The Spiral Pattern During Development*

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SUMMARY

It is postulated that, as growth occurs, the typical embryological stages and the typical vertebrate pattern can be explained by the gradual unwinding of a spiral pattern so that this pattern acts as a sort of predetermined mosaic of the future animal.

The postulated stages in this process of development are described and illustrated and the implications of the observations discussed.

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The underlying process by which the animal ovum becomes transformed into the fully developed animal remains one of the mysteries of biology.[1]

While examining early vertebrate embryos, it was observed that the cells are not haphazardly clumped together, as is generally described,[2] but are in fact arranged in a spiral pattern (Fig. 1) consisting of two helical spirals alongside each other (Fig. 2).

An investigation was therefore decided upon to determine to what extent, if any, this spiral pattern persists during embryological development.

It is the aim of this article to demonstrate that, if carefully looked for and interpreted, a spiral pattern (Figs. 1 and 2) can be detected throughout the stages of embryological development and can even be recognized in the fully developed animal.

It is postulated that as growth occurs, the typical embryological stages and the typical vertebrate pattern can be explained by the gradual unwinding of such a spiral pattern and that this spiral pattern acts as a sort of predetermined mosaic of the future animal.

By a series of careful staining experiments and comparative sections according to the methods of Vogt[3] and Huxley

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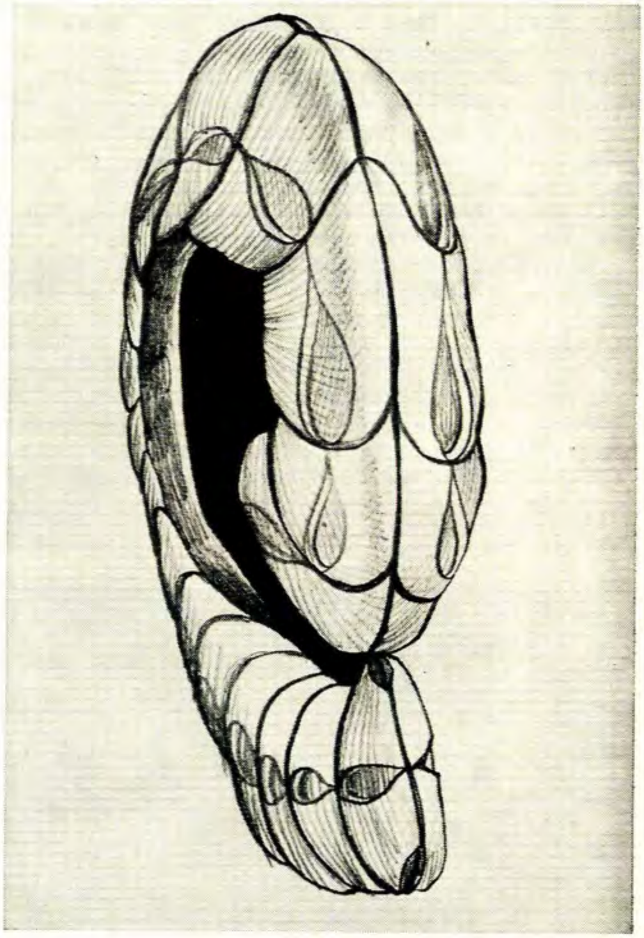

Fig. 2. The pattern in the early vertebrate embryo is of two spirals alongside each other.

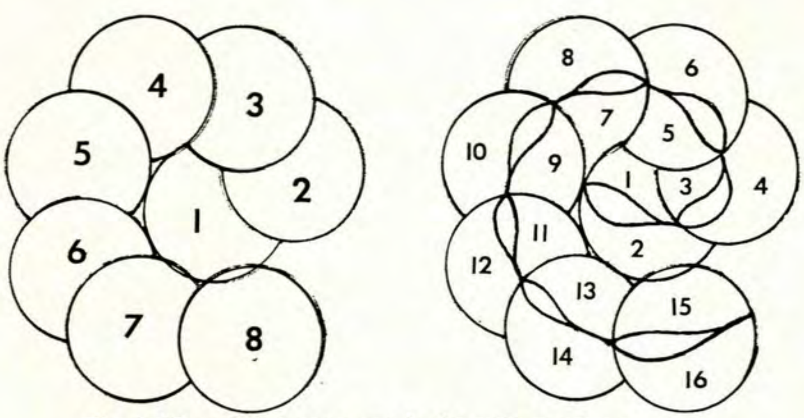

Fig. 1. The spiral arrangement in the early vertebrate embryo.

and De Beer,[4] it was gradually found possible to construct the diagram shown in Fig. 3. This illustrates approximately what each of various areas of the early vertebrate embryo develop into.

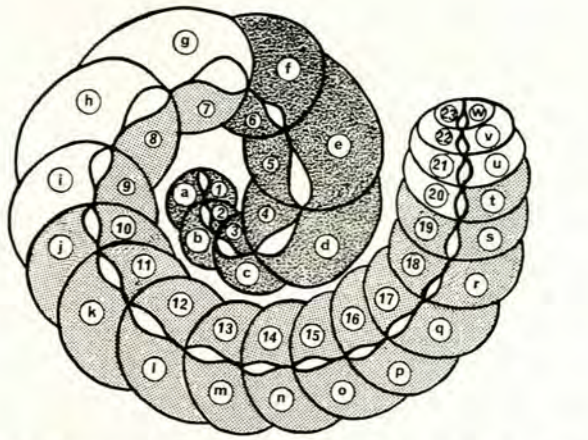

Fig. 3. Approximately what the various areas of the early embryo develop into. The densely shaded areas are destined to become the head. The lightly stippled areas are destined to become the limbs. The unshaded areas (g), (h) and (i), are destined to become the dorsal areas, and the distal unshaded areas are destined to become the thorax and the abdomen.

