of volcanos and igneous rocks, while avoiding the many difficulties which beset the hypothesis of a nucleus in a state of igneous fluidity. At the same time any changes in volume resulting from the contraction of the nucleus would affect the outer crust through the medium of the more or less plastic zone of sediments, precisely as if the whole interior of the globe were in a liquid state.

The accumulation of a great thickness of sediment along a given line would, by destroying the equilibrium of pressure, cause the somewhat flexible crust to subside; the lower strata becoming altered by the ascending heat of the nucleus would crystallize and contract, and plications would thus be determined parparallel to the line of deposition. These foldings, no less than the softening of the bottom strata, establishes of weakness or of least resistence in the earth's crust, and thus determine the contraction which results from the cooling of the globe to exhibit itself in those regions and along those lines where the ocean's bed is subsiding beneath the accumulating sediments. Hence we conceive that the subsidence invoked by Mr. Hall, although not the sole nor even the principal cause of the corrugations of the strata, is the one which determines their position and direction, by making the effects produced by the contraction not only of sediments, but of the earth's nucleus, itself, to be exerted along the lines of greatest accumulation.

It will readily be seen that the lateral pressure which is brought to bear upon the strata of an elongated basin by the contraction of the globe, would cause the folds on either side to incline to the margin of the basin, and hence we find along the Appalachians, which occupy the western side of such a great synclinal, the steeper slopes, the overturn dips or folded flexures, and the overlaps from dislocation are to the westward, so that the general dip of the strata is to the centre of the basin, on the other side of which we might expect to find the reverse order of dips prevailing, The apparent exceptions to this order of upthrows to the south-east in the Appalachians appear to be due to small down throws to the south-east, which are parallel to and immediately to the north-west of great upheavals in the same direction.

Mr. Hall adopts the theory of metamorphism which we have expounded in the paper just quoted above, *Canadian Naturalist*, Dec. 1859, (see also *Am. Jour. Sci.* (2) xxv. 287, 435, xxx. 135,) which has received a strong confirmation from the late researches of Daubrée. According to this view, which is essentially that put forward by Herschel and Babbage, these changes have been effected in deeply buried sediments by chemical reactions, which we have endeavoured to explain, so that metamorphism, like folding, takes place along the lines of great accumulation. The appearance at the surface of the altered strata is the evidence of a considerable denudation. It is probable that the gneissic rocks of Lower Silurian age in North America were at the time of their crystallization overlaid by the whole of the palæozoic strata, while the metamorphism of carboniferous strata in Eastern New England points to the former existence of great deposits of newer and overlying deposits, which were subsequently swept away.

On the subject of igneous rocks and volcanic phenomena, Mr. Hall insists upon the principles which we were, as far as we know the first to point out, namely their connection with great accumulations of sediment, and of active volcanos with the newer deposits. We have elsewhere said: "the volcanic phenomena of the present day appear, so far as we are aware, to be confined to regions of newer secondary and tertiary deposits, which we may suppose the central heat to be still penetrating, (as shewn by Mr. Babbage,) a process which has long since ceased in the palæozoic regions." To the accumulation of sediments then we referred both modern volcanos and ancient plutonic rocks; these latter, like lavas, we regard in all cases as but altered and displaced sediments, for which reason we have called them exotic rocks. (*Am. Jour. Sci.* (2) xxx. 133). Mr. Hall reiterates these views, and calls attention moreover to the fact that the greatest outbursts of igneous rock in the various formations appear to be in all cases connected with rapid accumulation over limited areas, causing perhaps disruptions of the crust, through which the semi-fluid stratum may have risen to the surface. He cites in this connection the traps with the palæozoic sandstones of Lake Superior, and with the mesozoic sandstones of Nova Scotia and the Connecticut and Hudson valleys.

It may sometimes happen that the displaced and liquified sub-stratum will find vent, not along the line of greatest accumulation, but along the outskirts of the basin. Thus in eastern Canada it is not along the chain of the Notre Dame mountains, but on the north-west side of it that we meet with the great outbursts of trachyte and dolerite, whose composition and distribution we have elsewhere described. (Report of Geological Survey for 1858, and *Am. Jour. Sci.* (2) xxix. 285.)

The North American continent, from the grand simplicity of its geological structure and from the absence, over great areas, of the more recent formations, offers peculiar facilities for the solution of some of the great problems of geology; and we cannot finish this article without congratulating ourselves upon the great progress in this direction which has been made within the last few years by the labors of American geologists.

Montreal, March 1, 1861.

VARNISHES.

(*Concluded from page* 167.)

Brown Varnish.—Rectified spirit 2 gallons; sandarach 3 pounds; shell-lac 2 pounds; pale turpentine varnish 1 quart. Put them into a tin bottle, cork securely and agitate frequently, placing the tin occasionally in hot water till the gum is dissolved, then add a quart of pale turpentine varnish.

Brilliant Amber Spirit Varnish.—Fused amber 4 oz.; sandarach 4 oz.; mastic 4 oz.; highly rectified spirit 1 quart. Expose to the heat of a sand bath, with occasional agitation, till dissolved. The amber is fused in a close copper vessel, havіug a funnel-shaped projection, which passes through the bottom of the furnace by which the vessel is heated.

Crystal Varnish.—Picked mastic 4 oz.; rectified spirit 1 pint; animal charcoal 1 oz. Digest, and filter.

Picture Varnish.—Chio turpentine 2 oz.; mastic 12 oz.; camphor ½ drachm; pounded glass 4 oz; rectified oil of turpentine 3 pints. This is for oil paintings.

Tingry's Essence Varnish.—Powdered mastic 12 oz.; pure turpentine 1½ oz.; camphor ½ oz.; powdered glass 5 oz.; rectified oil of turpentine 1 quart.