However complex the curves described by them may be, the points will be found to form a circle on the upper plane; and if we give to A different values, the corresponding circles will be found to be all concentric. Further, if we call the circle corresponding to the value $A = 0$ the *zero-circle*, the area of the curves described by the points on any other circle of the system equals N times the ring inclosed between that circle and the zero-circle. It is remarkable that such a singular point as the centre of the circles should exist.

In the special case in which $N=0$, *i.e.*, where there has been only an oscillatory movement of the upper plane and no complete rotation, the system of concentric circles is replaced by a system of parallel straight lines, the area of the curves described by the points on any straight line of the system being proportional to the distance of that line from the zero-line.

It should, perhaps, be pointed out that the area of a figure 8 is zero, as the two halves are of opposite signs; also that when a point reciprocates on a curve the area inclosed by it in its path is zero. For example : if we take the interesting case of a circle rolling inside another of twice its diameter, every point on its circumference reciprocates on a straight line, and consequently the circumference is the zero-circle.

This theorem was suggested to me by reading a paper by Mr. C. Leudesdorf in the *Messenger of Mathematics*, where I have already enunciated it. It seems, however, to be one which, from its somewhat startling simplicity, may interest a larger class of readers than a purely mathematical one.

The proof is simple. Let P, P' be two points on the moving plane, and let A, A' be the areas described by them. Let $P P' = r$, and let the total movement of P' perpendicular to $P P' = n$.

Then $A - A' = n r + N \pi r^2$.

If we take P' as origin and the position of $P' P$ in which n is a maximum and equal to n' as initial line, $n' = n \cos \theta$. Thus $A - A' = n' \cos \theta \cdot r + N \pi r^2$, the equation to a family of concentric circles. Transforming to the centre, we have　　　$A = N \pi (r^2 - a^2)$, where a is the radius of the zero-circle.

A. B. KEMPE

OLD MAPS OF AFRICA

MR. STANLEY, in the paper which he read at the Geographical Society on Monday, spoke of Africa being brought to light after an oblivion of 6,000 years. Notwithstanding the somewhat confused phraseology, Mr. Stanley's meaning is clear enough : Central Africa, with its great lakes and rivers, is now known, he means to say, for the first time. But recent investigation seems to show that the oblivion of Africa must be counted by hundreds and not thousands of years; that, in fact, it is only within two or three centuries that a knowledge of Central Africa has been allowed to lapse. A more rigorous search may show that between the fourteenth and the seventeenth centuries the great features that have been placed on modern maps within the past few years were discovered and recorded on the maps of the time.

We have recently referred, on more than one occasion, to two very curious globes that have been brought to light, one in the National Library in Paris, and the other in the Library of Lyons. On the Lyons globe, the date of which is 1701, the Congo is made to issue from a great lake, and wind its way westwards to the Atlantic, in a direction to some extent coincident with that recently discovered by Mr. Stanley. As a sort of preparation for the work of the great traveller, so soon to be issued, some account of the *data* on which these maps may have been constructed, may not be uninteresting. Our information is based on an article in *La Nature*, and on a report by a commission of the Lyons Geographical Society, ap-

pointed to investigate the value and origin of the Lyons globe.

The discovery made at Lyons is, in reality, no surprise to those who know the history of geographical exploration. Not only in the seventeenth century, does the Zaire-Congo appear on most of the maps with the direction definitely assigned to it by Stanley, but nearly all old documents, from the fifteenth century—and the date should be noted—make the great river issue from a considerable mass of water far in the interior of the African continent.

Already, in the year 1500, the famous *mappemonde* of Juan de la Cosa, the pilot of Christopher Columbus, gives the same indications; the picturesque *mappemonde* known as that of Henry II., repeats them with some variations, as also the master-work of Mercator (1569), the founder of modern geography. All the old geographers, or nearly all, repeat the same data :—Forlani (1562), Castaldi (1564), Sanuto (1588), Hondius (1607), Nicolas Picart (1644), Blœu (1569), Sanson, &c. Therefore there need be no surprise to find on a globe of the eighteenth century information which for more than 200 years previously had been registered on the map of Africa.

Whence, however, came this knowledge which our fathers had of certain regions in Central and Equatorial Africa ? The reply is simple : from the Portuguese, who, since the fifteenth century, undertook not only extensive maritime voyages, but several times crossed Africa from west to east and from east to west. It is even very possible that they discovered the sources of the Nile, the great equatorial lakes; thus, in the midst of the simplicity and incoherence of their tracings we find, in their old parchments, the great lines of African geography almost as science now represents them. Most of these Portuguese, with the exception of some missionaries, were but poorly educated; they travelled much oftener as traders than as experienced explorers; nevertheless, we have almost the certainty that before the year 1500 they had furnished very precise information on the centre of Africa. In nearly all these maps, and in that of Lyons, the Congo flows in a nearly straight line from Lake Zaire or Zembre to the Atlantic ; it bends only a very little to the north, and does not pass the equator, as we now know it does.

