the magnet draws the iron, or by way of impulsion, generating impelling vapours, as in certain mountains." A truly scientific and most suggestive remark!

We may compare the last clause with those well-known lines of the "Inferno," in which is described how the earth, and likewise the mountain of Purgatory were formed when Lucifer fell from Heaven:—

"Da questa parte cadde giù dal cielo;
E la terra, che pria di qua si sporse,
Per paura di lui fe del mar velo,
E venne all'emisperio nostro: e forse
Per fuggir lui, lasciò qui il luogo voto
Quella ch'appar di qua, e su ricorse."
—"Inferno," xxxiv. 121–126.[1]

But now it may be asked, Since that region of the heaven moveth circlewise, why did not this elevation happen circlewise? Because, Dante answers, the matter was not sufficient for so great an elevation. Then why was the elevation of the earth produced in our hemisphere rather than in the other? To this, says Dante, we must answer as Aristotle does (in "De Cœlo," book ii.) in answer to the question why the heavens move from east to west and not contrariwise, that such questions proceed either from much folly or from much presumption, because they are above our intellect. God made all things for the best, and when He said, "Congregentur aquæ in locum unum et appareat arida," then were the heavens virtuated to act and the earth potentiated to be passive.

"Let therefore men cease," cries Dante, "yea, cease from inquiring into those things which are above their intellect, and let them strive to the utmost of their power to raise themselves to things immortal and divine, and so leave those things which exceed their understanding. Let them listen to Job:—'Numquid vestigia Dei comprehendes, et omnipotentem usque ad perfectionem reperies.'—(Job xi. 7.) Let them hearken to the words of the Psalmist: 'Mirabilis facta est scientia tua; et me confortatus est, et non potero ad eam.'—(Ps. cxxxviii.) Let them hear Isaiah speaking in the person of God to man: 'Quam distant cœli a terra, tantum distant viæ meæ a viis vestris.'—(Is. lv. 9.) Let them hear the voice of the Apostle to the Romans: 'O altitudo divitiarum scientiæ et sapientiæ Dei! quam incomprehensibilia judicia ejus, et investigabiles viae ejus!'—(Rom. xi. 33.) Lastly, let them hearken to the very voice of the Creator, saying: 'Quo Ego vado, vos non potestis venire.'—(S. John vii. 34). And let these things suffice for the inquiry of the truth before us."

We may most fittingly compare this Dantesque passage with the close of Galileo Galilei's famous "Dialogo intorno ai due massimi sistemi del mondo, tolemaico e copernicano," which I here venture to translate:—

"*Simplicio.* If either of you were asked, If God in His infinite power and wisdom could confer upon the element of water the reciprocal movement which we perceive in it, in another way than by the moving of the vessel containing it, I know that you would answer, that He could have done so in many ways, even unimaginable by our intellect; whence I immediately conclude that, this being so, it would be excessive daring for any one to wish to limit and restrict the Divine power and wisdom to a particular phantasy of his own.

"*Salviati.* An admirable and truly angelical doctrine, to which very conformably answers that other divine doctrine, which, whilst it allows us to dispute about the constitution of the world, adds (perhaps in order that the exercise of human minds be not suppressed nor grow lazy) that we are not to find out the work of His hands. Let therefore the exercise permitted and ordained to us by God make us recognize and so much the more wonder at His greatness, as we find ourselves the less competent to penetrate into the profound abysses of His infinite wisdom.

"*Sagredo.* And this will serve for the last conclusion of our four days' argument."—Galileo Galilei, "Dialogo dei Massimi Sistemi, Giornata quarta."

Dante now briefly deals with the five arguments which he mentioned at the beginning of his treatise as the most important against his theory. These being made short work of, he concludes:—

"This philosophical question was determined by me, Dante Alighieri, the least of philosophers, beneath the sway of that invincible lord, Messer Cane Grande della Scala, for the holy Roman empire, in the illustrious city of Verona, in the church of S. Helena, and in the presence of all the Veronese clergy, save some few who, aflame with too much charity, do not admit the postulates of others, and through virtue of humility poor of the Holy Spirit, shun being present at their discourses, lest they may seem to approve their excellence.

