Karoo Series is traversed with igneous dykes. Limestones and Sandstones (9) with fossils of nearly pure Jurassic, but with some of Cretaceous type, occur unconformably in the Eastern Province. Their fossil Flora is like that of the Stormberg Beds. Cretaceous strata (10) are known on the Natal coast: and Tertiary and post-Tertiary deposits (11) form several patches on the east, south, and west coasts.

THE SOUTH AFRICAN FORMATIONS

11. Tertiary and Post-Tertiary, 100′?
(Unconformable on several different rocks)

10. Cretaceous
(Unconformable on Carboniferous?)

9. Jurassic — Uitenhage Formation: Trigonia Beds, Wood-bed, Saliferous Beds, Zwartkop Sandstone (400′?); Enon Conglomerate, 300′
(Unconformable on Devonian and other old rocks in Albany)

Triassic — Karoo Beds:
8. Upper: Cave Sandstone, 150′; Red Beds, 600′; Stormberg Beds, 1000′
7. Lower: Sandstones and Shales, 5000′; 7*. Kimberley or Olive Shales and Conglomerates, 2300′
(Unconformable on Ecca Beds in the south, and on the old Vaal and Kaap series in the north)

Carboniferous?
6. Ecca Beds: Upper Ecca Beds, 2700′; Dwyka Conglomerate, 500′; Lower Ecca Beds, 800′
5. Witteberg and Zuurberg Quartzites, 1000′?
4. Table-Mountain Sandstone, 4000′
(Unconformable on the Old Cape Schists and Slates and on the Bokkeveld Beds

Devonian
3. Bokkeveld Beds, 1100′
(Probably unconformable to the Malmesbury Beds)

Silurian?
2. Malmesbury Beds, Mica Schists and Slates of the Cape
(Probable unconformity)
1. Namaqualand Schists and Gneiss

SECTION G—MECHANICAL SCIENCE

On the Flow of Water through Turbines, by Arthur Rigg, President of the Society of Engineers, London.—After remarking that a strict adherence to the older accepted rules of design never produces thoroughly efficient turbines, and that in the best of such motors these rules are disobeyed, the writer pointed out how little reliable practical information can be obtained from all the voluminous literature relating to turbines. He also stated that the course of a stream flowing through the guides and buckets of a turbine had no appreciable influence upon the duty obtained, so long as one essential condition was observed—namely, that its velocity should be gradually reduced to the least that will carry it clear of the buckets. In comparing screw propellers and turbines, each were shown to possess similarities; and experiments made by the writer, and published in the *Transactions* of the Society of Engineers for 1868, were referred to as explanatory of this view of the case. It was further pointed out that there is no such thing as absolute motion, for all velocities are relative to something else; and thus in a turbine we need only concern ourselves with such diminution in velocity as occurs in relation to the earth, and not necessarily with velocities in relation to the moving buckets of a turbine. Impact was considered as a pressure due to the destruction of velocity in a direction perpendicular to a plane surface, while reaction, from a vertical stream, is the natural integration of the horizontal elements of the successive pressures which act vertically in regard to the concave surface upon which the stream is caused to flow. In most theoretical investigations it is assumed that impact and reaction are equal when a current is divided at right angles to its original course, and this condition implies that a maximum result should be obtained from screw propellers when their blades stand at 45° to the plane of rotation. But in practice an angle of 42° is found best, and this is so because impact and reaction under the conditions stated are not equal, but bear to each other the proportions of 71 to 62; and these proportions give an inclination of screw-blade of 41° by taking an experiment which corresponds most closely with the conditions of a screw propeller. The resultant due to these proportions is found to be 94·25 units, whereas if impact had been the same as reaction it would have been 100·75 units, and this is the total amount that can be aimed for in designing a screw prepeller, or pure impact turbine, where the stream is merely turned through a right angle from its original course. But if instead of turning the current only 90° it is turned through 180°, then impact and a still further reduced reaction both act vertically downwards; and it is their sum, and not merely their resultant, that constitutes the total pressure obtainable from a jet of water. Taking the standard unit employed in the experiments described, this sum is found to be 126, of which 71 represents impact, and the remaining 55 the effect of a complete reaction. Therefore, in designing a turbine or screw propeller, it would seem desirable to aim at changing the direction of a stream, so far as possible, into one at 180° to its original course, for it may be said that carrying out this view has placed the modern scientifically designed turbine in that preeminent position it now holds among all hydraulic motors.

The Severn Tunnel Railway, by T. Clarke Hawkshaw.—This paper described the Severn Tunnel Railway works, begun in 1873, and now approaching completion. The railway is being made to shorten the direct railway route between the South of England and South Wales. It passes under the River Severn about half a mile below the present steam ferry, which connects the South Wales and Bristol and New Passage lines. The river, or estuary, is about $2\frac{1}{4}$ miles wide. The length of the line is $7\frac{1}{2}$ miles, of which $4\frac{1}{3}$ miles are in the tunnel which passes under the Severn. The bed of the river is formed principally of Trias rocks (marls, sandstones, and conglomerates), in nearly horizontal strata. These overlie highly inclined Coal-measure shales and sandstones, which are also exposed in the river bed. The tunnel is made almost wholly in rocks of the Trias and Coal-measure formation, the exception being a little gravel passed through near the English end. The lowest part of the line is below the shoots, the deepest part of the river, where there is a depth of 60 feet of water at the time of low water, and 100 feet at the time of high water. Below the shoots, the line is level for 13 chains, rising 1 in 100 to the English end, and 1 in 90 to the Welsh end. Below the shoots, there is a thickness of 45 feet of rock (Pennant sandstone) over the brickwork of the tunnel. Under the Salmon Pool there is less cover, only 30 feet of Trias marl. Much water has been met with throughout the works, which have been flooded on several occasions. In 1879 the works under the Severn were drowned for some months by the eruption of a large land spring into one of the driftways under land on the Welsh side of the river. On another occasion a cavity was formed from the driftway under the Salmon Pool to the bed of the river, when a hole, 16 feet by 10 feet, was found in the marl. The works were flooded by the water which found an entry through this hole. It was filled with clay, and the tunnel is now finished beneath it. The quantity of water now being pumped is about 19,000 gallons per minute. Additional pumps have been erected, as the large land spring, which has been penned back by a brick wall, still remains to be dealt with. When all the pumps are available, the total power will be equal to 41,000 gallons a minute. The tunnel is for a double line of way, and will be lined throughout with vitrified bricks set in Portland cement mortar. It is being made by the Great Western Railway Company. Sir John Hawkshaw is engineer-in-chief; Mr. C. Richardson, engineer; and Mr. T. A. Walker, the contractor.

SECTION H—ANTHROPOLOGY

THE first paper read in this Section was that of Prof. Boyd Dawkins, *On the Range of the Eskimo in Time and Space.* In his introductory sentences Prof. Dawkins remarked on the importance and interest of his subject. He began his inquiry into the condition of the Eskimo by particularising those of Greenland. By the aid of a sketch-map upon the blackboard, he traced the progress of the dwellers on the Arctic shores, following them to the continent of Asia. He noted that in the