having unit cross-sectional area must have the same mass". Elevated rocks are characterized by rocks of low density and depressed basins by rocks of higher density.

(*a*) **Pratt's Hypothesis.** "All blocks of the same weight and cross-section sink to the same depth in a suitable liquid-medium". Salient features are : compensation takes place by lateral density variations because the crust varies laterally in density ; thickness of the crust is constant only at the bottom ; crust synonymous with lithosphere.

(*b*) **Airy's Hypothesis.** "All blocks of the same material but different heights will sink to different depths in a liquid medium and irregularities will be on both the surfaces *i e.* top and bottom". Salient features are : compensation takes place by adjustment of crustal base ; density of the crust and the subtratum is constant throughout ; thickness of the crust varies by the top and bottom while that of the substratum varies only by the top ; lithosphere comprises both crust and part of the upper mantle.

Transform Faults

These are named by J. Tuzo Wilson in 1965. These form a type of plate boundary called Conservative or Parallel plate boundary in which only transform motion (large horizontal displacement) occurs *i.e.* the plates move past each other with no destruction or construction. At these faults the displacement suddenly stops or changes the direction. These are horizontal shear faults which terminate abruptly at both ends but may show great displacement of the crustal blocks. These are parallel to the direction of relative motion of the plates on either side of the plates and are therefore controlled by the relative velocity of the two plates. They commonly trend at right angles to the MORs and appear to offset them. Their motion is opposite to that of the transcurrent faults (offset increases with transcurrent motion but it remains constant with transform faults). In between the offset ridges, transform faults show shallow seismicity i.e. earthquakes are confined to the area between the offset ridges. Another important feature is that transform motion occurs only in the area between the offset ridges, and beyond the ridges the motion again changes to that of a transcurrent fault. In many areas they connect belts of of plate generation with zones of plate destruction, *e.g.* Mendocino fault, San Andreas fault, etc. Transform faults are of 3 types : Ridge-Ridge which are most common and retain a constant length as a function of time and Ridge-Trench and Trench-Trench which increases or decreases in length as they evolve.

Triple Junctions. These are Y-shaped junctions where three plates share a corner. They are classified as stable or unstable, depending on whether or not they preserve their geometries as they evolve. The geometric conditions for stability are described with vector velocity triangles. Only RRR triple boundaries are stable for all orientations of plate boundaries. *e.g.* Pacific, Coccos and

term is derived from the Karst Plateau on the Adraitic Coast of Yugoslavia. Ideal conditions for karst development are : a considerable thickness of pure limestones with high crushing strength and low permeability ; considerable uplift of the land above the sea level ; and high annual precipitation.

Karst Features. 1. Terrarosa—Reddish-clayey soil characteristic of moderate to gentle slopes in limestone terranes, specially in tropical and temperate regions ; often contain fossils of Pliestocene age.

2. Lappies or Karren complex—An etched, pitted, grooved and rugged surface formed in areas of high relief is called karren, lapies or Griekes. Best developed in non-porous limestones with steep surface slopes.

3. **Sink Holes**—Assymetrical cup-shaped hollows occurring above the water table in limestone terranes.

(*a*) Dolines—are the sink holes that exhibit steep-sided, rocky and abruptly descending forms. They are a result of collapse of near surface caves.

(*b*) Uvalas—are larger depressions formed by the collapse of extensive roof sections.

(*c*) Poljes—are large, more or less closed depressions with steep sides and flat alluvial floors, frequently dotted with conical residual hills.

(*d*) Ponors (Swallow holes)—are vertical channels leading to UG karstic caverns within the limestone.

(*e*) Dripstones—Calcareous deposits formed by percolating water containing $CaCO_3$ in solution and occurring in the form of solid columns are called dripstones. It consists of downward extending stalactites and upward—growing stalagmites.

(*f*) Hums—These are the erosional remnants of a limestone upland occurring as residual hills analogous to monadnocks in the fluvial cycle. These are also described as Pepino hills (Haystack hills), Mogotes or Temoines.

(*g*) Helictites—are crystalline formations of most varied shapes arranged in spirals or loops in limestone caves.

(*h*) Anthodites—deposition of calcite in the roof of caverns in the form of delicate flower-like formations.

Coastlines. It is the boundary between the coast and the shore. It is the seaward limit of the coast.

Coastlines of Submergence. 1. These are produced either by subsidence of land or rise in sea level ; (2) It is very irregular with bays and headlands ; (3) Typical features include : sea caves, blow holes, arches, stacks, inlets, etc.