"Now this was done in the year from the Nativity of our Lord Jesus Christ, 1320, on Sunday, which the Saviour injoined on us to venerate for His glorious Nativity and His wondrous Resurrection. The which day was the 7th from the ides of January and the 13th before the calends of February" (*i.e.* January 20).

I have dealt merely with the chief parts of this Dantesque dissertation. According to Signor A. Stoppani ("La questione dell' Acqua e della Terra di Dante Alighieri," in "opp. Lat. di Dante," ed. Giuliani, vol. ii.) there are nine truths relating to cosmology, presaged, affirmed, and in part demonstrated. These nine he makes out thus:—

(1) The moon the principal cause of tides.
(2) Equality of the sea's level.
(3) Centripetal force.
(4) Sphericity of the earth.
(5) Dry land simply protuberance of the earth's surface.
(6) Northern grouping together of the continents.
(7) Universal attraction.
(8) Elasticity of vapours a motive power.
(9) Heaving up of the continents.

Let me now add a tenth: A vague foreshadowing of our modern idea of chemical elements as distinct from those of Aristotle, or at least of homogeneous chemical bodies; "Corpora enim homogenea et simplicia sunt; homogenea, ut aurum depuratum; et corpora simplicia, ut ignis et terra."

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[1] "Upon this side he fell down out of heaven;
And all the land, that whilom here emerged,
For fear of him made of the sea a veil,
And came to our hemisphere; and peradventure
To flee from him, what on this side appears
Left the place vacant here, and back recoiled."
—"Inferno," xxxiv. 121-126, Longfellow's trans.

MOROCCO.[1]

MOROCCO has a paradoxical place in the history of exploration; although the only part of Africa fully in sight from the shores of Europe, and dotted with one or two half European coast towns, its interior is more firmly closed to the traveller, sportsman, and missionary than the dense forests of the Congo, or even the shores of Lake Chad. The difficulties in the way are not physical, nor are they wholly political. They arise mainly from the deeply-rooted antagonism in race and creed between the inhabitants of Morocco and all Christendom—this quaint and semi-fossil phrase is still here a necessary and sufficient term. At this moment public atten-

[1] "Bibliography of the Barbary States." Part IV. A Bibliography of Morocco from the earliest times to the end of 1891. By Lieut.-Col. Sir R. Lambert Playfair and Dr. Robert Brown.

tion is turned somewhat intently on the political conditions of the Oriental despotism which has so anomalously maintained itself to the west of our prime meridian. Hence the politician has a temporary interest in what would otherwise have appealed mainly to the geographer and man of science, the publication by the Royal Geographical Society of a "Supplementary Paper," the "Bibliography of Morocco." This is a work of splendid thoroughness, almost, if not quite, exhaustive in its list of 2243 titles, and made convenient for reference by two copious indexes of subjects and authors. But it is much more than a catalogue. Comments, judiciously brief, but in some cases of exceptional interest extending to a couple of pages, give information as to little-known authors, or record some striking circumstance in or concerning the books referred to. There is a specially-compiled map, and an introduction which is really an essay on the growth of knowledge regarding Morocco in European countries. With regard to the map, it is explained that only the coast-line has been surveyed. As to the interior :--

"The best mapped districts are laid down solely from running *reconnaisances* or sketch-maps. Positions fixed by astronomical observations are few. Many wide areas have never been visited by any Europeans, and most of the Atlas is at this hour as little known as it was in the days of Leo Africanus. There are cities within a few hours' ride of Tangier, which no person capable of giving a correct account of his observations has visited; and there are others not much farther away, to attempt to enter which—Zarhoun, for example—would, were the intruder detected, be certain death. There is scarcely a river laid down with even approximate accuracy, and, not to enumerate more distant provinces, the entire Riff country, that bold *massif* which is familiar to the thousands who every year sail up and down the Mediterranean, is less explored than many regions in the centre of the continent."

