



XXIX. Observations relative to the structure and origin of the diamond

Sir David Brewster K.G.H. LL.D. F.R.S.

To cite this article: Sir David Brewster K.G.H. LL.D. F.R.S. (1835) XXIX. Observations relative to the structure and origin of the diamond , Philosophical Magazine Series 3, 7:40, 245-250, DOI: [10.1080/14786443508648711](https://doi.org/10.1080/14786443508648711)

To link to this article: <http://dx.doi.org/10.1080/14786443508648711>



Published online: 01 Jun 2009.



Submit your article to this journal [↗](#)



Article views: 3



View related articles [↗](#)

XXIX. *Observations relative to the Structure and Origin of the Diamond.* By SIR DAVID BREWSTER, K.G.H. LL.D. F.R.S. &c.*

IN the year 1820 I communicated to the Royal Society of Edinburgh an account of a very singular fact relative to the structure of the diamond, and I added to this communication some conjectures respecting the origin of this remarkable gem. As these conjectures have been referred to by some late and able writers on the diamond mines of India without sufficiently separating the fact from the conjectures, and as I consider the structure which I discovered around the cavities in this mineral as a leading fact in the natural history of this gem, I have been induced to re-examine it with care, and to make a drawing of the phenomena which it presents.

In order to bring all the facts into one view, I shall make no apology for quoting my original observations.

“Had the diamond not been placed at the head of the mineral kingdom, from its unrivalled lustre and high value as an ornamental gem, it would have attained the same distinction from its great utility in the arts. Separated from all other gems by its remarkable refractive power, and from all mineral substances by its extreme hardness, its chemical composition, and its locality in the crust of the earth, it has always been regarded as an anomalous substance which set even speculation at defiance.

“When Sir Isaac Newton compared the refractive power of several bodies, he remarked that amber and the diamond had a refractive power three times greater in respect of their densities than several other substances, and he conjectured that the diamond was probably an unctuous substance coagulated. This relation between the inflammability of bodies and their absolute refractive power I had an opportunity of confirming and extending by ascertaining that sulphur and phosphorus exceed even the diamond in absolute refractive power, and that these three simple inflammable bodies stood at the head of all other solid and fluid substances in their absolute action upon light.

“In this arrangement, amber stood next to diamond; and as both these substances had a similar locality, and had also carbon for their base, it became of some importance to discover that their general polarizing structure was the same. The analogy, however, to which I wish to direct the attention of the Society is founded on the existence of small portions of

* From the Transactions of the Geological Society, N.S., vol. iii. p. 455. See Lond. and Edinb. Phil. Mag., vol. iii. p. 220.

air within both substances, the expansive force of which has communicated a polarizing structure to the parts in immediate contact with the air. This structure is displayed in four sectors of polarized light encircling the globule of air, and can be produced artificially either in glass or in gelatinous masses by a compressing force propagated circularly from a point. It is obvious that such an effect cannot arise from any mode of crystallization; and if any proof of this were necessary, it might be sufficient to state that I have never observed the slightest trace of it in more than 200 mineral substances which I have examined, nor in any of the artificial salts from aqueous solutions. It can, therefore, arise only from the expansive force exerted by the included air in the diamond and the amber, when they were in such a soft state as to be susceptible of compression from so small a force. That this compressible state of the diamond could not arise from the action of heat is manifest from the nature and recent formation of the soil in which it is found; that it could not exist in a mass formed by aqueous deposition is still more obvious; and hence we are led to the conclusion rendered probable by other analogies, that the diamond originates, like amber, from the consolidation of, perhaps, vegetable matter, which gradually acquires a crystalline form by the influence of time, and the slow action of corpuscular forces.

“As the preceding results were obtained from flat diamonds, which did not seem to have been regularly crystallized, I was anxious to detect the same structure in those which had a regular crystalline form. With this view I examined several of the diamonds in Mr. Allan's collection, and was fortunate enough not only to detect in a perfect octohedral crystal the same structure which I had observed in the flat specimens, but also an air-bubble of considerable size, which had produced by its expansion the polarizing structure already described.”