The densely shaded areas (a) - (f) and (1) - (6) (Fig. 3) become the head of the future animal, and the close resemblance between the spiral pattern and the final vertebrate skull is apparent (Fig. 4).

Immediately distal to the head area are three unshaded areas (g), (h) and (i) (Fig. 3). These areas form the dorsal areas of the future animal and the close resemblance between the spiral pattern formed by these areas and the trapezius muscle, the latissimus dorsi muscle, and the gluteus maximus muscle is apparent (Fig. 5).

The lightly stipled areas (7) - (19) and (j) - (t) (Fig. 3) represent the areas becoming the future limbs. The areas (7) - (19) (Fig. 3) become the upper limb and the areas (j) - (t) (Fig. 3) become the lower limb (Figs. 6, 7 and 8).

Distal to these limb areas the unshaded areas (20) - (23) and (u) - (w) (Fig. 3) would then become the future thorax and abdomen respectively.

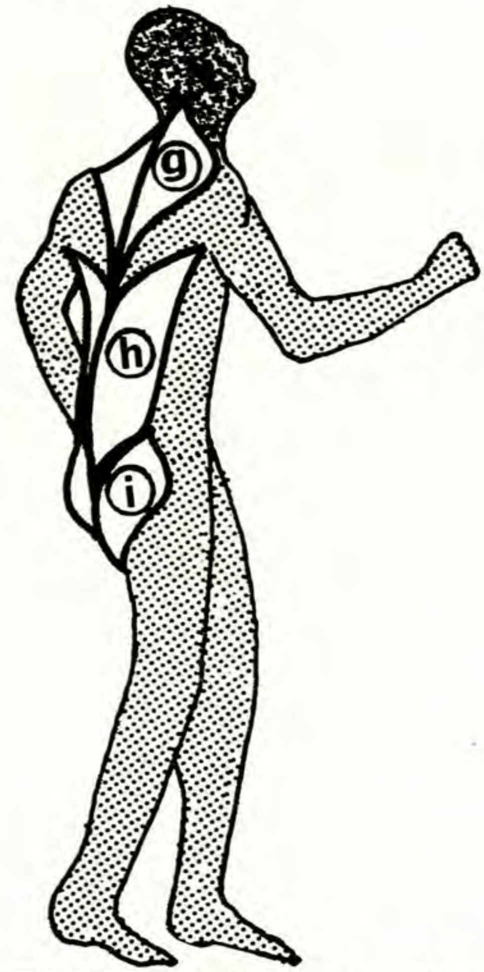

Fig. 5. The close resemblance between the spiral pattern formed by the cells destined to give rise to the dorsal areas of the future animal and the trapezius muscle, the latissimus dorsi muscle and the gluteus maximus muscle of these areas.

THE STAGES OF DEVELOPMENT

By carefully examining and comparing embryos at various stages of development, the spiral pattern can be persistently recognized.

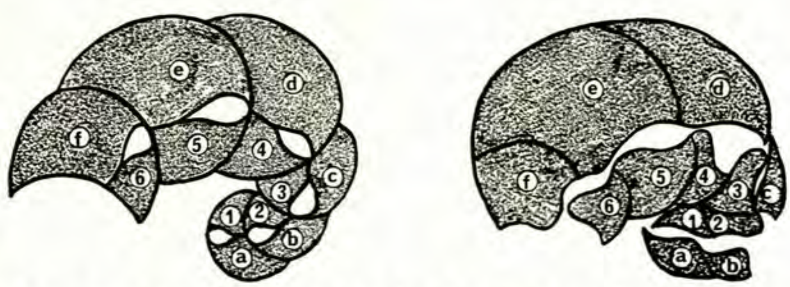

Fig. 4. The areas destined to develop into the future head. The close resemblance between the spiral pattern and the pattern of the vertebrate skull is apparent.

The human embryo of about 4 mm CR length and age of about 30 days is shown in Fig. 9. The spiral pattern is recognizable and is demonstrated in a diagrammatic form in Fig. 10.

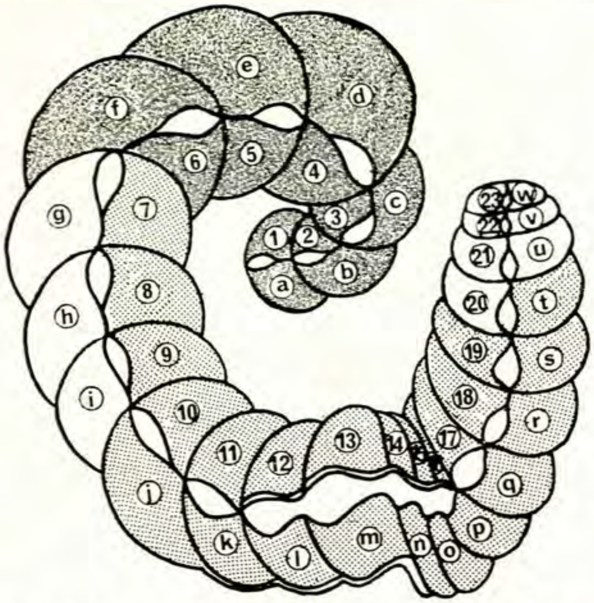

Fig. 6. The cells of areas (7) - (19) are destined to become the upper limb, and the cells of the areas (j) - (t) are destined to become the lower limb. As growth occurs, the spiral pattern formed by the early cells unwinds, so that the limb areas bud out laterally.

