The experimental production of metabolic or respiratory acidosis has been shown to cause some increase in blood ammonia in normal and Eck fistula dogs(5). This is of importance because most of the rises in blood ammonia were associated with decrease in blood pH. There were 2 observations, however, that suggested these changes in blood ammonia with exercise were of additional significance. Dogs subjected to mild voluntary exercise demonstrated elevation of blood ammonia in the post-exercise period, despite lack of significant change in blood pH. Also, a decrease in pH by acid infusion was associated with much smaller rise in blood ammonia than a comparable change in pH occurring after experimentally produced convulsions(5).

The source of the increase in blood ammonia would seem to be from within the muscles themselves as a result of deamination. Earlier work with isolated muscle suggests that ammonia formation is more prominent following the period of muscle fatigue than during the active period of contraction(6), and this is supported by the observed changes in blood ammonia in this study.

Although the respiratory stimulant, ammonia, was elevated following muscular exercise or active convulsive states, the actual significance of this observation is not entirely clear. The peak of increase in ventilation was immediate in the post-exercise period, but maximal elevation of blood ammonia did not occur until approximately 4 minutes post-exercise. Ammonia elevation which did occur, persisted to some extent after ventilation had returned to control values. The increase in cardiac output and oxygen consumption with muscle exercise also continues for a longer period than the hyperpnea. The possibility that ammonia plays some role in normal respiratory response to exercise is suggested by the consistent observation of increased blood ammonia following various forms of exercise studied.

Summary. 1. Peripheral blood ammonia concentrations were elevated following convulsions due to electroshock therapy in patients, convulsions in dogs due to metrazol, and active voluntary exercise in human subjects. 2. The possibility that increase in circulating blood ammonia may be a factor in hyperpnea of muscular exercise is discussed.

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Electromagnetic Blood Flow Meter Yielding a Base Line Without Interruption of Flow.* (24104)

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The latest modification of the electromagnetic flowmeter(1) constitutes an improvement over previous forms(2,3,4) in that it permits recording of blood flow in essentially freely moving conscious animals. But 2 problems remained to be solved to make it an instrument of unrestricted usefulness in physio-

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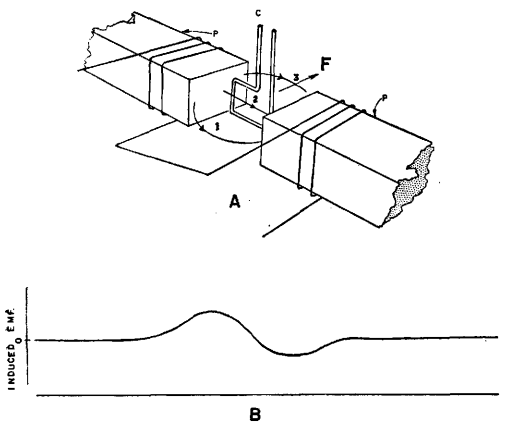

FIG. 1. A. Non-homogeneity of magnetic field depicted with exaggeration by flux lines 1, 2, 3. C: equivalent loop representing electrode circuit. F: direction of blood flow. P: pole pieces of magnet. B. Emf induced in coil C as a function of its position along the flow axis F.

logical research: 1) The instrument had to be made insensitive to the ever present 60 cps pickup so that the animal could move about and be handled during recordings of blood flow; 2) determination of zero base line had to be accomplished without interruption of flow and thus without auxiliary devices, such as plastic occlusion bags previously used(1,3) implanted in addition to flow meter unit. Both problems have now been solved by measures here described.

