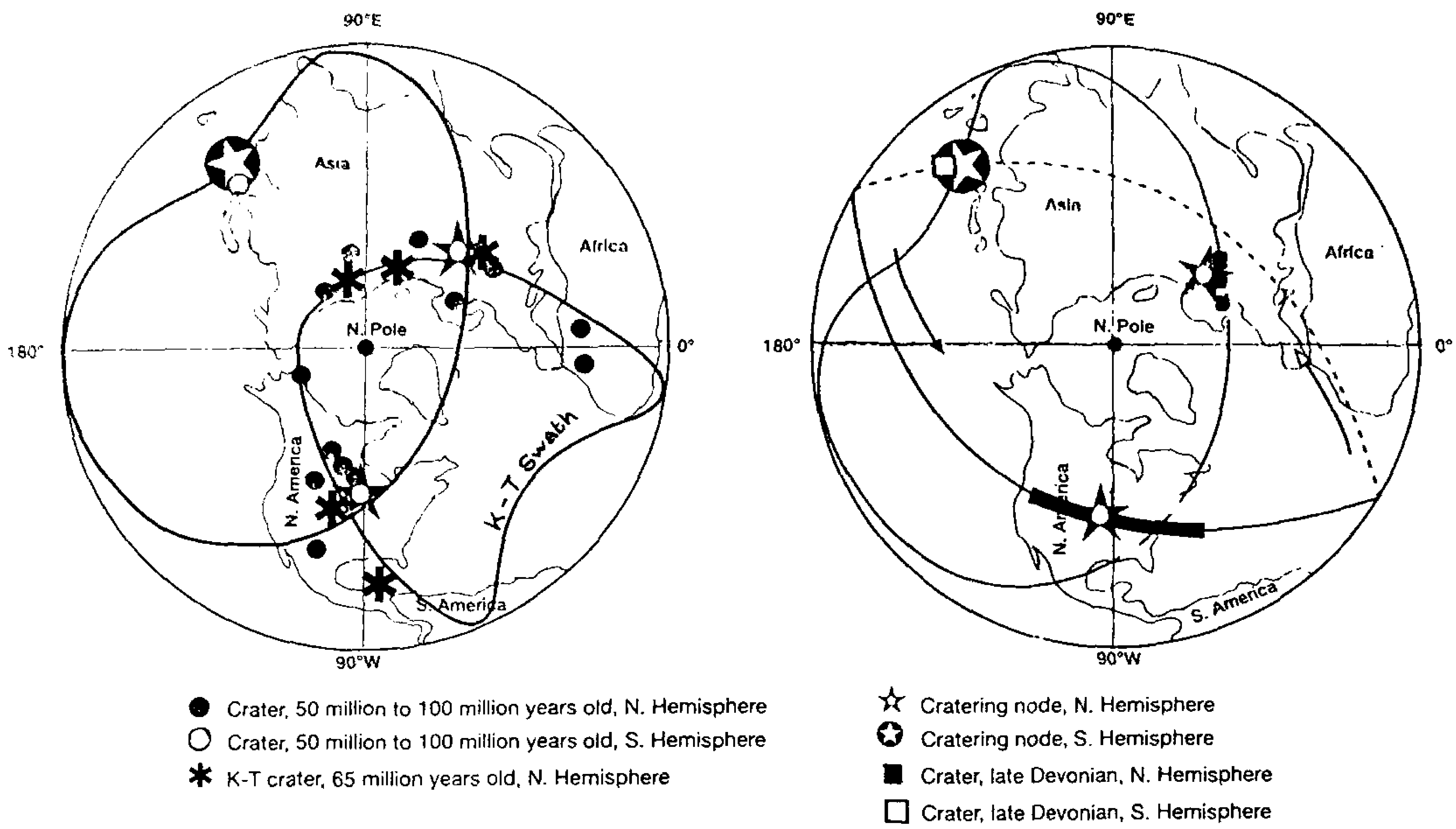

Figure 1.

After elaborate computer calculations, Shaw has derived a potential orbit for Earth-circling asteroids.

