clinical Science, 38, 741). A similar rise has been observed in hypertension resulting from renal compression (Ferrario et al., 1970, Circulation Research, in press). This excess cardiac output is unexplained by changes in haematocrit or oxygen uptake (Ledingham & Pelling, 1967; Meinders, 1965, Nature, 207, 196) and appears inappropriate to tissue requirements. During the reversal of renal hypertension by release of renal artery constriction the cardiac output falls primarily and peripheral resistance secondarily (Ledingham & Cohen, 1962, Clinical Science, 22, 69); again the fall in output is inappropriate to tissue requirements. In the early renoprival state, increased cardiac output is solely responsible for the hypertension (Ledingham & Pelling, 1970, Journal of Physiology, 210, 233). All these changes are compatible with a mechanism for hypertension primarily involving changes in cardiac output and secondarily, possibly through autoregulation, peripheral resistance.

COMMUNICATIONS

1. KETONE BODY, FREE FAITTY ACID, AND GLUCOSE CONCENTRATIONS IN 'MATURITY' AND 'JUVENILE' DIABETICS AFTER INSULIN

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A standard dose of soluble insulin (0.1 u/kg body wt) was injected intravenously into twenty-eight untreated diabetics after an over-night fast of at least 11 h. Blood concentrations of 3-hydroxybutyrate, acet-