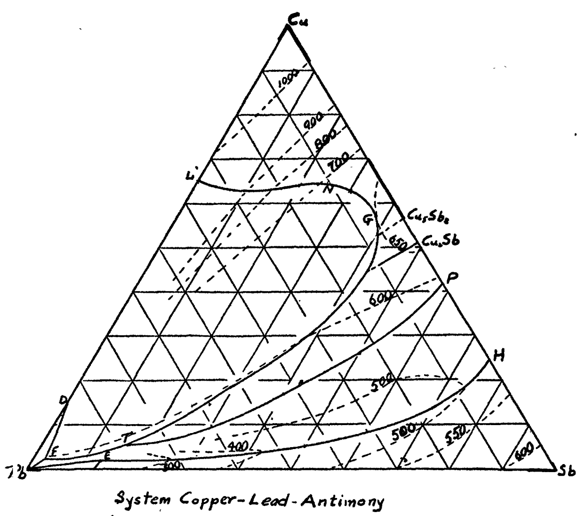
complications in the liquid phase of the lead-antimony system are not to be expected. The internal pressures of copper and lead on the other hand are widely separated, and the effect of this wide difference is shown in the binary system.[8] There are no compounds formed so a miscibility gap appears. Between 15 per cent. and 65 per cent. copper by weight, there are two liquid phases. An eutectic between copper and lead appears at about 0.05 per cent. copper. Copper and antimony are just as widely separated in internal pressure values as copper and lead. However, the fact that a compound,[9] Cu_5Sb_2, forms, which is stable at its melting-point, changes the consideration. Two other compounds, Cu_3Sb and Cu_2Sb, are known in this system, but they are unstable at their melting-points and are formed by the decomposition of Cu_5Sb_2 on cooling. For this purpose, therefore, we shall consider the copper antimony system as divided into two parts, namely, copper-Cu_5Sb_2 and Cu_5Sb_2-antimony. The fact that solid solubility occurs at both ends of the system and that both copper and antimony dissolve in the Cu_5Sb_2 crystals indicates that the internal pressure of Cu_5Sb_2 is between that of antimony and copper.

With this information, it is now possible to see how the shape of the immiscibility gap in the ternary system copper-lead antimony checks with the theory. Since there is a break on the copper-lead side and none on the copper-antimony line, the curve of immiscibility must close on itself. Fig. 1 is a representation of



System Copper-Lead-Antimony

FIG. 1

the system reproduced from the paper of Morgen,[10] Swenson and Nix. The two liquid layer region found experimentally is bounded by the line DFTGL. Starting at D the boundary drops sharply towards F, which corresponds to about 2.5 per cent. antimony by weight. This is the amount of antimony which has solid solubility in lead, so that up to this amount in the liquid state, the antimony just acts to replace so much lead, probably approaching a perfect solution. The following generalization then seems to follow: Over the range where a solid solution separates, the liquid behaves like the pure solvent or approaches a perfect solution of the two constituents. From F to K the line is practically horizontal. This is the region in which lead is the primary crystal and so further addition of antimony, over 2.5 per cent., makes little difference in the ternary liquid mixture. K probably corresponds to the point at which lead and antimony are in the proportions in which they exist in the eutectic. From K to T the line starts to curve, but since in this region an antimony compound, Cu_2Sb, is the primary crystal, the effect of the low internal pressure of antimony is still noticeable, tending to extend the area of immiscibility. After the line PT is passed, the primary crystal is Cu_5Sb_2, and so this compound is the dominating factor, and the curve turns away from the antimony corner. The point G, the nearest approach to the copper-antimony line, is at 5 per cent. antimony. This corresponds to the solid solubility of lead in antimony and agrees with the generalization made previously. From G the curve returns sharply to the copper-lead axis. In this region the three substances to be considered are copper, Cu_5Sb_2, and the copper-lead mixture indicated by L. These three have effective internal pressures close enough together so that they are completely miscible in the liquid phase.

CONCLUSIONS

A method has been suggested whereby the shape of miscibility gaps may be predicted.

A relation is pointed out between solid solution formation and an effect on the liquidus surface.

RALPH A. MORGEN

KANSAS CITY, MO.

[8] F. Friedrich, *Met. u. Erz.*, 10: 578, 1913.

[9] H. Reimann, *Z. Metallkunde*, 12: 321, 1921.

[10] *Loc. cit.*

DIMORPHISM IN THE DEVELOPMENTAL HISTORY OF THE SEX VEINS OF THE RABBIT

THE right sex vein of the adult male rabbit is described by Krause (1884)[1] as entering the vena cava inferior at the level of the fifth lumbar vertebra. The left sex vein of the adult male rabbit is described in the same account as entering the left renal vein. According to Krause, both sex veins of the adult female rabbit directly enter vena cava inferior

[1] Krause, W., "Topographische Anatomie des Kaninchens," II Aufl., Leipzig, 1884.

at the segmental level at which the right sex vein enters the V. cava inferior in the male rabbit.