Since these observations were written, Dr. Voysey has shown that the matrix of the diamonds produced in Southern India is the sandstone breccia of the clayslate formation; and Captain Franklin has found that in Bundel Kund the rocky matrix of the diamond is situated in sandstone which he imagines to be the same as the new red sandstone of England, that there is at least 400 feet of that rock below the lowest diamond beds, and that there are strong indications of coal underlying the whole mass. The following are Captain Franklin's observations on the origin of this mineral:

“There is another circumstance to which I must advert, but I do so with diffidence, and under a hope that it will be

considered merely conjectural. Dr. Brewster supposes the diamond to have originated like amber, perhaps from the consolidation of vegetable matter, and that it gradually acquired its crystalline form by the influence of time, and the slow action of corpuscular forces. The late Dr. Voysey adverted to this opinion in his account of the diamond mines of Southern India; and on the occasion of publishing an abstract of that paper in his *Journal of Science*, Dr. Brewster observed that he saw no reason to alter his opinion. Now, as the rock matrix of the diamond of *Panna* appears, in some respects, though not altogether, to resemble that of *Banganpilli* in Southern India, there would seem to be little chance of any conjecture being useful; still, however, as every opinion regarding the origin of this fine mineral is as yet theoretical, I will not withhold what occurred to me on this subject, though I again repeat that I offer it with great diffidence. The theory of Sir James Hall on the consolidation of strata frequently recurred to me when examining the sandstone in which the diamond is found: I thought that I could discern much in favour of it, and particularly in the gradual changes of its nature from the lower to the upper strata. Now, if the principle of this theory is admitted to be correct, and applicable universally, it follows of course that it must be applied here; and then it may be questioned, how the diamond was preserved under that degree of heat which must have been necessary to form its matrix the gritstone? In answer to this objection, I suggest that the circumstance of calc spar occurring in trap rocks is somewhat analogous; and if it is admitted that compression under the weight of strata and a superincumbent ocean had the effect of resisting the expansion of its carbonic acid, and constraining it to continue in combination with lime, might not the same principle be reasonably enough applied to account for the preservation and detention of the elements of the diamond in the gritstone? And, again, should it be further shown that crystals, such as those with which we are familiar in nature, may be produced by slow cooling, or other processes, according to the above theory, may we not look to it also to account for the crystallization of the gem?

“This conjecture rests upon the truth or fallacy of Sir James Hall’s theory, or on a modification of it; and when this theory is considered as the result of long and patient experiment, and the high reputation of its author is taken into account, it will require something more than limited observation or ordinary ability to answer its objections; my part, however, is merely the suggestion of a traveller, and I there-

fore conclude my paper by expressing a hope that this important mineral may meet with more able investigation."

This discovery of a new matrix of the diamond takes away the foundations of the argument from which I concluded "that the compressible state of the diamond could not arise from heat," for it is possible that the rocky matrix in which it was found had an igneous origin; and Captain Franklin's supposition that it might be fused under compression, is quite conceivable.

But, though I admit the possibility of the diamond having been in a state of igneous fusion, I consider it highly improbable that it was so. In the laborious examination, which I carried on for several years, of the cavities in topaz, quartz, amethyst, chrysoberyl, &c., and in salts formed from aqueous solutions, I had occasion to observe the condition of many thousands of cavities, and in no one case, neither in crystals which exist in rocks known to be of igneous origin, nor in crystals artificially formed, have I been able to discover a single cavity in which the expansible fluid which it contained had compressed the surrounding mass, and communicated to it the polarizing structure existing around the cavities in the diamond.

Now, in glass which is known to have been in a soft state, and in amber, which is generally allowed to be an indurated gum, I have discovered cavities similar to those in the diamond, and surrounded by the same polarizing structure; a structure which could only be produced by a compressing force emanating from these cavities.

As I am desirous that mineralogists should thoroughly understand the nature of this structure, I have made two drawings of the diamond Laske which contains the cavities under consideration.

Fig. 1.

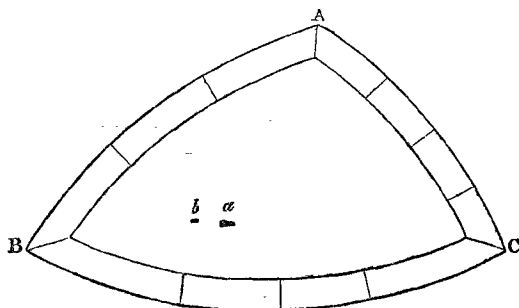


Fig. 2.