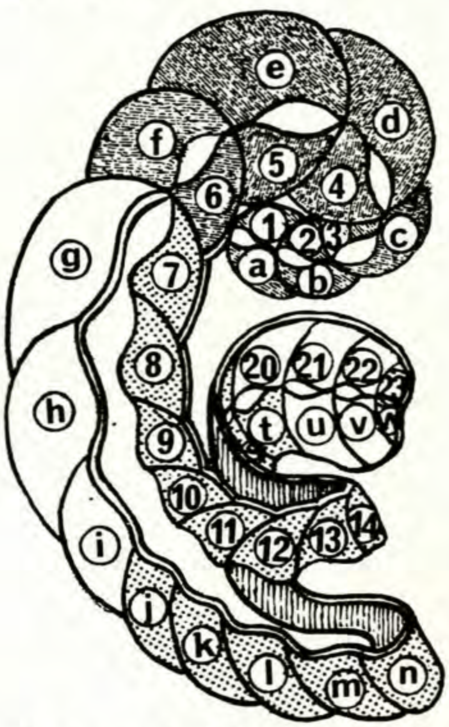

Fig. 7. The manner in which it is postulated the areas which are destined to become the limb areas bud out laterally.

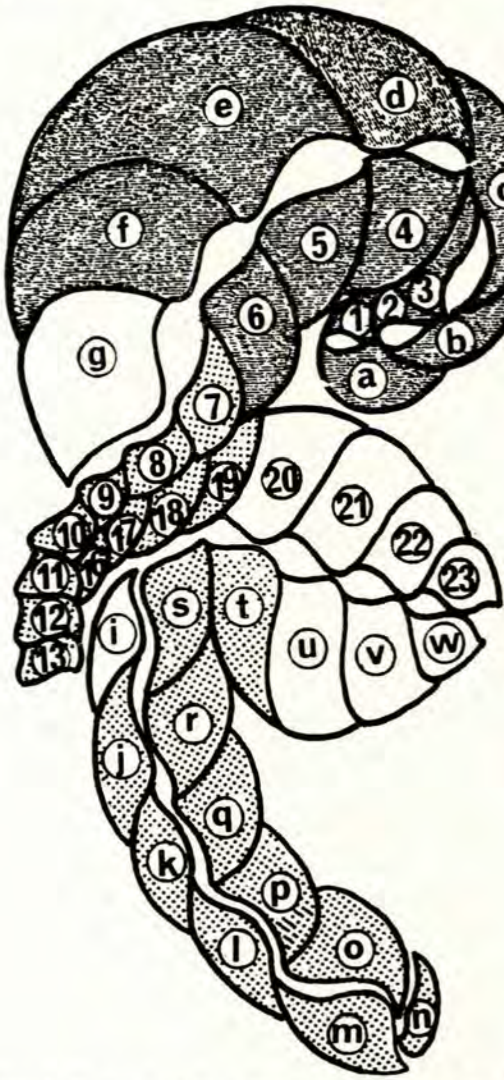

Fig. 8. The early cells, which are destined to develop into the upper and the lower limbs, after lateral budding has occurred.

Fig. 11 demonstrates the human embryo of about 5 mm CR length and age of about 32 days. The spiral pattern is present and is illustrated in diagrammatic form in Fig. 12.

Fig. 13 shows the formation of the head, face and pharyngeal regions of the human embryo. It is correlated with the spiral pattern from which it develops.

Fig. 14 shows the human embryo of about 7 mm CR length and age of approximately 34 days and the spiral pattern is still recognizable.

Fig. 15 shows the human embryo of about 14 mm CR length and age of about 41 days, in which the spiral pattern is still present, this is shown diagrammatically in Fig. 16, which represents the spiral as it would appear at this almost fully formed stage.

In the series of diagrams (Figs. 17 - 22), a process of gradual unwinding of the spiral pattern is illustrated which, it is postulated, occurs as it grows purely by virtue of the shape of the spiral.

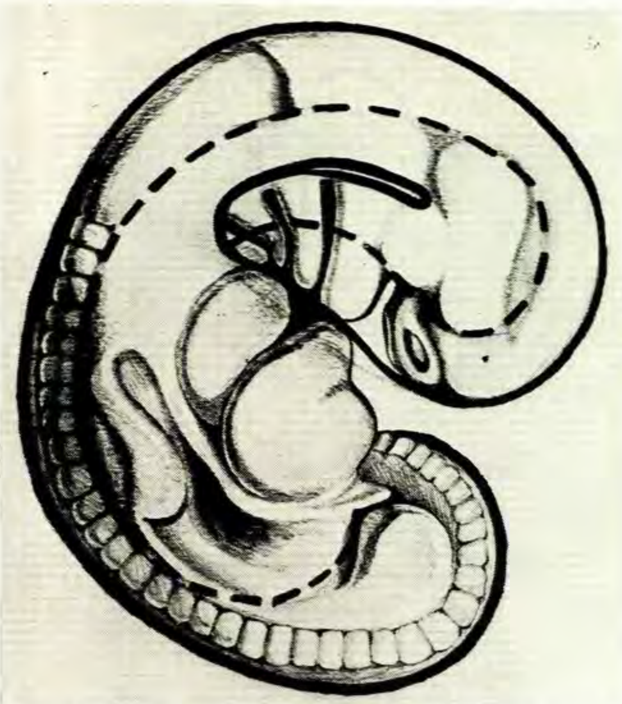

Fig. 9. The human embryo of about 4 mm CR length and age about 30 days, showing in outline the postulated spiral pattern of the cells from which it is derived.