According to Hochstetter (1902)[2] the right sex vein of the rabbit is a derivative of the cranial portion of the original ventro-lateral posterior cardinal element of the venous ring about the ureter. He states that the left sex vein of the rabbit contains two elements: one of these corresponds bilaterally to the right sex vein; the other element corresponds bilaterally to that portion of postrenal V. cava between the right renal vein and the point of entry of the right sex vein into V. cava. His diagrams give the impression that in rabbits of either sex the sex veins are entirely of posterior cardinal origin; that the developmental procedure is the same in the two sexes.

Our recent studies have convinced us that the sex veins of the adult female rabbit enter the V. cava inferior not at the level of the fifth lumbar vertebra but at the level of at least one segment caudal to this. They enter symmetrically or very nearly so.

The sex veins of the adult male rabbit have the relationships to V. cava described by Krause for the male rabbit. They have a development (in the male) similar to that shown in Hochstetter's schemata for rabbits of either sex. The development of the female sex veins has never been correctly described for the rabbit or for any other placental mammal.

The counterparts of male sex veins are well developed in the female. So far as they are in relation to the mesonephros, they lie dorsal to the mesonephric arteries. They never acquire (in the female) connection with the longitudinal vein which directly drains the gonad. Intra-mesonephric segments of posterior cardinal veins (portions of true sex veins of the male rabbit foetus) normally acquire such connections.

In the female rabbit embryo, and to a slightly lesser degree in the male, there develops on the ventromedial surface of the caudal pole of each mesonephros a strong transverse venous drainage. On each side it enters directly the medial cardinal vein (possibly the "cardinal collateral" of Huntington and McClure). At this same level on each side there is established a transverse anastomosis between medial cardinal vein and paraureteric vein (lumbar "supracardinal" of Huntington and McClure). Adjacent to this level, cranially and caudally, the medial cardinal veins degenerate or become very slender. Thus each ventro-caudal mesonephric drainage appears to enter directly the corresponding paraureteric vein. The condition is only secondarily established. At this same level an anastomosis forms transversely between the paraureteric veins. This anastomosis is a product of the dorsal aortic plexus (of L. H. Strong).[3] When, finally, the left paraureteric vein degenerates, the ventro-caudal drainage of the left mesonephros appears to empty into the paraureteric portion of postrenal V. cava by way of a path dorsal to the aorta. These ventro-caudal mesonephric drainages, together with their transverse connections with postrenal V. cava, form the definitive sex veins of the female. They degenerate in the male. This description applies to the rabbit.

Medially directed ventro-caudal mesonephric drainages were well-described and beautifully illustrated by Rathke in his studies of the pig embryo in 1832. This work is reviewed by F. P. Reagan, in an article now in press. Rathke[4] evidently interpreted the immediately pre-iliac position of these vessels as indicating that the sex veins of ungulates are generally in this position. Vessels comparable to those seen by Rathke were observed in pig embryos by Butler (1927).[5] From the latter account one gets the impression that these are the definitive sex veins of pigs of either sex. In some ugulates, at least, it is certain that the male sex veins are not derivatives of this ventro-caudal mesonephric drainage. In the pig, Butler calls these veins "mesial caudal tributaries" to the "supracardinals" of his terminology. It is not clear whether these are comparable to the "postcardinal mesial-caudal tributaries" of McClure and Butler (1925).[6]

The strikingly great difference in degree of posterior cardinal persistence in adult male and in adult female rabbits is not reflected in a comparatively great difference in degree of mesonephric activity in their male and in their female embryos.

Our investigations were carried out in Laboratory of Embryology, University College, University of London. This was made possible through the courtesy of Professor J. P. Hill.

FRANKLIN P. REAGAN
MARGARET TRIBE

DEPARTMENT OF ANATOMY,
INDIANA UNIVERSITY
DEPARTMENT OF ZOOLOGY,
KING'S COLLEGE, UNIVERSITY OF LONDON

2 Hochstetter, F., "Die Entwicklung des Blutgefässsystems," Hertwig's *Handbuch*, III, 2 Teil, 21, 1902.

3 Strong, L. H., "The Dorsal Aortic Plexus, a Factor in the Dorsal Body Wall Drainage of the Rabbit," *Univ. of California Publ. in Zool.*, 9, 305, 1927.

4 Rathke, H., "Untersuchungen über die Geschlechts-Werkzeuge der Säugethiere. Abhandlungen zu Bildungs- und Entwickelungsgeschichte des Menschen und der Thiere," I Th., III Abh., 42, 1832.

5 Butler, E. G., "The Relative Rôle Played by the Embryonic Veins in the Development of the Mammalian Vena Cava Posterior," *Am. Jour. Anat.*, 39: 267, 1927.

6 McClure, C. F. W., and Butler, E. G., "The Development of the Vena Cava Inferior in Man," *Am. Jour. Anat.*, 35: 331, 1925.