glycine and imino acid residues with two and four residues in the monomer unit and also for polyglycine and poly–L–proline. The details of these will be reported elsewhere.

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BIOISOMERISM IN CYCADS

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ABSTRACT

Left and right handedness in *Cycas revoluta* Thunb., and *C. circinnalis* L. (Cycadaceae) with regard to spirality of scale and foliage leaves are described. Left and right handed plants occur at random in almost equal ratio, although the left handers are in slight excess. The phyllotaxy is symmetrical and multijugate in both the species.

INTRODUCTION

HANDEDNESS in gymnospermous plants though known for over hundred years since Beal[5] first observed in cones of *Picea* (Pinaceae), this phenomenon has been recorded during this century in *Pinus austriata*[7]. In this communication, we describe observations on handedness in *Cycas revoluta* Thunb., and and *C. circinnalis* L. (Cycadaceae).

MATERIAL AND METHODS

Mature plants of *C. revoluta* and *C. circinnalis* growing at different places in Hyderabad, Secunderabad, Warangal (A.P.) and Agra (U.P.) have been examined. A cycad is regarded as right handed (dextrorotatory) when the spirality of the leaves is counter-clockwise and a mirror image with clockwise spiral constitute a left handed (levo-rotatory) plant. Regular observations for several years confirmed that handedness is not a sporadic phenomenon but a regular feature of the species, for a right handed plant produces even the foliage leaves in counter -clockwise spiral and the left handed plant in clockwise spiral. Observations as to the spirality of the mega and microsporophylls further confirm the handedness in both the species.

OBSERVATIONS

Mature plants of *C. revoluta* and *C. circinnalis* have a branched or unbranched stout columnar and woody trunk with a crown of large palm like leaves at the summit. The leaves are dimorphic. In Plate 1, left (L) and right (R) handed plants of *C. revoluta* are shown. Both the L and R plants look alike but a close examination reveals that they are different the way the scale leaves show spirality.

PLATE 1—L: Left handed plant of *Cycas revoluta* showing clockwise spirality of scale leaves in side and top view. R: Right handed plant of *Cycas revoluta* showing counter-clockwise spirality of scale leaves in side and top view.

The scale leaves are small, brown felted, cover the foliage leaves in bud condition and exhibit clear spirality, their tips turning sharply either to the left or to the right in a given plant. The tips of the scale leaves are spiny in *C. revoluta*, and are helpful in determining the spiral. There are 3 to 5 whorls each whrol containing 20 to 28 scale leaves.

The foliage leaves are large pinnate, measure equally in both the left and right handed plants. They form a crown at the summit in a spiral fashion. The spirality of the foliage leaves can be observed in top view only. These are produced in 5 distinct whorls of alternating spirals. The leaves of the consecutive spiral (whorl) 'orthostichy' fall in a row and on connecting these a clockwise and a counter-clockwise spiral devtlops (Fig. 1). Following Thomas[16] the phyllotaxy in *Cycas* may be regarded as symmetrical and multijugate.