As a sort of exception, there has been found among the riches of the National Library at Paris, a Spanish globe of copper (without date, but probably between 1530 and 1540), which is not content with presenting the same data, but which reproduces, with wonderful closeness, the course of the Congo as discovered by Stanley. The river issues from a lake, flows towards the north, describes a large curve well to the north of the equator, then turns west-south-west to the Atlantic. This is indeed a summary of the last journey of the intrepid American correspondent. Fig. 1 gives a perfectly accurate idea of a portion of this valuable globe.

From all this it must not be concluded that Stanley has discovered nothing new. These discoveries of the ancient travellers, if genuine discoveries they were, seem to have been forgotten as soon as they were recorded ; and although the maps referred to above have been known for generations, no one ever seems to have taken them as trustworthy guides to the lines of African exploration. Indeed, it is only now that Stanley has made a discovery never to be forgotten that these old maps have come to have a real interest, for we suspect that till now geographers regarded the tracings as having their basis in the cartographers' imaginations. The glory of being really the first discoverers of the two Nyanzas, Nyassa, Tanganyika, Bangweolo, and the course of the Congo cannot be taken away from Speke and Baker and Burton and Livingstone and Stanley ; or if so it must be by some ancient Arab or possibly Egyptian, many, many centuries ago, for there can be no doubt that long before Europe

G 2

awakened to modern geographical enterprise, these great features of Central Africa were known; Herodotus had an inkling of them, and Ptolemy all but located the central lakes. These modern explorers deserve the glory of first discoverers as much as Columbus deserves that of discoverer of America.

Without then detracting from the originality of the work of modern explorers, it is evident that from the fifteenth century onwards some travellers whose names have fallen into oblivion but who may have been companions of Diego Cam and Martin Behaim, ventured into the heart of Africa; followed certain arteries of communication and discovered the course of the Congo; geography kept possession of these discoveries for two centuries and gave them as articles of faith; besides, in the sixteenth and seventeenth centuries many Portuguese, Capuchins or simple traders, entered anew the interior, published the same facts, sometimes with corrections and additions.

Father Ricioli, a Jesuit and very intelligent man, furnished the Fathers Placide, of St. Amien, and Crespinien, two laborious monks, with documents to prepare the Lyons globe, in 1701. The actual constructor of the globe seems to have been the celebrated Lyons mechanician, Henri Marchand, in religion Père Gregoire, a Franciscan, with the help of the Venetian Contarini, a pupil of Nolin, belonging to the Flemish cartographic system. Evidently this was the last word of science. Fig. 3 is a much reduced copy of the facsimile made from the globe by M. Deloncle, the reporter of the commission we have alluded to.

How came it that just about the same time, about 1700, one of the princes of modern geography, Guillaume Delisle, was so badly inspired as to reconstruct an alto-
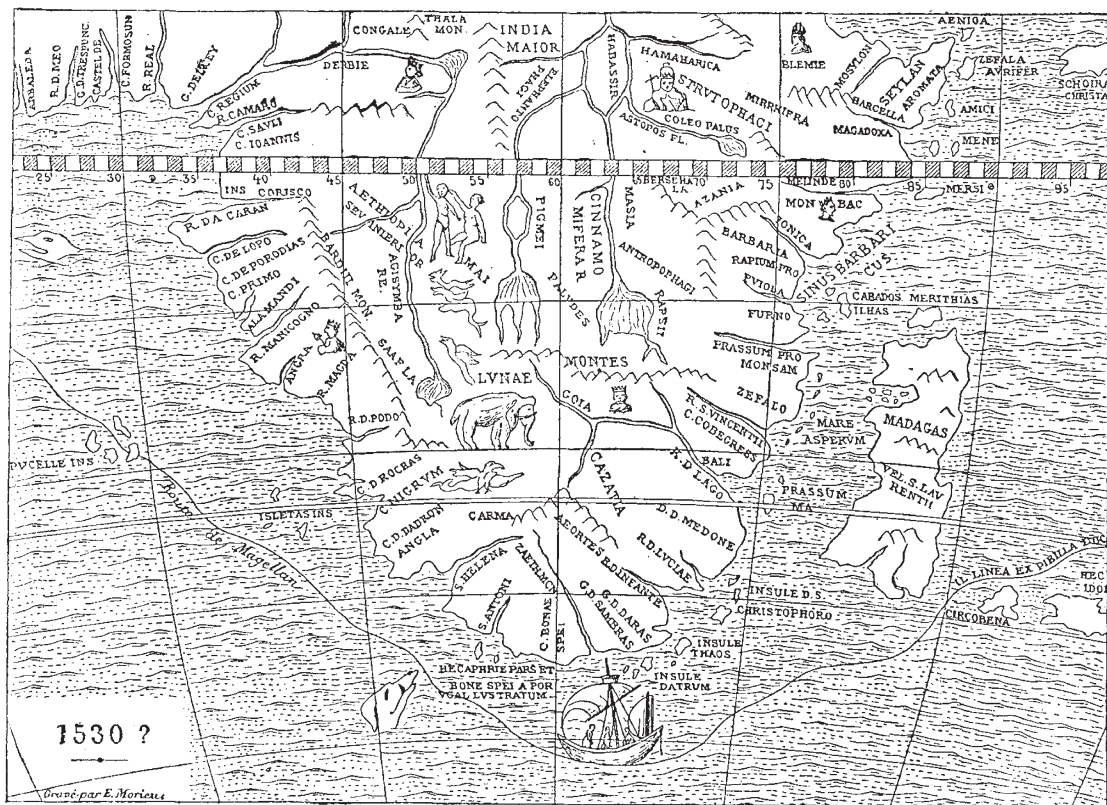

