On Granite Veins.

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Notwithstanding the different opinions which from time to time have been advanced respecting Granite veins, I consider the subject to remain at present in much the same state as Dr. Hutton left it, viz. that the originally fluid granite has been injected into such rocks as chanced to bound it: there are, however, two memoirs in the Transactions of the Geological Society of Cornwall,—one by Mr. Carne, and the other by Dr. Forbes, which appear to convey doubts whether the hypothesis of casual injection, or forcible intrusion, will satisfy all the conditions of the problem.

These granite veins occur so abundantly and so uniformly in Devon and Cornwall along the confines of the granite and sedimentary rocks, that I conclude they are physical constants and not local accidents. They commonly exhibit phænomena altogether irreconcilable with mere injection, but perfectly intelligible on the theory of intense heat fusing down pre-existing rocks. Specimens on the table show the granite to insensibly blush out in the stratified rock, or the latter to shade out in the granite. I would particularly direct attention to the strings, and threads, and more delicate filaments of granitic matter, sometimes insulated, but more commonly emanating from the larger veins, and sometimes, by a complication of anastomosing processes, traversing the rock like net-work: these circumstances can be satisfactorily explained neither by injection nor by voltaic action, for if we arbitrarily assume that such gross matter as incandescent lava might be forced among adjacent rocks so as to imitate certain fine anatomical preparations, it fails to explain the perfect incorporation and the insensible shading out in their confines, of two rocks of perfectly different orders:

the latter fact is equally fatal to the supposition of segregation by galvanic action; besides which, the so called granite veins, properly speaking, have no walls: it is also opposed to our experience of the contents of mineral veins or metalliferous lodes, to suppose that granite should be separated out of granite, and reaggregated as the same triple compound of its many constituents.

In innumerable instances along the confines of the granite and sedimentary rocks, I have observed the walls of the joints in the latter to be perfectly granitified, and that the granite matter radiated laterally among the laminæ of deposition, apparently shewing that the process of reduction seized on the readiest and most accessible approaches, viz. the joint lines and the lamination or cleavage planes. Guided by my experience in this respect, I have recently discovered several small granite veins under the Lighthouses at the Lizard.

I submit therefore that these so called veins not only evidence the reduction and conversion of pre-existing rocks, but that they manifestly indicate how the process was effected,—that instead of being passively injected into casual rents or fissures, they were the active instruments of fusion, always in advance of the molten sea within, and augmenting its volume, until eventually the outer crust being reduced to its point of last resistance, would necessarily yield to the internal pressure of the molten mass, which would expand into the dome-shaped forms presented by granite districts, or be raised by a simple vertical movement, like the elevation craters so clearly established by Von Buch.

The specimens on the table were collected at the many localities labelled on them, with the view of showing that the evidences of fusion and conversion they present, are not the accident of one locality, but are common to all: happily however, they testify something more, viz. that the granites vary in character and constitution round their outer zones, according to the mineral constitution of the rock reduced and converted: this circumstance, and the infinite varieties of igneous rocks, appear to show that they are not the crystalline residue of some primitial fluid which had been incorporating together for ages, but the result of an infinite play of changes and combinations, such as varying degrees of temperature, varying proportions of mineral constituents in the rock acted on, and a crystalline arrangement varying with the varying conditions of pressure, cooling, &c.

My observations have enabled me to ascertain one fact beyond a doubt, viz. that the immediately adjacent rocks will in all cases enable an observer to discriminate whether an igneous rock be the result of fusion *in situ*, or whether it has been an erupted product: in this view, I regard all the greenstones I have met with as of the same age with the beds which inclose them. On the other hand I regard gneiss and mica-schist as sedimentary strata in a definite stage of conversion into granite: these I term *intermediate* volcanic products: and granite, porphyry, hornblende, trap, greenstone, basalt, and flinty, talcose, chloritic, and clay slates, with their associated breccias, grit, and ash-beds, as *immediate* products; the delicate glossy clay-slate being only a highly levigated volcanic mud, or sorted out of the coarser breccias.

Recent volcanic products first taught us the true nature of many rocks and minerals, which perhaps would otherwise have been inexplicable, and here these ancient products return the full value of the information, by instructing us somewhat of what is now going on in the heart of the volcano,—that its fuel is supplied by pre-existing strata, and that its products are not *rejectamenta* from some primeval molten mass, as some philosophers have supposed: not only that, but by a consilience of induction, we ascertain the truth of what the great Cornish philosopher Davy contended for so strenuously in his best days, viz. that chemical eliminations were the true sources of volcanic excitement and subterranean heat; for if the granites can be so manifestly shewn to have been pre-existing stratified rocks converted by intense heat to a crystalline aggregate, granite is *not* the result of the simple cooling of some imaginary central incandescent fluid, but of a temperature emanating from other sources which necessarily must be chemical in their nature: and the only fulcrum is removed upon which Leibnitz fixed the lever of his hypothesis, and the sober enquirer finds that to existing causes, and the controlled operation of the physical agents, he may safely refer whatever phænomena in the mineral world he may encounter.

It only remains for me that I perform a duty I owe to myself. It has been invidiously alleged that I have borrowed my volcanic theory of the origin of slate and granite from a lecture given by Professor Johnston of Durham to a party of geologists, during their return from an excursion to the Isle of Arran, in the autumn of 1840. I shall always be proud to acknowledge any information I may derive from that distinguished chemist, but two reasons will, I feel assured, satisfy those whom I have the honour to address, that in the present instance I have no such obligation on me to discharge: the first is that during the whole of the voyage to Ardrossan, I was occupied in the bow of the steamer, taking notes and sketches of the varying outlines of Arran, and never heard a syllable of Professor Johnston's lecture: the next is that at the meeting of the British Association at Glasgow in 1840, I exhibited a diagram of the granite veins at Ivy Bridge, which I attributed to fusion and conversion, and not to injection, as may readily be seen in the abstract of my communication, published in the Transactions of the Association for that year. I have studied the rudimentary elements of geology at the knees of Dr. Hutton and Professor Playfair, and my main aim and object is to carry out the sound and philosophic principles of those sole founders of geology as a science.