While the postulated mechanics of asteroid capture appear plausible, their role as prime agent shaping Earth opposes well-accepted theories. For example, Shaw feels that their powerful impacts in the past triggered some of the flood basalt eruptions which he finds located along the great circle. This runs counter to the accepted idea that they arise as plumes of hot lava from Earth's molten interior. Similarly, his hypothesis is opposed to current theories of plate tectonics, or the drifting of continents. He finds that the regions frequently hit, i.e. the cratering nodes, have remained the same during the vast span of 600 million years, thereby implying that the continents have not drifted for long periods, or they did so, much less than what is believed, or they have been returning again and again to the same location. Even the well-documented shifting of the Earth's magnetic field, believed to be caused by drifting currents of molten iron within the Earth's core is attributed by Shaw to powerful asteroid impacts inducing the drifts.

Although a few scientists in the past have linked asteroid impacts to the onset of volacanism and drifting of magnetic field, it is however Shaw who unified these by applying nonlinear dynamics and predicting patterns in their paths, otherwise not apparent.

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RESEARCH NEWS

The manganese hide out in the photosynthetic reaction centre

M. K. Raval

A manganese cluster oxidizes water to oxygen in the reaction centre II of oxygen evolving photosynthetic organism. This photochemical reaction is crucial for production of biomass and maintenance of oxygen level on earth. Therefore, the study of structural and functional aspects of the Mn-centre has received much attention[1]. Knowledge of structural organization of Mn and its ligands in the catalytic centre and mechanism of photooxidation of water might lead to design of synthetic Mn-centre mimicking photosynthetic reaction centre II for harvesting solar energy[2]. However, it has not been