FIG. 1.—Portion of a Spanish Globe of 1530-40, found in the National Library, Paris.

gether New Africa in which he accumulated heresy on heresy? The Central lakes, the immense reservoirs of the Nile, disappear at one stroke of the pen; as to the Congo it is no longer connected with the lakes of the interior, although it is allowed to retain a little of its semicircular direction. The error accredited by a celebrated geographer like Delisle made way. The old map of Africa was demolished stone by stone, so to speak. In short the work was so well done that, after having piled nonsense upon nonsense, for the sake of peace, all was expunged; after having believed in tribes with dog-heads, placed a few anthropophagi everywhere, and confounded countries situated a thousand miles from each other, they ended by making a *tabula rasa* and leaving a white space where formerly were rightly placed the great lakes and sources of the Nile. Yet a few years and here was geography doubting, denying, and ridiculing the follies of our predecessors. The students of geography of the period of 1840-50 were too much on their guard to commit the colossal blunder at that period of making the Nile issue from the lakes to the south of the equator. "So far as concerns a part of Africa," to quote M. R. Cortambert, in the article in *La Nature*, "the past has been resuscitated: 'old things have become new.' That which was laughed at yesterday is taken seriously to-day. Then, my friends, these good ancestors of the fifteenth and sixteenth centuries, who counted among them Columbus, Gama, Magellan, and many other conquerors of the world, have not, perhaps, left altogether to their descendants of the nineteenth century the glory of inventing geography."

From the report of the Lyons Commission we learn that the following works were probably accessible to the Flemish map-makers, and later to the constructors of the

Lyons globe :—1. The Geography of Ptolemy; 2. The "Portuguese Asia" of De Barros (1552); 3. The "Description of the Congo," by Pigafetta, according to Lopez (1592); 4. The "Historical Description of Ethiopia" of Dom Francesco Alvarez" (1558); 5. The "Africa" of Leo Africanus (1556); 6. And the old maps and portulans.

Among these old maps and portulans, those which appear at this period to have had a certain influence are :—1. The Medicean Portulan (1351); 2. The Catalan Atlas (1375); 3. The Map of Mecia de Viledestes (1413); 4. The Map of Johannes Leardus (1448); 5. The *Mappemonde* of Fra Mauro; 6. The Ambrosean Map (1480); 7. The *Mappemonde* of Juan de la Cosa (1500); 8. The Map of Diego Ribera; 9. The Spanish *Mappemonde* of the National Library, Paris (Fig. 3) (1540); 10. The

Maps of Ramusio, of Pigafetta, and of Hugues Linschoten.