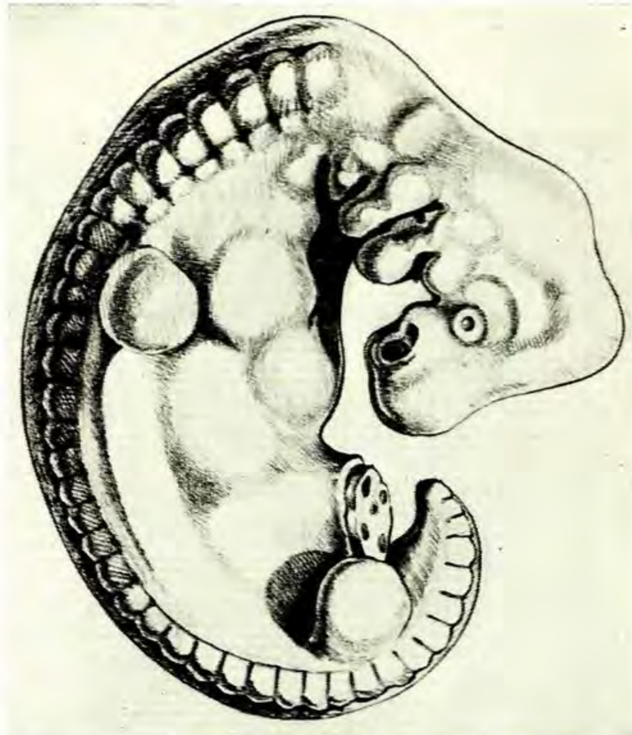

Fig. 11. A human embryo of about 5 mm CR length and age about 32 days.

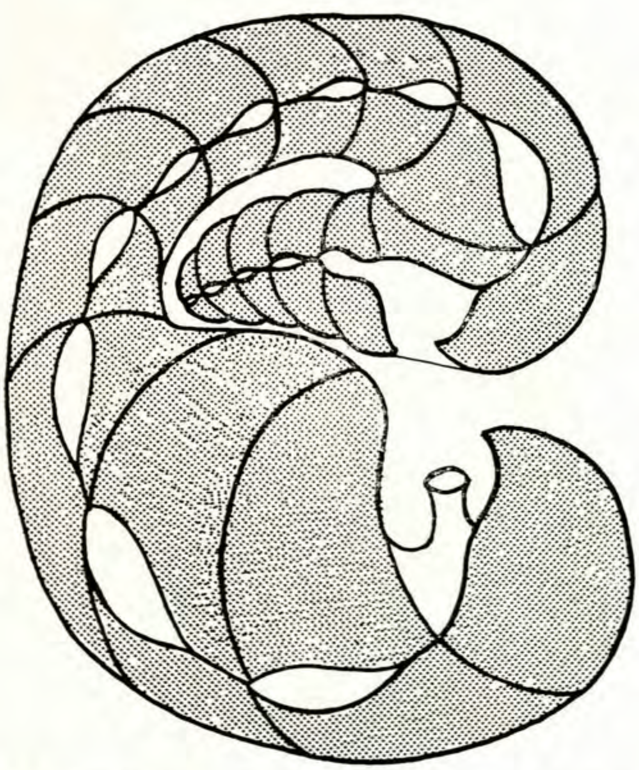

Fig. 10. Diagrammatic representation of the spiral pattern of cells from which the 4-mm embryo shown in Fig. 9 is derived.

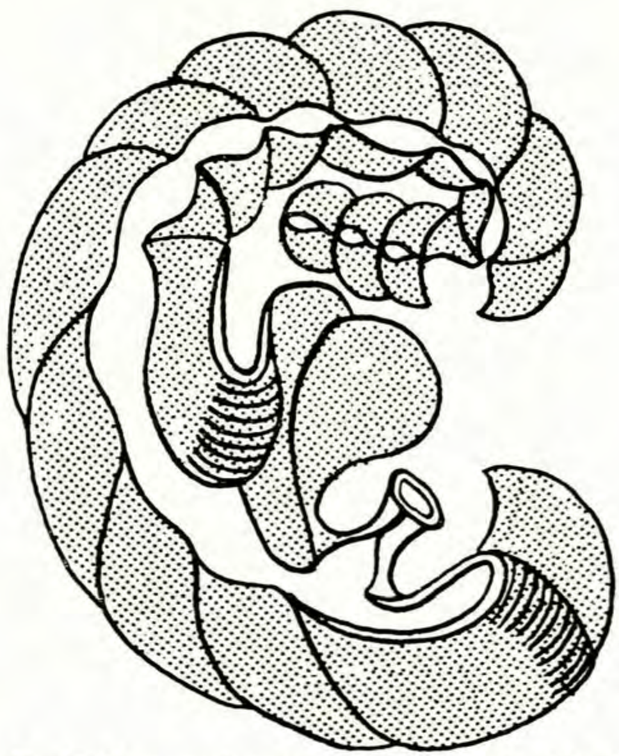

Fig. 12. Diagrammatic representation of the early cells of the vertebrate embryo showing their spiral pattern and illustrating the budding out of the upper and lower limbs.