Methods. Elimination of the 60-cycle pickup has been accomplished by energizing the magnet with 400 or 1000 cps current and using an amplifier utilizing band pass filters sharply tuned to one of these frequencies. This obviates use of compensator(1,3) and permits injecting and otherwise handling the animal while recording of blood flow is in progress without noticeable disturbance of the record. In addition to freedom from interference, a second advantage is realized. The signal to noise ratio is considerably improved at higher frequency, as shown in Fig. 2 which shows records of blood flow in the carotid artery of a dog. Fig. 2A was taken at 60 cps and Fig. 2B at 400 cps. The reduction in noise at 400 cps is most clearly seen by inspection of sections of records during intervals when flow meter magnet is turned off *i.e.*, when flow record is absent. A frequency above 60 cps (200 cps) has previously been used with a sinusoidal field flow meter(5). Working at higher frequency increases the difficulty in obtaining the zero-flow base line without interruption of flow. This is due to the fact that transformer emf induced in flow meter output circuit is proportional to frequency of the magnetic field. This emf comes about as follows: the 2 pickup electrodes bridged by the artery can be considered as the secondary loop of a transformer. The primary coil is formed by the turns energizing the magnet. The primary and the secondary coils are linked by the magnetic field in the gap of the magnet. The above mentioned secondary loop can be symbolized by the one-turn loop C shown in Fig. 1A. Since the magnetic field lines are not strictly parallel, there is, in general, an emf induced in the coil C due to the magnetic field component which is perpendicular to the plane of the loop. This emf varies as the loop is moved parallel to its original orientation through the magnet gap parallel to the flow axis F. Fig. 1B shows the record of the phase and magnitude of the emf induced in coil C as it moves from position 1 in the gap to position 2. Curvature of the magnetic flux lines in Fig. 1A is greatly exaggerated to emphasize the change in direction of the magnetic field near the visible pole face as the coil is transferred from position 1 to position 3. This transfer is accompanied by phase reversal of the emf induced in C as shown in Fig. 1B. Between these two extreme positions, there is a position 2 in which the resultant magnetic flux perpendicular to area

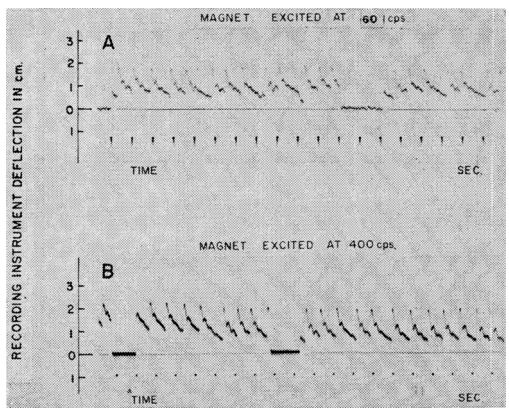

FIG. 2. Comparison of signal to noise ratios at 60 cps (Fig. 2A) and 400 cps (Fig. 2B).

of loop C is zero. At this critical point the transformer emf induced in C vanishes, and the output of the secondary loop C becomes independent of whether the magnet is on or off.

The preceding discussion assumes that the loop C is solely responsible for the induced emf which is to be eliminated. This is not the case. Part of the undesired emf is induced in the input leads connecting to loop C by the alternating magnetic stray field. This emf is balanced out along with the emf induced in the loop C by the positioning of the sleeve described above.

In the process of construction of an electromagnetic flow meter, the plastic sleeve containing the electrodes(1) is adjusted by movements parallel to F until the critical position is reached in which the signal voltage detected between electrode leads remains unchanged as the magnetic field is turned on and off. This adjustment is carried out preferably with the flow meter submerged in saline, although smaller units can be satisfactorily adjusted in air while electrodes are connected by a metal bar parallel to their axis or by a filling of Wood's metal.†

After completion of this adjustment, the sleeve is polymerized in the plastic body of the flow meter, as previously described(1), and the sensing unit is ready for use without the need for an occlusion bag for the establishment of a base line. The latter can now be established by turning off the electromagnet.

De-energizing the magnet to ascertain the base-line has previously been used in connection with constant magnetic field flow meters (6,7). Subsequently, a square wave current has been used to energize the magnet(4) in order to obtain during the constant current interval of the square wave conditions similar to those which prevail in a constant magnetic field. This arrangement also permits the establishment of the base line by de-energizing the magnet. The method herein described accomplishes the same by energizing the magnet

† To facilitate the zero adjustment, it is helpful to slightly distort the magnetic field by making one pole piece somewhat thinner than the other.

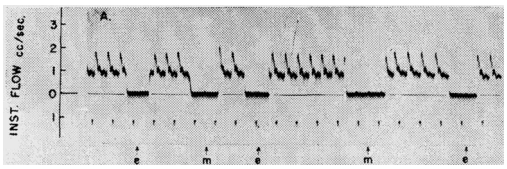

FIG. 3. Comparison between base lines obtained by interruption of flow (m) and switching off magnetic field (e).

with an ordinary sinusoidal current and basing the avoidance of a signal voltage at zero flow on a different principle which was described above. This obviates the need for complex circuitry used with the square wave device(4). A standard 4 stage amplifier with transformer input utilizing two Z-8324 EEco plug-in amplifier units proved quite satisfactory.

