ART. VI.—THE GREAT COMET OF 1882.

THE appearance of a comet like that which made its perihelion passage on the 17th of September last, and is still visible in the south-eastern sky in the early mornings, is a sufficiently rare occurrence to attract the attention even of those who are not systematic observers of the heavens. According to a very high authority on such a subject, the late Sir John Herschell, a "*great* comet hardly occurs on an average more than once in fifteen or twenty years; though," he adds, "as sometimes happens in matters of pure accident, or in the course of chances, it not unfrequently happens (and we have recently had it remarkably exemplified) that two or three great comets follow one another in rapid succession." And so far at least as living memory extends, these words, penned in 1863, will be found in close accordance with the facts. If we exclude from this list (for reasons which will presently appear) the comet which is now visible, there have been only six comets, since the beginning of this century, that can claim to rank as *great* comets—viz., those of 1811, 1835, 1843, 1858, 1861, and 1862. That which will probably be best remembered by the present generation is the comet of 1858 (Donati's), which was so conspicuous an object in the evenings of September and October of that year. There are, however, many still living who can remember the comets of 1843 and 1835, and a few who can recall that of 1811, probably the finest that has appeared within living memory.

It is not surprising that a phenomenon which occurs so rarely, which is so unlike any of the heavenly bodies with which we are familiar, and which presents so strange and, in many cases, so sublime a spectacle to the eye, should excite universal interest and give rise to many strange speculations and baseless fancies. And accordingly we find that history abounds with accounts of the excitement and alarm produced by the appearance of comets in the early and Middle Ages. For in those days the appearance of a great comet was looked upon in the light of a portent, as a sign of some great change impending in the political world, of the death of a king, the outbreak of a war, or some other event that might seriously affect the destiny of a nation. It is a matter of history that the abdication of the Imperial throne by the Emperor Charles V. was occasioned by the impression produced upon his mind by the great comet of 1556. He regarded the comet as a sign from Heaven, sent to warn him of the approach of death, and of the need of preparation for the eternal state into which he was soon to enter. And it would be easy to adduce other instances

of the same kind, showing the deep impression created by the appearance of a great comet in early times.

Thanks to the spread of truer views of the nature of the material universe, and of the relation in which man stands to the Creator and Governor of that Universe, the appearance of a comet is no longer the occasion of superstitious fears of this kind. But the spread of knowledge, while it has thus removed one cause of fear, has tended, at least in the case of those who are imperfectly informed on such subjects, to inspire another. It has relieved men's minds of the superstitious dread occasioned by the appearance of a comet in former times by showing them that a comet is after all only a member, a very erratic member it is true, but still a member of the great solar system, governed by the same general laws as the planets and their satellites, and moving in an orbit which, when once its elements have been satisfactorily determined, may be computed with almost as perfect accuracy as that of the earth itself. While doing this, however, it has at the same time suggested another cause of fear by indicating certain consequences of a physical kind which might result from the collision of one of these erratic bodies with our earth, or with the Sun. When, in the year 1832, it was announced that a comet would actually cross the earth's orbit, and that at a point not far from where the earth would be passing at the time, something like a panic seized upon the public mind, and though it soon became known that the earth would pass the point indicated a full month before the comet would reach it, it was by no means an easy task to allay the apprehensions that had been aroused, and it is said that not a few persons actually died of terror.

As there is no suggestion that the comet with which we are now concerned is likely ever to come into contact with our earth, we need not speculate upon the consequences of such a collision, though it may be reassuring to those who have any misgivings on the subject to know that in the opinion of Sir John Herschell, "had a meeting taken place, from what we know of comets, it is most probable that no harm would have happened, and that nobody would have known anything about it." But *there are* reasons, and very strong reasons, for supposing that the comet which is now visible will ere long come into collision with the sun: and it will be the object of the present article to explain, as briefly as may be, 1st, What are the grounds for believing that this will take place; and, 2nd, What consequences, if any, affecting our earth are likely to result from it.