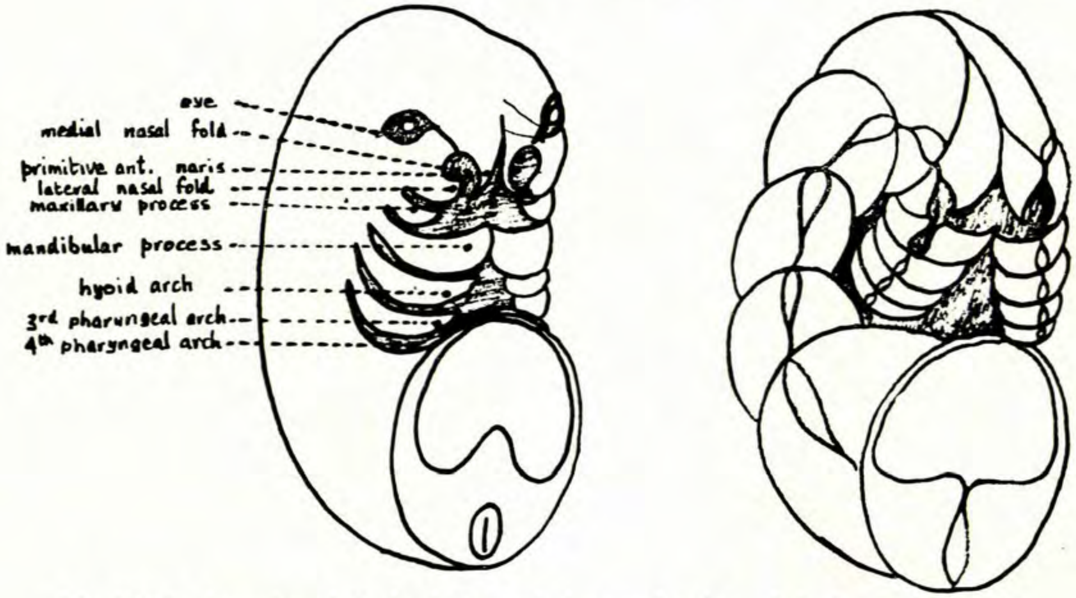

Fig. 13. The formation of the head, face and pharangeal regions of the human embryo is correlated with a diagram showing the spiral pattern of the cells from which these areas are derived.

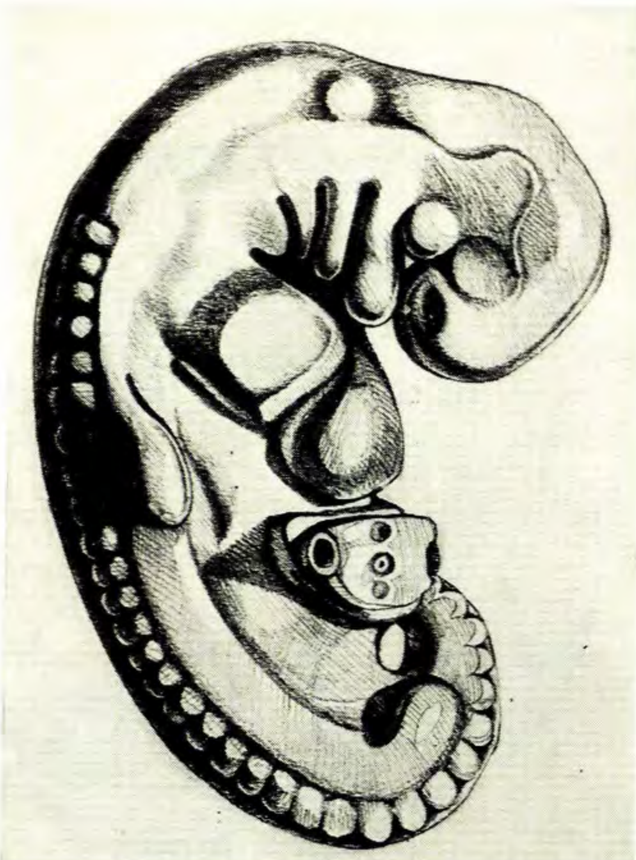

Fig. 14. A human embryo of about 7 mm CR length and age about 34 days.

Fig. 15. A human embryo of about 14 mm CR length and age approximately 41 days.

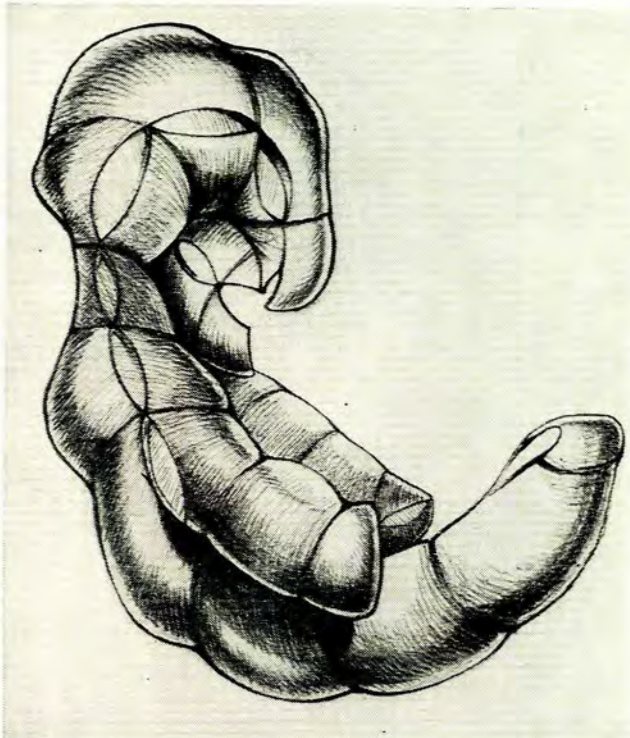

Fig. 16. Drawing of a model postulating the structure which the early spiral pattern of cells would show at the stage of development reached by a 41-day-old human embryo as shown in Fig. 15.