The present population of Morocco is a puzzle almost as difficult, although on a smaller scale, as that of China. The authors of the Bibliography give 4,000,000 as an estimate, but the guesses of various authorities vary between 1½ and 15 millions. The roads shown on the map are mere mule and camel tracks made by the feet of the pack-animals, unaided by any engineer. Ferries are rare, and, of course, bridges are unknown in the interior. The distribution of towns and villages is often at variance with the rules holding for civilised countries. The villages are built out of the way of the main tracks, because people never travel in Morocco for the good of the inhabitants, and it is safer to live off the path of the tax-collector and the Government official, who demands free food and quarters. The great number of place-names on the map of so thinly-peopled a country is due to the fact that the tombs of saints are such important landmarks that they must be indicated, even if only a few persons live beside them. "All the places beginning widh 'Sidi' (Lord, master) are either actually tombs or the tomb has formed, as in so many of our cathedral cities, the nucleus of the town or village." "Sok," another affix of frequent occurrence, means market-place, and many of the established sites for periodical fairs are uninhabited between the gatherings of people from far and near. Many of the place-names on the coast exist in two forms at least—the native word and its Portuguese or Spanish translation; Casablanca and Dar-el-beida (both meaning White house) for example. We regret that the authors did not see their way to lay down precise rules for the spelling of Moorish place-names, either by giving a standard transliteration of the Arabic, or a uniform phonetic system. Indeed, even in the introduction a few anomalous spellings are found, *e.g. Zarhoun* and *Zerhun*, *Moulai* and *Mowlai*.

The physical geography of Morocco appears to be changing, and the natural conditions of the country are less favourable for agriculture than they were a few centuries ago. The forests have been destroyed with such recklessness that the soil has been dried up and swept away in many places; there is evidence that the rainfall has diminished, lakes have dried, and rivers formerly navigable have become silted up, or alternate as dry tracts of stone and raging torrents.

In one respect alone—the enthusiastic Moslemism of its people—does Morocco show no sign of degeneration. Although the Moors can no longer seize and hold the Christian slaves, whose stories bulk so largely in the bibliography, their hatred and contempt towards "unbelievers" is in no sense abated. Into such a land no Europeans could penetrate far, except in the past as slaves, or now as official messengers of European Powers under special protection, jealously watched and prevented from studying places or people. The last serious attempt at scientific exploration that of Mr. Joseph Thomson was again and again almost stopped by the fanatical Kaids, and only his remarkable persistence and daring stratagems carried him as far as he reached. Such stratagems would hardly serve again, and for the present the exploration of the Atlas Mountains, with their half-guessed topography, imperfectly-known flora, and unsurveyed mineral wealth is at an end. The futility of disguise as an aid to exploration is fully proved in the records before us, where the ghastly fate of many who tried to pass as Moslems, and the unsatisfactory results obtained by others who escaped alive, are briefly told.

It seems to us that an attempt might well be made to open communications with fanatical Mohammedan countries either by explorers or diplomatic agents of the same faith, and there must be many amongst the educated Mohammedans of India who are well suited for such work. The religious beliefs of a people with whom belief and conduct are so closely related, must be taken into account in dealing with them, just as much as the physical features of a country. And as Arctic sailors have been proved to be the natural explorers in the Antarctic seas, Swiss mountaineers the safest pioneers on New Zealand glaciers, and Canadian boatmen the most expert in shooting the Nile cataracts, so Mohammedan envoys might be expected to make the most favourable impression on the people of Morocco or of the Mohammedan Sudan.

Sir Lambert Playfair and Dr. Brown deserve the heartiest thanks for completing their Bibliography of the Barbary States in such an admirable way, and we do not doubt that the work will be very widely consulted in the immediate future.

THE RATE OF EXPLOSION IN GASES.

THE following is an abstract of the Bakerian Lecture on "The Rate of Explosion in Gases," delivered before the Royal Society by Prof. Harold B. Dixon, on January 19 :--

1. Berthelot's measurements of the rates of explosion of a number of gaseous mixtures have been confirmed. The rate of the explosion wave for each mixture is constant. It is independent of the diameter of the tube above a certain limit.

2. The rate is not absolutely independent of the initial temperature and pressure of the gases. With rise of temperature the rate falls; with rise of pressure the rate increases; but above a certain *crucial pressure* variations in pressure appear to have no effect.

3. In the explosion of carbonic oxide and oxygen in a long tube, the presence of steam has a marked effect on the rate. From measurements of the rate of explosion with different quantities of steam, the conclusion is drawn that at the high temperature of the explosion wave, as