subjective judgments of an accident investigation team are involved. Major disasters in anthracite mines are also shown in Fig. 1 for the period 1911 to 1970. There is no increase in the relative frequency for the winter months, which provides more evidence that it is dust and not gas that accounts for the seasonal trend.

If we assume that a major mine explosion is a rare and random event unaffected by the occurrence of any other similar event then the probability that a number of such explosions will occur in a particular time interval (for example, 1 month) should be given by the Poisson distribution function. This was found to be the case for a number of 10- to 30-year intervals. However, when we considered the number of explosions that occurred during each of the four quarters over the period 1911 to 1970 we found that there is a statistically significant difference in the results obtained for the major (gas and dust) explosions. Similarly, the major explosions attributable to dust showed a statistically significant difference; however, those attributable to gas (total minus dust) appeared to be randomly distributed throughout the year.

Similar results were obtained when anthracite mine (gas) explosions were analyzed for the period 1911 to 1970, and minor gas and dust explosions in bituminous mines for the period 1941 to 1970. That is, the gas explosions appeared to be randomly distributed throughout the year, while the dust explosions occurred with greater frequency during the fall and winter months (that is, during cold weather).

Boyer's report (*1*) contains indirect evidence that dust is at the root of the seasonal trend, even though he did not call attention to it. He showed that the worst disasters had the strongest seasonal trend. Roughly, it might be said that these disasters resulted from the most extensive explosions which, in turn, involved the most dust. If this is true, then the more that dust was involved, the greater the seasonal trend.

The notion that humidity is an important factor in the incidence of disastrous explosions in the winter is hardly a new one. Scholz (*3*) called attention to a humidity effect in 1908. A year later, Eavenson (*6*) calculated the quantity of water lost by mines in the winter and the quantity gained in the summer. For mines that circulated 2800 to 4200 m^3 (100,000 to 150,000 cubic feet) of air per minute, about 21 to 69 tons of water per day would be lost in the winter and about 12 to 33 tons per day would be gained in the summer. Similar results are obtained in today's mines. Eavenson also presented tabulations of explosions and fatalities on a monthly basis, and the results are similar to those shown by Boyer (*1*) and in Fig. 1.

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Do the Pyramids Show Continental Drift?

Abstract. *The mystery of the orientation of the Great Pyramids of Giza has remained unexplained for many decades. The general alignment is 4 minutes west of north. It is argued that this is not a builders' error but is caused by movement over the centuries. Modern theories of continental drift do not predict quite such large movements, but other causes of polar wandering give even smaller shifts. Thus, continental drift is the most likely explanation, although somewhat implausible, especially as relevant measurements have been made over a 50-year period, whereas geophysical measurements of sea-floor spreading relate to million-year time scales.*

Flinders Petrie (*1*) made the first (modern) detailed survey of the pyramids of Giza (*2*), but his observations seem to have been overlooked by scientists outside archeology. He concluded that the average of some six alignments from the pyramids of Cheops (Khufu) (see Fig. 1) and Chephren (Khafra) was about 4′ west of true north, with an error of 1′. This indicated to him that the earth's pole had shifted by this amount.

Petrie argues that the east and west sides of each pyramid must have been set independently because the pyramids were built centered on a high point of bedrock. The entrance to Cheops' pyramid is in the form of a shaft with two distinct elevations, each section requiring independent alignment. As these are made of well-dressed and well-preserved rocks the alignments are still highly accurate, differing by only 1′. This is the origin of Petrie's estimate of alignment error, and it is well within the limits placed by the acuity of the eye, which must have been used unaided by the builders.

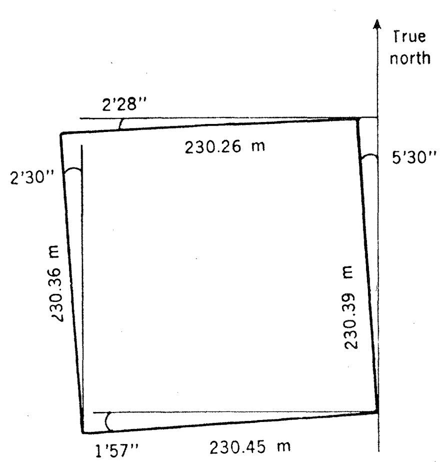

Fig. 1. The Great Pyramid of Cheops.

An independent assessment of the builders' accuracy is afforded by the north and south sides of both pyramids. There is no direct astronomical method of east-west alignment, so that right angles must have been constructed. They were done with an accuracy of about 1.5′.