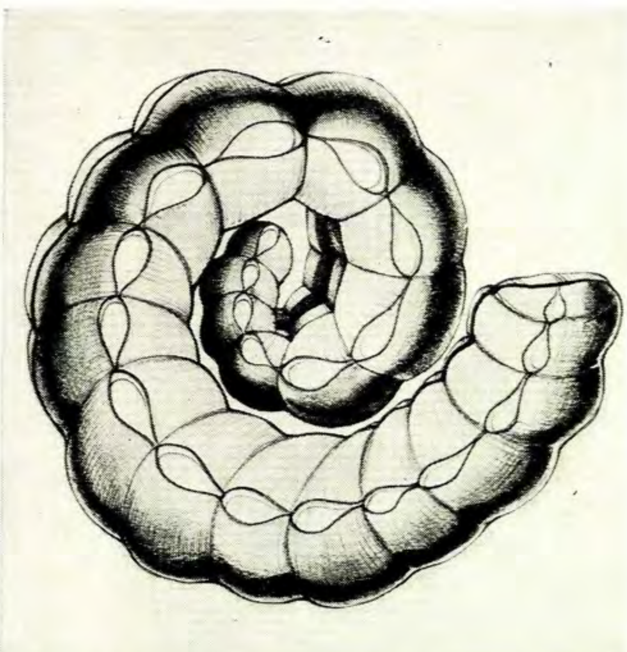

Fig. 17. Diagrammatic representation of the spiral pattern formed by the very early vertebrate embryo.

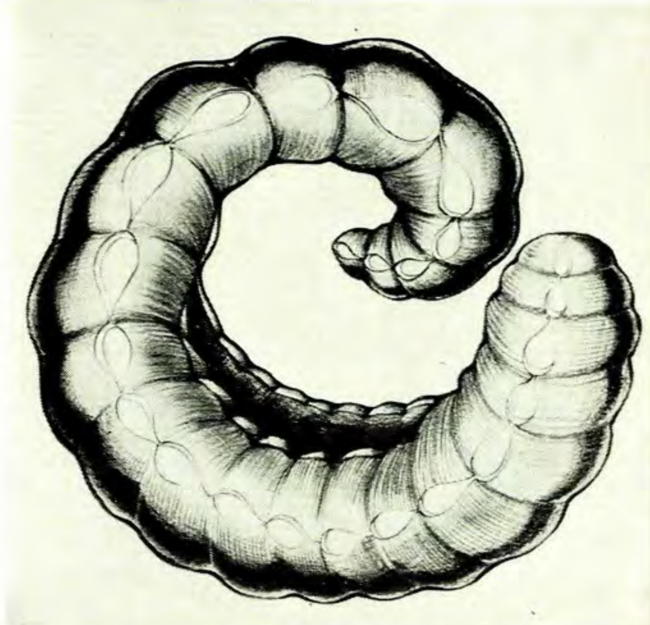

Fig. 18. Diagrammatic representation of the unwinding of the spiral pattern which it is postulated occurs as growth proceeds.

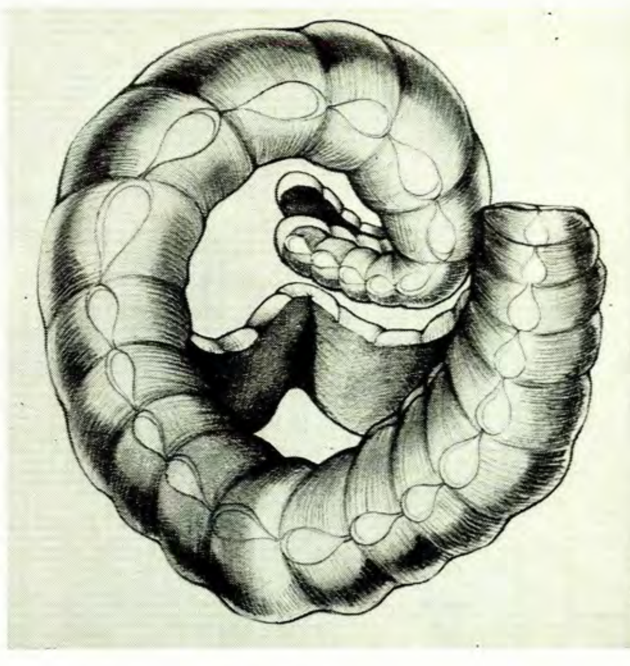

Fig. 19. Drawing of a model postulating the manner in which unwinding and lateral outbudding occurs in the spiral pattern of the early vertebrate embryo as growth occurs.

As the embryo grows the spiral pattern gradually unwinds and this leads to a lateral 'outbudding' which produces the limbs.

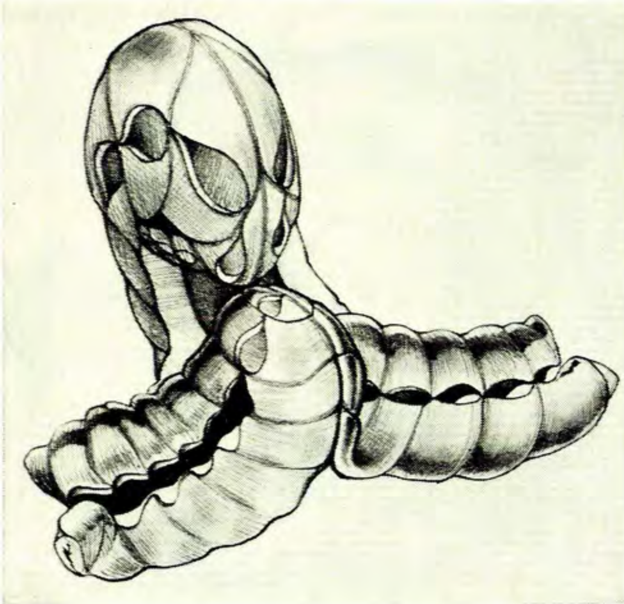

Fig. 20. Drawing of a model postulating the manner in which the further lateral outbudding of the spiral pattern occurs in the areas destined to become the limbs.