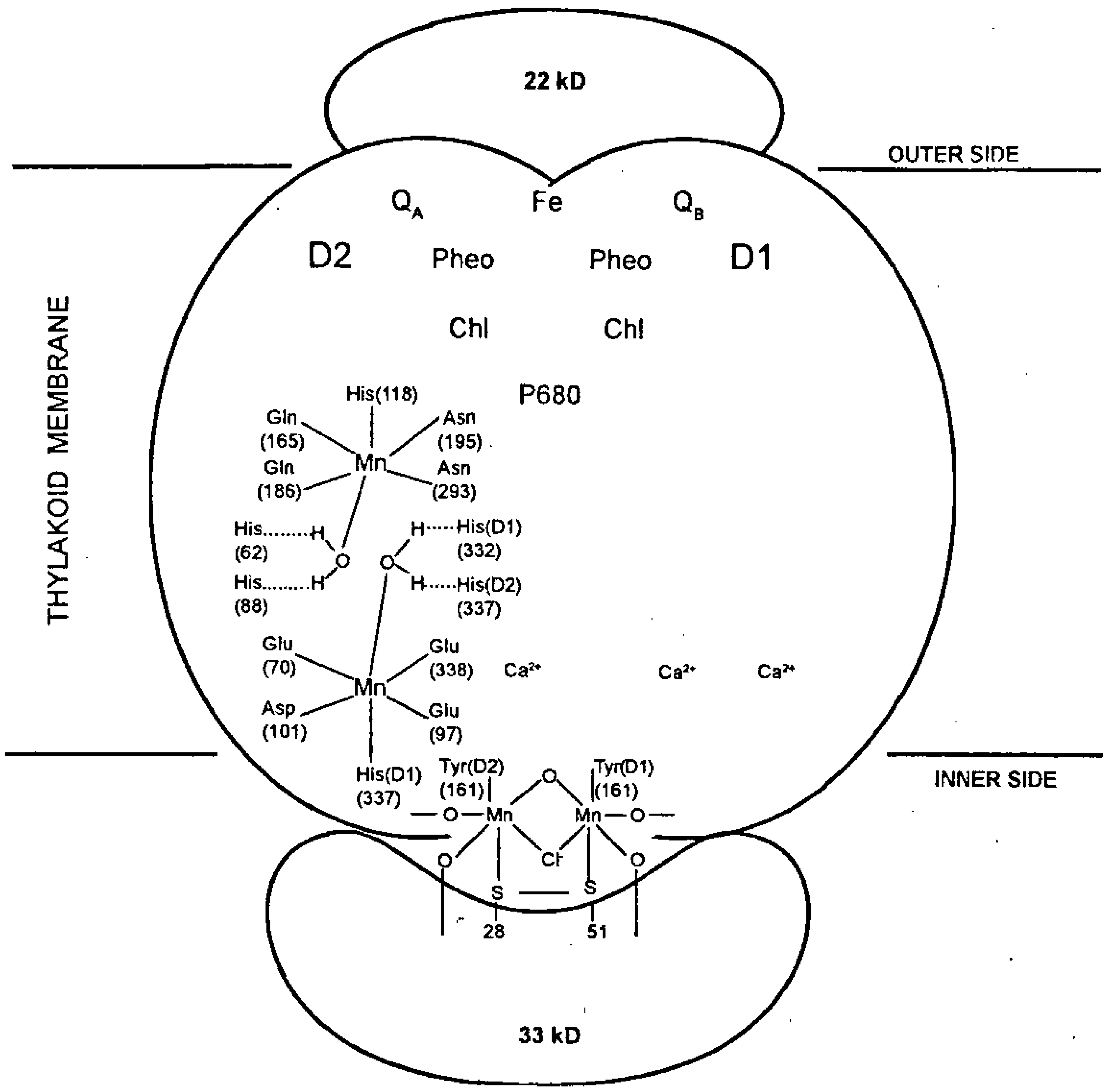

Figure 1. A model for structural organization of Mn in photosynthetic reaction centre II of higher plants[8]. D1, D2: heterodimeric proteins of reaction centre II; P680: Special pair Chlorophyll *a* absorbing at 680 nm; Chl: Chlorophyll *a*; Pheo: Pheophytin *a*; Q,Q: Quinones A and B.

possible to discover the nature of this cluster (two dimers or a tetramer) as well as the hide out (amino acid residues ligating to Mn cluster) in the heterodimer proteins D1/D2, even after an untiring endeavour of almost two decades by scientists with elegant techniques like electron spin resonance (ESR)[3] and extended X-ray absorption fine structure spectroscopy (EXAFS)[4]. X-ray crystallographic structure determination of purple bacterial photosynthetic reaction centre and its similarity with oxygen evolving reaction centre II, inspired building of a number of models for the catalytic site of reaction centre II.

Recently, site-directed mutagenesis has shown promise to locate the manganese hide out. Debus and colleagues have reported some amino acid residues as probable ligands to Mn through mutant study in cyanobacteria[5,6]. The probable Mn binding ligands are H332, E333 and H337 of D1 protein. Earlier in 1990 Vermaas *et al.*[7] had reported probability of E69 of D2 protein in cyanobacteria (E70 of D2 in higher plants)[7]. These results coincide with theoretical propositions made earlier. We had reported in 1990 in a theoretical model of reaction centre II, H332, H337 of D1 and E70 of D2 as ligands to Mn (Figure 1)[8]. The theoretical model of Coleman and Govindjee also proposes E70 of D2 and E333 of D1 to be possible Mn ligands[9].

Though cumbersome the site-directed mutagenesis appears to be the only effective technique next to X-ray crystallography to discover the Mn hide out.

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Research Snippets *(edited by K. Manjula)*

Giant magnetoresistance: New concepts

Magnetic coupling has played a key role in the discovery of the Giant Magnetoresistance (GMR) effect in thin films. In certain multilayers consisting of alternating ferro- and non-ferromagnetic films (e.g. Co/Cu), adjacent ferromagnetic films couple to each other through the nonferromagnetic film separating them. When an external magnetic field is applied to overcome this coupling, the ferromagnetic moments align and as a result, a change in the electrical resistance of an unprecedented magnitude is observed. This is referred to as Giant Magnetoresistance or GMR effect.

The large drop in electrical resistance of a solid in a magnetic field is an important phenomenon that has a potential application in magnetic storage media like magneto-optical recording and magnetic sensing devices. Lanthanide manganites doped with alkaline earth metals like calcium or strontium having the formula $La_{1-x}A_xMnO_3$, (A = Ca, Sr) exhibit a