In the detailed report which the Lyons Commission will communicate to the Society will be shown to what extent each of the above documents contributed to the establishment of the Flemish maps, on which probably the Lyons globe was more immediately based. The same Report will contain an investigation into the travels known or unpublished which, from the tenth century, have contributed to the progress of the African geography of the Middle Ages and of the Renaissance. This investigation will include the following :—1. The Arab voyages and Compendia; 2. The voyages of the mendicant Spanish friar of the fourteenth century; 3. The expedition of eight dominicans of Montpellier to the sources of the Nile (1317–1350), unpublished; 4. The travels of
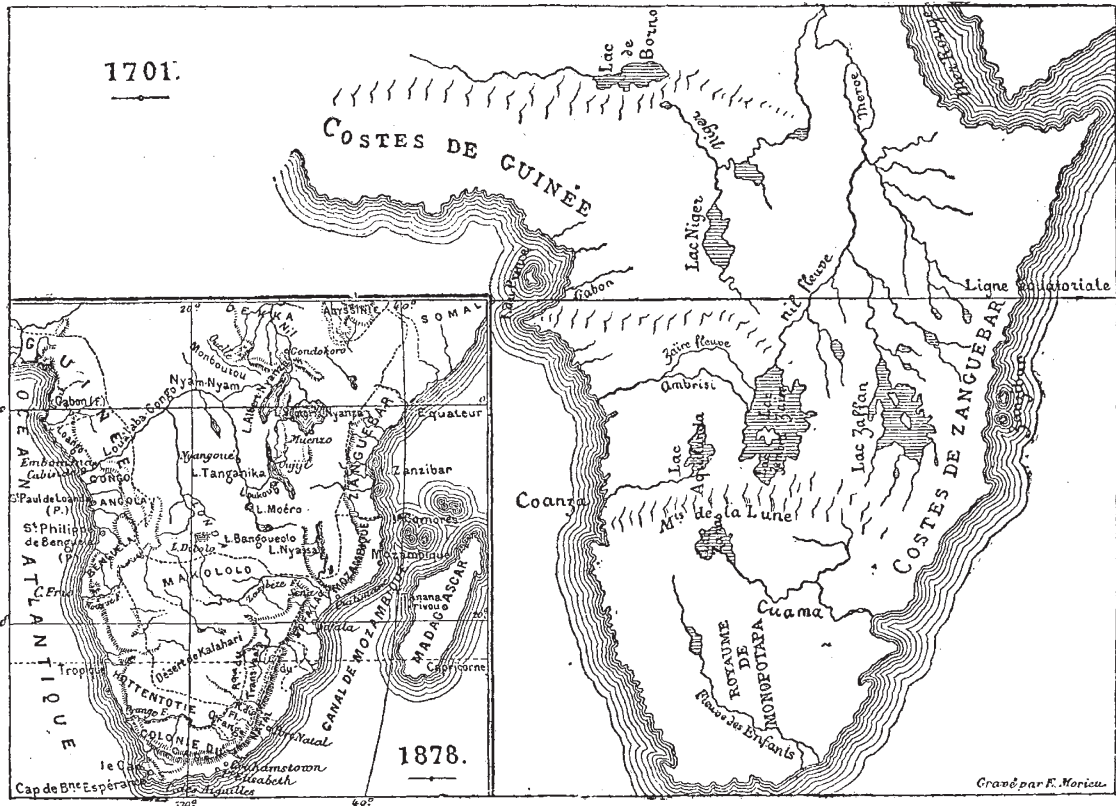

FIG. 2.—Map of Stanley's Recent Journey Across Africa. FIG. 3.—Portion of a Globe of 1701, belonging to the Lyons Library, from a copy by M. Deloncle.

the brothers Vivaldi, thirteenth century; 5. The expedition of the Catalan Ferrer in 1346, unpublished; 6. The voyages of Diego Cam; 7. The itineraries of the early *pombeiros;* 8. The "Eastern Ethiopia" of Joan dos Santos; 9. The travels of Barbosa; 10. The exploration of the Dutch Jan van Herder, in the country of the Akkas, unpublished; 11. The Derrotero desde Lisbõa Al Cabo de Bueno Esperanza y India Oriental, anonymous and unpublished; 12. The description of the Congo, by Martinus Abarca de Boléa et Castro (1601), unpublished; 13. The "Universal Book of the Navigations of the World" (1590?), Spanish, unpublished; 14; The Travels of the Belgian Pierre Fardé from Algiers to the Congo (1686), unpublished; 15. The "Travels of Manoël Godinho" (1663); 16. The Letters of Father Mariano, the Jesuit, on Kaffraria, &c., &c.

The work undertaken by the Lyons Geographical

Society is creditable to them in the highest degree and will result in a valuable addition being made to historical geography. Their work, as the Commission rightly maintain, is to some extent international, and deserves the countenance and assistance of geographers all the world over.

COSMIC METEOROLOGY [1]

II.

INFLUENCE of the Moon on the Earth's Magnetism.—
There is a fact in connection with the moon's influence on our earth for which an explanation is necessary, and M. Faye has proposed for this end a hypothesis in advance. He had already pointed out Dr. Lloyd's investigation which showed that the diurnal magnetic variations could

[1] Continued from p. 128.