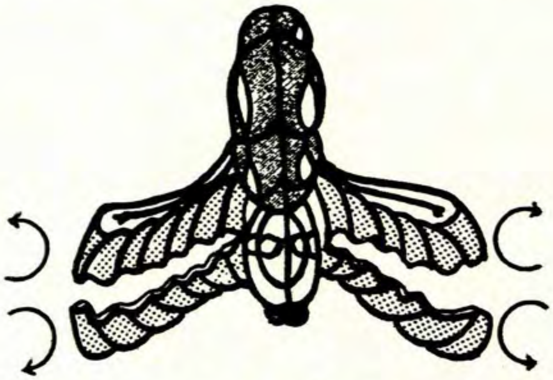

Fig. 21(b). The direction of the limb rotations.

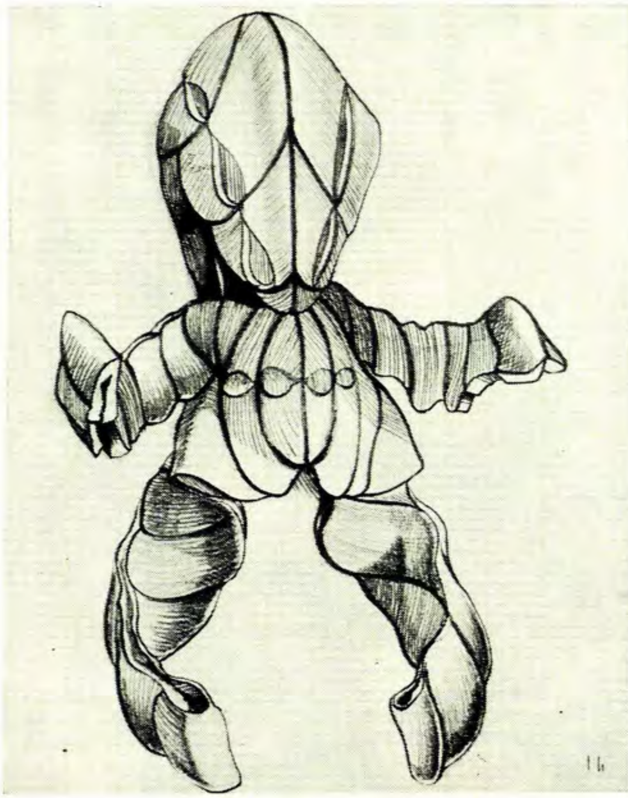

Fig. 21(a). Drawing of a model illustrating the rotation which the limbs undergo as they bud out.

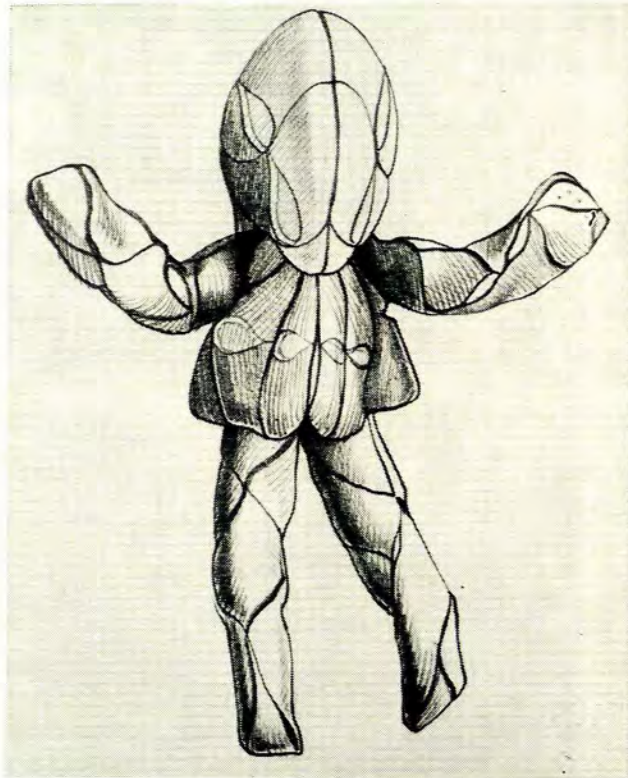

Fig. 22. Drawing of a model showing the fully formed animal in terms of the spiral pattern from which the various areas are destined to develop.

As growth progresses, the original spiral pattern (Fig. 17) unwinds (Fig. 18) and the two spirals alongside each other, split apart (Fig. 19). With further growth, further unwinding of the spiral occurs, and the limb areas commence budding out laterally (Fig. 20).

As they bud out, they also undergo movements of rotation (Figs. 21(a) and 21(b)). The upper limb rotates so that its cranial or pre-axial border becomes posterior. The lower limb rotates so that its cranial or pre-axial border becomes anterior.

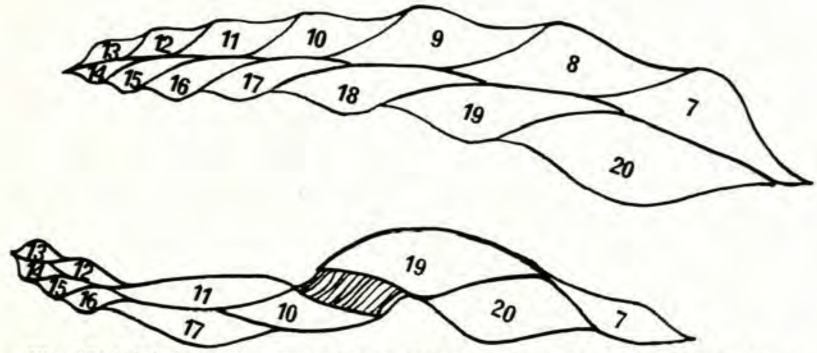

Fig. 23(a) (above). The approximate arrangement of the spiral pattern from which the muscles of the upper limb are destined to be formed. Fig. 23(b) (below). Diagrammatic representation after rotation has occurred of the spiral pattern which is destined to develop into the upper limb.

