arguments in support of these views, I will here only recapitulate the principal points as briefly as possible:

1. In the solfataric volcanic phenomena enormous quantities of hydrocarbon gases and vapors are constantly thrown out in the air in all the volcanic districts of the world. See my previous papers and Dr. G. F. Becker, Bulletin No. 401, U. S. Geological Survey, for short reviews of this evidence, which, however, will be found at length in the writings of the eminent geologists and chemists who have made special original studies on this subject, notably, Elie de Beaumont, Humboldt, De Lapparent, Suess, Fouque, Le Blanc, Silvestri, Stocklassa, Brun, Charles Sainte-Claire Deville, Lacroix, Gauthier, Tschermak, Janssen, Libbey and Sokolow. A. Gauthier, for instance, has shown not only that hydrocarbons and other combustible gases are to be found in the lavas or volcanic rocks of to-day, or associated with these rocks in their eruptions, but that enormous quantities of these combustible gases are contained also in ancient igneous rocks, and that by simply warming these rocks to a moderate red heat he could extract from them at least 100 times their volume of mixture of combustible gases and water vapor.

After giving the details of his experiments and analyses he says:

"Putting aside the reactions pertaining in the melted portion of the interior of the globe if we consider what happens when certain already crystallized masses of the crust are reheated to red heat on account of their sinking internally, or because lateral pressures of different parts of the crust cause an uplift of the melted rocks from the interior along the points of minimum resistance.. When these rocks already solidified once are thus reheated by the incandescent masses it will be seen that they will be bound to give off by all possible vents the gases and vapors produced in the experiments just cited and recorded. From these, as we have seen, one liter of granite gave (at 1,000 deg. and calculated only for this temperature) about 20 liters of various gases and 89 liters of water vapor, that is to say, more than one hundred times its volume of gases. One can understand from this the great explosive force due to these reactions, and that it is not at all necessary to admit the hypothesis of the penetration of superficial or meteoric waters down to the igneous masses as a necessary condition to the production of volcanic phenomena. . . . One will understand that to explain the origin of the water in volcanoes the nature of the gases emanated and the violence of the eruptive phenomena, that it is sufficient for the deep crystalline strata to be reheated only a few hundred degrees, and the emanation of volcanic gases with their composition (combustible gases) and their formidable pressures, will be the necessary result of this reheating."

Dr. Albert Brun in his Researches sur l'Exhalaison Volcanique gives many interesting analyses of the gases found in volcanic rocks, and given off at volcanic or explosive temperatures, that is to say, above 600 deg. or 800 deg. C., which he recognizes as the only true volcanic gases. These analyses show that hydrocarbons are frequent in volcanic rocks all over the earth and that they are sometimes quite abundant. For instance, in an obsidian from the Plomb du Cantal, France:

"The analysis showed that the vapor which is distilled is slightly ammoniacal and carries much bitumen. Heated in the vacuum its fused, vitreous residue is perfectly black with carbon. Moreover, there is enough bitumen present to form on the cold parts of the apparatus oily striations. These oils are soluble in chloroform, with a brown fluorescence, and are combustible with a clear flame."

Many other analyses of lava, obsidian, and other volcanic rocks are stated by Dr. Brun to have given from traces of hydrocarbon to quantities even more abundant than in the instance cited above, and out of 67 analyses 38, or 57 per cent., gave hydrocarbons. The volcanic rocks containing the petroleums were from widely distributed localities, such as Mt. Erebus (antarctic), Armenia, Abyssinia, Java, Japan, Peru, Tamanfaya, Canaries, Iceland, Milo, Vesuvius, Stromboli, Etna, Arran Islands, Scotland, Sweden, Germany, Hungary, Italy and France.

In view of these and other evidences, no geologist can to-day deny that petroleums are now proved to be abundantly produced in the phenomena of vulcanism, whether recent or ancient.

2. There are no geological phenomena of to-day or of ages past in which, through organic agencies, petroleums—that is to say, the mixtures of hydrocarbons known as petroleums—are being produced, or are known to have been produced. The gradual decomposition of entombed vegetable organic matter in nature to-day, and during the past geological ages, is and has been accomplished in the sedimentary strata at low temperatures and has resulted in the formation of peat, lignite, coal, and anthracite; that is to say, in the formation of oxygenated fixed carbon compounds very different from petroleums. If these "coals" had been distilled it might be argued that "petroleums" were thus formed, but it is, of course, well known that as a general rule they have not been distilled; the necessary heat to bring about distillation was never attained in the unaltered sedimentary strata. At any rate, it is a matter of geological record that the "coals" are found everywhere in the sediments in the undistilled state and not as coke, and that coal and petroleum deposits have no genetic connection of any sort one with the other.

It is equally a matter of geological record that the soft tissues of animal organic matter were not finally entombed in the sediments, where they have left absolutely no trace of their former existence, as demonstrated by the billions of fossils in our paleontological museums and collections, and in the impervious rocks everywhere, without the slightest trace of any carbon compound to be found in them. The former animal organic matter of what is to-day the fossil animal world evidently decomposed fully, or otherwise disappeared entirely, before the final entombment of the hard part of the animal; and therefore no petroleums could possibly be formed from it.

It is insufficient to argue, against such evidence to the contrary, that petroleums must have an organic derivation, because the large petroleum deposits are always found "associated" with sedimentary strata and fossiliferous rocks. This word "associated" is very vague. It takes more than the presence of water in a cave or in a porous rock to prove that that water originated there. Are not volcanic rocks themselves thus "associated" with sedimentary strata—often in successive horizontal flows or laccolitic intrusions interbedded with sediments, or in veins and masses cutting across sediments? Are not the solid petroleums thus found in irregular veins or masses cutting across the sediments? Are not the liquid or gaseous petroleum deposits themselves local and irregular impregnated spots of the porous sediments, not at all in sheets like coal beds? In some districts