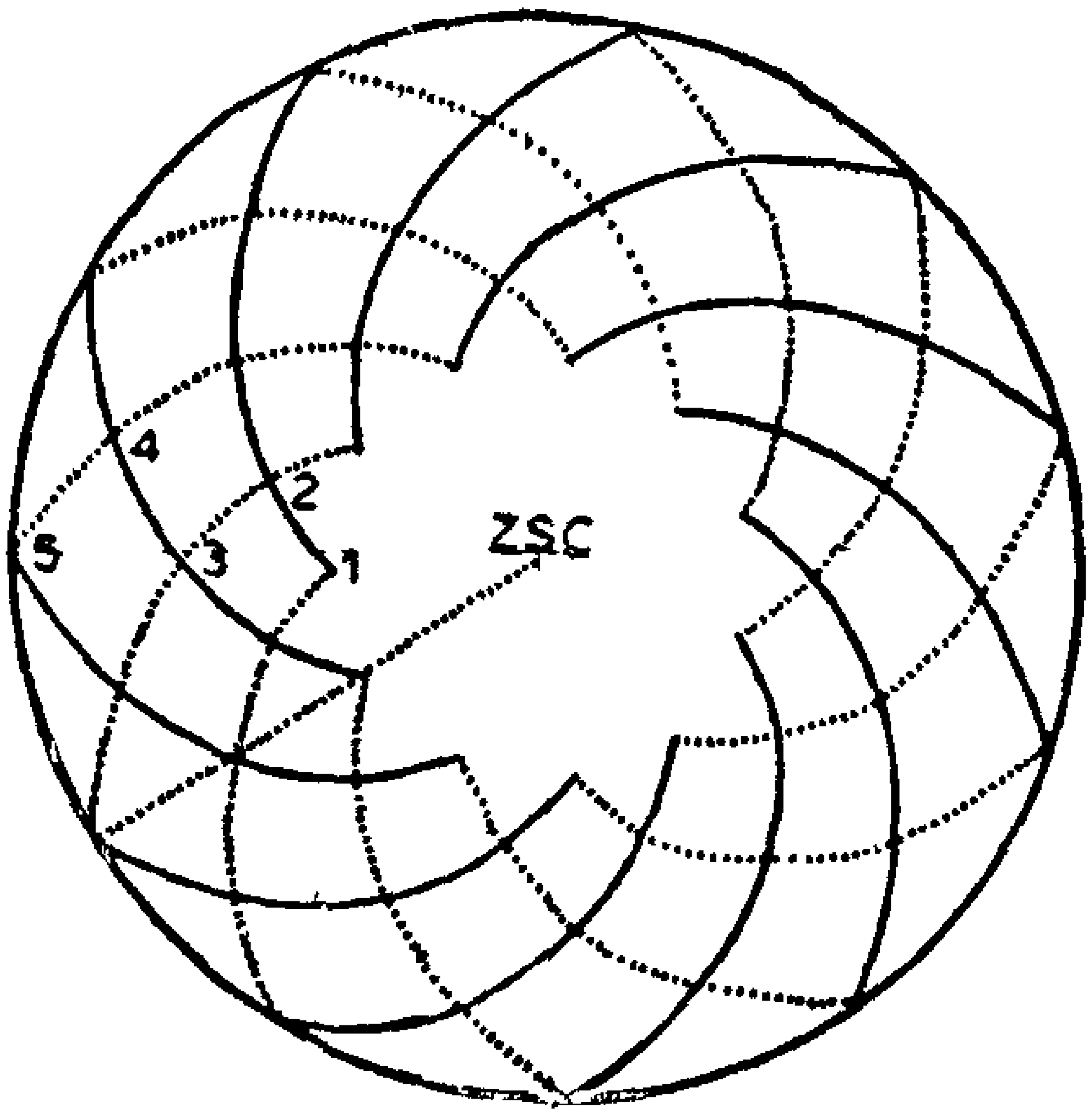

FIG. 1. Construction of the shoot apex of *Cycas revoluta* where ZSC represent the zone of scale leaves while 1 to 5 show alternating spirals of foliage leaves.

Combined data as to the distribution of left and right handed plants in each of the two species sampled from various places are summarised in Table I. A total of 73 plants of *C. revoluta* were sampled, out of which 39 were left handed (53·124%) and 34 right handed (46·576%). The χ^2 for deviation from equality is not significant and the L/R ratio is 1·11 indicating a slight excess of left handers. In *C. circinnalis*, however, an excess of left handed plants was observed. The χ^2 value is not significant but the L/R ratio indicates an excess of left handed plants. Combined data on both the species also show an excess of left handers but the χ^2 for deviation from equality is not significant. The L/R ratio, however, is very high and this may be attributed as due to the heterogeneous nature of the samples. The only information available, comparable to *Cycas*, is that of Cooke[7] who found equality in the ratio of left and right handed scales in the cones of *Pinus austriaca*. Elsewhere, Davis[8] and Bahadur *et al*[3] have observed equality in coconut palms and in seedlings of *Bambusa arundinacea* respectively.