Coastlines of Emergence. (1) These are produced either by the uplift of the sea bottom or gradual fall in the sea level : (2) It is very regular and does not offer shelter from wind and waves ;

Xm=rotation axis with a vertical plane of symmetry

X_2=rotation axis with a diad axis normal to it

X/mm=rotation with both kinds of planes of symmetry.

In the Cubic Sys. the first position of the H-M-S refers to an a-axis, the 2nd position to an axis coincident with the body diagonal of the cube, or the normal to the (111) face ; and the third to the axis normal to (110). All Xl. is this Sys. have 4 axes of 3-*f* symm. hence, in H-M-S the no. 3 is always in the second position. This arrangement is not found in any other Xl. class. In the Tetragonal sys. the first position refers to the *c* axis, the second to a_1 or a_2, the third to the axis which bisects the 90° angle between a_1 and a_2. In this sys. the first unit in the H-M-S. is always either 4 or $\bar{4}$. In the Hex. Sys. the 3rd position refers to an axis which bisects the 60° angle between adjacent '*a*' axes.

$\bar{1}$ corresponds to ... a Centre of Symmery (C)

$\bar{2}$ corresponds to . a Reflection plane (m)

$\bar{3}$ corresponds to ... a 3-*f* axis combined with a centre ($\bar{3}=3+\bar{1}$)

$\bar{6}$ corresponds to ...a triad axis combined with a perpendicular mirrior plane ($\bar{6}=3+m$).

The Seven Crystal Systems

Crystal system	*Symmetry elements*	*Characteristic symmetry*	*No. of classes in system*
Triclinic	$a\neq b\neq c$		
	$\alpha\neq\beta\neq\gamma\neq 90°$	monad	2
Monoclinic	$a\neq b\neq c$		
	$\alpha=\gamma=90°\neq\beta$	1 diad (//*y*)	3
Orthorhombic	$a\neq b\neq c$		
	$\alpha=\beta=\gamma=90°$	3 diads (//*x*, *y*, *z*)	3
Tetragonal	$a=b\neq c$		
	$\alpha=\beta=\gamma=90°$	1 tetrad (//*z*)	7
Hexagonal	$a=b\neq c$		
	$\alpha=\beta=90°$ $\gamma=120°$	1 hexad (//*z*)	7
Trigonal	$a=b=c$		
	$\alpha=\beta=\gamma\neq 90°$	1 triad (//[111])	5
Cubic	$a=b=c$		
	$\alpha=\beta=\gamma=90°$	4 triads (//<111>)	5

4. Trigonal—Trigonal trapezohedral (32) and Trigonal pyramidal (3)

5. Orthorhombic—Rhombic Disphenoidal (222)

6. Monoclinic—Sphenoidal (2).

7. Triclinic—Pedial (1).

Centrosymmetrical classes. Xls. having a centre of symmetry Total=11. *i.e.* 4/m $\bar{3}$2/m ; 2/m $\bar{3}$; 6/mm ; 6/m ; $\bar{3}$2/m : $\bar{3}$; 4/mm ; 4/m ; 2/m ; $\bar{1}$.

Bravais Lattices. 14—(*a*) Cubic—P, I, F (*b*) Tetragonal—P, I (*c*) Orthorhombic—P, C, I, F (*d*) Monoclinic—P, C (*e*) Triclinic—P (*f*) Trigonal—R (*g*) Hexagonal (and trigonal)—C.

Unit Cell. The geometrical block-like outline enclosing a unit of pattern in a crystal's structure.

Xl.	*Cell Shape*	*Symmetry of shape of cell*
Triclinic	General parallelepid	$\bar{1}$
Monoclinic	Right prism on parallelogram as base	2/m
Orthorhombic	Rectangular parallelepiped	2/m 2/m 2/m
Tetragonal	Square prism	4/m 2/m 2/m
Cubic	Cube	4/m $\bar{3}$ 2/m
Trigonal	Cube deformed along one diagonal	$\bar{3}$ 2/m
Hexagonal	Prism on 60°—120° base	This cell does not itself have hex. symm. but the complete lattice does.

Unit Net. The unit net is obtained by joining the nearest points in a net in such a manner as to show the highest symmetry. In a primitive unit cell the points are only at the corners.

Symmetry exhibited by a Unit Net. Oblique—2 Hexagonal—6 mm Square—4 mm Centered rectangular—2 mm.

Screw Axis. A symmetry element in a repeating pattern whose operation is a combination of a rotation about the axis by 360°/n and a shift parallel to the axis by m/n of the lattice translation, where $1 \leqslant m < n$.

Glide Plane. A symmetry element in repeating pattern whose operation is a combination of reflection in the plane and shift of the reflected image parallel to the plane by half of a lattice translation.

CONTENTS

Section : III (Previous Papers)