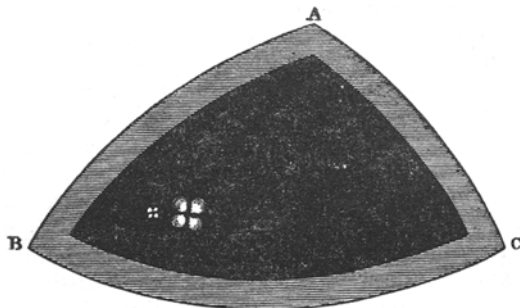


Fig. 1. represents the diamond considerably magnified. At *a* and *b* are seen two minute cavities, which appear perfectly black, as if they were filled with opaque matter. This blackness, however, arises from the high refraction which takes place at the concave surfaces of the cavity, as may be proved by the application of a microscope, which exhibits a minute pencil of light transmitted through them. Fig. 2. shows the four luminous sectors around each cavity, as exhibited by the agency of polarized light. When a plate of sulphate of lime which polarizes a blue tint of the second order of colours in Newton's scale is placed across these sectors, so as to have its axis coincident with the radii of two of the luminous sectors opposite to each other, and perpendicular to the radii of the other two sectors, its blue tint of the second order is depressed, by that which is polarized by the sectors, to a red of the first order in the sectors whose radii are coincident with the axis of the sulphate of lime, and raised to a whitish yellow of the second order in the other two sectors. Hence, it follows that the character of the polarization in the sectors is negative, like that of calcareous spar, and that it has been produced by a compressing force acting outwards from the cavities.

I have, in my former paper, supposed that the compressing force was the expansive power of air included in the cavity; but this, of course, is a conjecture, though it seems quite certain that it must have been a gaseous body. That it was not a fluid is obvious, from there being no fluid in the cavities. This was certainly the case in the cavities in amber and glass; but it is possible that a fluid of very low refractive power may exist in the diamond cavities without my being able to see it, on account of the high refractive power of the gem. If this should be the case, however, it will not be difficult to observe it in larger cavities, if they should ever be discovered.

Third Series. Vol. 7. No. 40. Oct. 1835. 2 K

The existence of a compressed structure round the cavities clearly proves that the diamond has been in a soft state; but it may be shown, from various considerations, that this softness was not the softness produced by igneous fusion, and that it is likely to have been the softness of a semi-indurated gum. I have already stated that no such cavities exist in minerals of igneous origin; a fact which entitles us to separate the diamond from that class of crystals; and it is equally important to observe that its polarizing structure, which I have studied with peculiar care in a great variety of specimens, connects it closely with amber and indurated gum. From such substances, indeed, it differs in having a distinct crystalline form; but in the mineral resin called mellite we have an equally distinct crystalline form, though there can be little doubt, both from its composition and its locality, that it derives its origin from the vegetable kingdom.

XXX. *On the Ancient and Modern Formation of Deltas in the Persian Gulf by the Euphrates and Tigris, in answer to Mr. Beke.* By W. G. CARTER, Esq.

[Continued from p. 202, and concluded.]

SINCE writing the foregoing remarks, I have seen Mr. Beke's paper on what is termed the geological evidence of the advance of the land at the head of the Persian Gulf, which commences by bringing again into notice the single passage of the historical, in which Pliny, after mentioning three different admeasurements from the gulf to Charax, a port lying near the course by the Euphrates, to Babylon,—the 1st, and shortest, made in the time of Alexander the Great; the 2nd, and longer, furnished by Juba; and the 3rd, and longest, being of Pliny's time,—the historian, very remarkably, goes on to account, as it seems, for these varying estimates by saying that the silt of the rivers had made additions to the land*. The peculiarity is, that in the preceding chapter he had given measurements of the whole distance from the gulf past Charax up to Babylon, which presented a totally different result. For the first there, is the longest, and is also made in the time of Alexander, and the second is shorter, and yet also is furnished by Juba; and the inference there is the very natural one, that the account being thus discordant, he had not been able to determine the distance†.

* Pliny, *Hist. Nat.*, lib. vi. cap. 27.

† Errata in former part, last Number:—p. 200, *note*, for "Bosra, 12 miles below Khorna," read 42; p. 198, *note*, for "35 miles" read 37; and p. 199, for have read has.