The effectiveness of this device is shown in Fig. 3. This record shows a comparison between base lines established by interruption of blood flow by means of a device compressing the artery (m) and by turning off the magnet without interruption of flow (e). The two base lines can be considered to be identical for all practical purposes. Periodic checks of the stability of the base line established in this fashion reveal that it remains unchanged in the course of many hours of continuous operation.

Summary and conclusion. The necessity of implanting an occlusion bag to secure a base line at zero flow has been eliminated. This has been accomplished by placing the pick-up electrodes in the magnetic field to eliminate the transformer emf induced in the input lead circuit. As the sleeve is moved parallel to flow axis a point is found at which the a.c. voltage between electrodes vanishes regardless of whether the magnet is on or off. Thus, the baseline is obtained by merely switching off the magnet. The circuit has been improved to a point where the animal can be handled without interference with the recording of blood flow.

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Postnatal Histogenesis and Endocrine Function of Abnormal Testes in the AxC Rat. (24105)

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Deringer and Heston have described the relatively frequent occurrence of multiple abnormalities in the genitourinary tract of the AxC rat(1). In the male the anomalous pattern includes a total absence of kidney and ureter on one side frequently associated with presence on the same side of an atrophic testis which lacks a vas deferens or epididymis. In addition the seminal vesicle, but not the coagulating gland, is absent on the involved side. In this strain of rats varying patterns of this anomalous picture are observed in approximately 20% of all male animals studied(1). Similar patterns of genitourinary abnormality have been described in man by Whitehorn (3) and Longo and Thompson(4).

We wish to report our observations on postnatal development of the abnormal testis in the AxC rat. These studies have indicated that during prepuberal period the testis which is destined to be atrophic in adult life is morphologically and histochemically indistinguishable from the normal testis of comparable age. With onset of puberty the abnormal testis presents its initial deviation from normal developmental pattern, namely complete failure of tubular maturation and spermatogenesis.

Materials and methods. The rats were derived from a highly inbred strain previously described by Heston and Deringer(1). They were kept in metal cages in constant-temperature animal quarters maintained between 76 and 80°F. They were fed Purina stock diet *ad libitum* and provided constant supply of tapwater. Pregnant animals were isolated for delivery and date of birth of all litters recorded daily. All animals were sacrificed by ether at indicated age. Testes which could be expected to be atrophic were identified by occurrence on the same side as the observed absence of vas deferens, kidney, ureter and seminal vesicle. This was most commonly on the right side. The contralateral testis was used as normal control tissue since no instance of bilateral testicular failure has occurred in this colony. All tissues were promptly weighed and fixed for histochemical analysis. The following fixatives and staining methods were employed: I. Bouin's solution; for morphological study, glycogen and mucopolysaccharide. II. Cold alcohol, 80%; for alkaline phosphatase; III. Barnett and Bourne's solution(5); for ascorbic acid; IV. Baker's Formaldehyde(6); for total lipids, cholesterol and silver impregnation; V. Mallory's trichrome stain as modified by Crossman(7); VI. Lillie's allochrome stain(8); VII. Del Hortega's(9) or Gridley's(10) silver impregnation; VIII. Weigert's resorcin-fuchsin(11); IX. McMannus' P.A.S. for glycogen(12) with takadiastase digestion at 37°C for control; also with hyaluronidase digestion to eliminate reaction with some muco-polysaccharide; X. Gomori's method as modified by Kabath and Fursth(13) for alkaline phosphatase; XI. Metachromatic reaction with Azur B and Toluidine Blue O (0.055%, pH 6 and pH 4) and P.A.S. for acid mucopolysaccharides; XII. Sudan (III, IV and Black) for lipids; XIII. Schultz's(14) and Brunswick's methods(15) for cholesterol and cholesterol esters; XIV. Dean and Morse's method(16) for ascorbic acid. Thirty-five abnormal specimens were selected to cover the prepuberal as well as postpuberal and adult period (Table I). In addition, tissues from 65 normal animals at different ages were studied for com-