TABLE I

The ratio of left and right handed plants in two species of Cycas

Species	Left	Right	L-R	L+R	L/R	χ^2 1:1 deviation	P value %
C. revoluta	39	34	5	73	1·14	0·341	50–70
C. circinnalis	72	59	13	131	1·22	1·290	20–30
Total	111	93	18	204	1·93	1·59	<20

DISCUSSION

In the literature the leaves and sporophylls are reported to be spirally arranged in the living cycads[5-7,13,16] According to Lawrence[11], however, the leaves are alternately arranged in close spirals, "that seem to be whorls and forming crowns at trunk apices". This appears to be true in the light of the present observations. It is interesting to point out that even the fossil cycads show spirality[14,15]. It is thus obvious that the handedness based on spirality of leaves or cones in cycads represents a clear case of bioisomerism associated with mathematical isomorphism[1,4,12].

The causal aspects of spiral phyllotaxy in *Cycas*, at the moment are unknown but we are also of the opinion that it is not due to Mendelian inheritance[9]. According to Dormer[10] phyllotaxy represents a case of three dimensional (or solid) pattern of morphogenetic regulation and includes all stereoisometric configurations. The bioisomerism in *Cycas* presently studied possibly comes under the same category. The possible mechanisms that govern handedness in plants have been reviewed by Bahadur *et al*[1].

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NOTE ADDED IN PROOF

A comment on phyllotaxy and Fibonacci series was inadvertently omitted. According to Davis (personal communication) the male cone of *Cycas* species shows a Fibonacci series of 8, 13, and 21. A similar series very likely exist in the shoot apex of *Cycas* species presently studiel. Recently, G. J. Mitchison has published an excellent paper on this subject (see *Science*, 186 : 270, 1977).

INHIBITION OF PASSIVE CUTANEOUS ANAPHYLACTIC (PCA) REACTION IN MICE BY COBALT AND IRON COMPLEXES

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ABSTRACT

Various co-ordination complexes of iron (2+) and cobalt (2+) have been synthesised and tested for their anti-anaphylactic effect in mice. All of them exhibited more pronounced activity than their parental constituents. The complexes of both iron (2+) and cobalt (2+) with 2–picoline were most active followed by their complexes with 4–picoline.

INTRODUCTION

HEAVY metals such as cobalt and iron are capable of combining with a wide variety of organic chemicals and producing numerous biological effects (1–4). It has been known for many years that cyanocobaltamin and haemoglobin, which are the co-ordination compounds of cobalt and iron respectively, play important physiological roles in the biological system (5).

Nicotinamide and pyridine have been reported to have anti-anaphylactic activity in rats and guinea-pig mast cell preparations (6–7). A series of metal complexes containing either cobalt (2+) or iron (2+) oxalates with pyridine or its derivatives as donor molecule has, therefore, been synthesised and tested for inhibitory effect on passive cutaneous anaphylactic reaction in the mouse. The present paper describes the results of this investigation.

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EXPERIMENTAL SECTION

(A) Chemical

(*i*) *Chemicals used* : Cobalt (2+) and iron (2+) oxalates of L.R. grade were used for co-ordination with organic ligands (G.R. grade) after purification employing standard literature procedures.

(*ii*) *Preparation of the complexes* :The co-ordination complexes were prepared by direct interaction of metal oxalates with ligands in a suitable solvent. Pyridine complexes were prepared by the method of Lapiere (8) whereas those of picolines were obtained by the methods of Logan and Costa (9).

(*iii*) *Characterization of complexes* : Various physicochemical techniques, *viz.*, microanalysis, conductivity, measurement, infrared spectral studies, diffuse reflectance and magneto-chemical investigations were