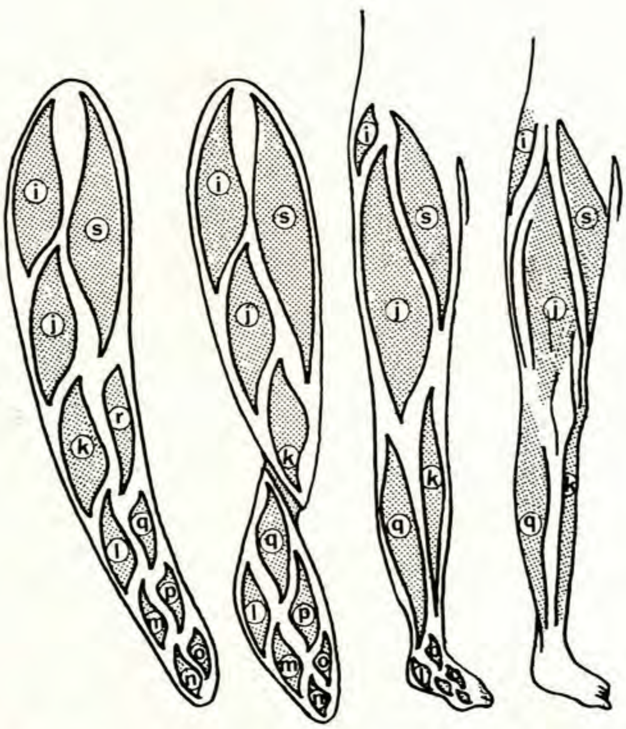

Fig. 24. The approximate arrangement of the spiral pattern which is destined to develop into the muscles of the lower limb.

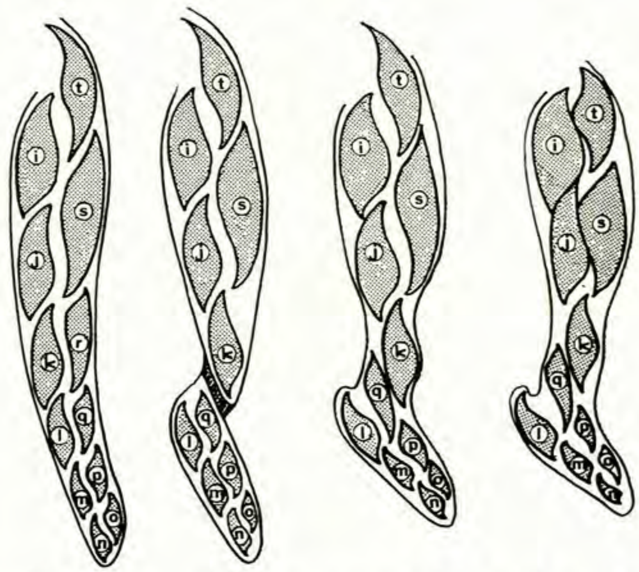

Fig. 25. The approximate arrangement of the spiral pattern which is destined to develop into the bones of the lower limb.

As growth continues these rotations are repeated. Each rotation results in the formation of one of the limb segments, so that eventually the upper arm, the forearm and the hand are formed in the upper limb, and the thigh, the leg and the foot are formed in the lower limb (Fig. 22).

The fact that the exact shapes of the various muscles and bones of the limbs of a vertebrate can be calculated from this spiral pattern, strongly suggests that the plan is derived from this pattern (Figs. 23(a), 23(b), 24 and 25).

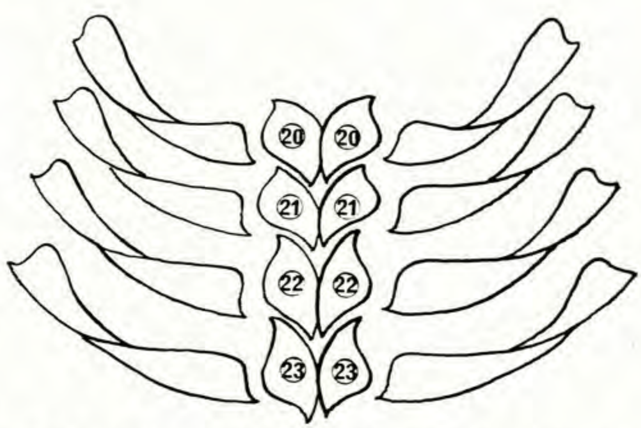

Fig. 26. The spiral pattern which is destined to develop into the sternum.

The thoracic cage itself is formed by the more distal part of the spirals, and the areas of the right and left spirals, fusing together in the midline, form the sternum (Fig. 26).

DISCUSSION

The observation that a spiral pattern exists in the early vertebrate embryo, and that it persists throughout development, suggests a means by which DNA, the genetic material, may control the development and appearance of the animal. For example, if the exact shape and curve of the spiral pattern at the position of the future nose resembles the parents' original spiral pattern, it would explain the resemblance between the offspring's nose and that of the parents.

The persistence of a spiral pattern throughout development also offers an explanation for the maintenance of the relative sizes and proportions of the organs of the body to each others, since the pattern is maintained as growth continues.

Finally the observation of a spiral pattern may have evolutionary implications, since it offers an alternative to natural selection for the existence of a common vertebrate pattern, for if all vertebrates commence from a similar spiral they would have a common pattern. In addition, the early features of all vertebrate embryos would resemble each other.

The differences between species might in fact be due either to differences in the initial spiral or to different degrees of unwinding of the same spiral.

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