The northerly alignment must have been intended to be true north as there is no way of aligning to a point just off true north. A star so close to the pole would still describe a small circle in the sky, and this circle would alter considerably in its size in one generation owing to the precession of the equinoxes. Any thought of a magnetic alignment can be discarded because the magnetic variation over one generation would be enormous when the magnetic pole is near the true pole. In any case, the ancient Egyptians were not thought to have the lodestone, and this could never be used to achieve an accuracy of 1′. Petrie hints that astronomical parallax would have to be overcome by taking records 6 months apart, but it should be possible to get an alignment of the required accuracy in a single night.

There are no other remains in Egypt which can give corroborative results; the other pyramids are smaller and of less accuracy, and many other buildings have solar or stellar alignments. The two pyramids that give us this unique result were built at the zenith of pyramid construction, and it is not surprising that they alone yield such accuracy.

Giza is situated approximately 30°E, 30°N; hence, we can say that the pole of about 4500 years ago (as seen from the center of the earth) is now 3.5′ ± 0.9′ along longitude 60°W toward Greenland, and with an unknown component along longitude 30°E. At the time of building, the "pole star" would have been Vega. Being at an elevation of 30°, Vega would be ideal for alignment, but it would be worthwhile to conduct an experiment on the actual site so that all possible sources of error could be investigated.

It is now well documented that the true pole moves at 0.0032″ annually along longitude 60°W (*3*). This would amount to 0.24′ over 4500 years, is far too small, and is of the wrong sign. Some variation is thought to be caused by the melting of the ice on Greenland and Antarctica. Other variations of the polar position are oscillatory in nature and are of very small amplitude (*4*).

Continental drift can cause the direction of true north to vary with respect to the moving block. The Americas have been separating from Africa and Europe owing to the spreading of the sea floor. This movement has a hinge southwest of Iceland, and is about 5 cm per year between South America and Africa. If this causes only the latter to rotate and if the rotation is uniform, in 4500 years the pyramids would be rotated 0.1′ in the observed sense.

Africa and the Arabian peninsula are moving apart as if hinged near the north end of the Red Sea. This suggests a rotation of the pyramids in the wrong sense, but again of a magnitude far too small. Both these movements are shown in Fig. 2.

Earthquakes are a possible mechanism for a local reorientation. The Mediterranean and Red Sea areas are well known for earthquakes, but a single quake of unprecedented magnitude

Fig. 2. The pattern of continental drift, showing two hinge points.

would be needed to move the pyramids by strain release. Expert geological opinion would be worthwhile on this point as the local fault system must be understood in detail, as also the effect of the quake thought to have occurred in 908 B.C.

An observation of the movement of the pole exists on a time scale which is rare to modern science. The continental drift theory is based on very recent measurements, and there is controversy over whether drift is continuous or jerky. In this debate the pyramid observation may make a contribution, as it should be explainable in geophysical terms.

If we accept the evidence of the pyramids as valid we may well ask what other archeological remains can give further information. There are some extremely accurate yet unexplained plateau markings in Peru, made by the Nasca people, and these are in danger of destruction. The megalithic sites in Britain and Brittany are also candidates for study, but first we must be convinced of the arguments that these are solar and lunar observatories (*5*). The best of these may be accurate enough, although this is doubtful. The pyramids probably yield the most accurate record, and it would be a pity if this unique fact was lost in the rush of science.

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Species Number and Endemism: The Galápagos Archipelago Revisited

Abstract. *Regression analyses to determine plant species number are repeated for the Galápagos Islands with new data. The multiple curvilinear regression gives the best prediction of species number, with island area making the only significant contribution. The proportion of species endemic to the Galápagos is highest in the arid, transition zone and on small islands, and lowest in the littoral and mesic zones. This is explained in terms of zone-specific immigration and extinction rates and the very recent appearance of moist upland climates in the archipelago.*

The major factors determining the number of plant species on the Galápagos Archipelago were analyzed and discussed by Hamilton *et al.* (*1*). They concluded that ecologic diversity (estimated by topographic relief) and isolation (estimated by interisland distances) were the two most important regulators of species number. While island area was the best single predictor of the number of plant species on each island (when logarithms of the species number and area were used), the multiple regression that best predicted the island species number was a linear one to which area did not make a significant contribution. Elevation made the major contribution to the determination of the number of species on each island in that linear regression. Area may also be considered a measure of ecologic diversity and has been the better predictor of plant species numbers in other island groups (*2, 3*). Do the Galápagos differ from other island groups in the determination of species number and, if so, why?

A major criticism of the results of