(1.) The grounds for believing that the comet which recently made its perihelion passage will before long fall, or be drawn into the sun, though resting on abstruse and elaborate calcula-

tions, are in themselves so simple that I do not despair of making this plain to the least scientific of my readers.

Mention has already been made of the great comet of 1843. It was remarkable for the immense length of its tail, which extended from the horizon to the zenith, or halfway across the sky. But it was also remarkable for the exceeding closeness of its approach to the sun, its distance, when at its perihelion, or nearest point, being less than a tenth of the sun's diameter. Now, the first thing that is done by astronomers on the appearance of a new comet is to compute its elements, as they are called, or, speaking unscientifically, to determine from actual observation all the particulars of its position and movements in the heavens which are required to enable them to calculate its orbit and the probable time of its return. The next thing is to search the records of former comets, in order to ascertain whether the elements of the new comet are the same as those of any that has already appeared, in which case it may be assumed to be a reappearance of that comet. When, then, the elements of the comet of 1843 had been satisfactorily determined, and were compared with those of previous comets, they were found to bear a striking resemblance to those of a comet which had been observed in 1668, and though its identity was not regarded as a certainty, "there was considerable reason" (to quote again from Sir John Herschell) "to believe that it was a reappearance of that comet."

This would give it a period of 175 years—viz., from 1668 to 1843. But, strange to say, in the year 1880, or after an interval of only thirty-seven years, a comet appeared which, from observations taken in the southern hemisphere, was found to have almost precisely the same elements as the great comet of 1668 and 1843, and, stranger still, when after another interval of only two years the comet which is now visible presented itself, its elements were found to so closely resemble those of the last-mentioned comet, that its identity with it may be considered as practically established.

Assuming, then, as there seems every reason to do, that the comets of 1843, 1880, and 1882 were not separate and independent comets, as at first supposed, but reappearances of one and the same comet, how are we to account for the rapid shortening of its period from 175 years on its first reappearance to thirty-seven years on its second and two years on its third return? There appear to be only two ways in which such a contraction of the comet's orbit can be explained. It might have been caused by the comet's having come within the sphere of attraction of one of the planets, as was the case with Lexell's comet, which was completely diverted from its original orbit and started in an entirely new track while passing near the planet Jupiter; or it might have been brought

about by the retardation of its velocity occasioned by some resisting medium. As it is known that the comet with which we are now concerned does not pass near to any of the planets at any point in its orbit, the former explanation will not apply in the present case, and there seems no escape from the conclusion, with which all the facts agree, that the shortening of the comet's period has been brought about by the resistance it has encountered from the solar atmosphere in passing so near to the sun's surface. But this process is one which tends to repeat itself, and that with constantly-increasing rapidity. An astronomer who has given some special study to the history of this comet, Mr. R. A. Proctor, calculates that its next return may be expected in the course of a few months, and, if so, the time of its final absorption into the sun cannot be very far off.

(2.) And now let us consider, so far as the space at my disposal will allow of our doing so, what are the probable consequences of such a catastrophe. Two widely divergent opinions have been held on this subject, dependent on the views that have been entertained as to the nature and constitution of a comet's mass.

Sir Isaac Newton, who, in accordance with the prevailing views of his time, supposed that a comet was composed of solid matter, was firmly convinced that the collision of a comet with the sun would produce a conflagration such as would inevitably destroy our earth and the whole solar system. Speaking with reference to the comet which bears his name, he said: "I cannot say when the comet of 1680 will fall into the sun, possibly after five or six revolutions; but whenever that time shall arrive, the heat of the sun will be raised by it to such a point that our globe will be burnt, and all the animals upon it will perish." And if the body of a comet was, as he supposed it to be, "solid, compact, fixed, and durable, like the bodies of the planets," there can be no doubt that such would be the case. Sir John Herschell, on the other hand, who believed a comet to consist of matter in a state of almost infinite extension, or attenuation, held the opinion, as we have said, that the collision of a comet with the sun would produce either no perceptible effects at all, or effects so insignificant as not to be worth considering.

According to our present knowledge, the truth would seem to lie somewhere between the two views. There can be no doubt that Sir Isaac Newton was mistaken in his notion as to the solid nature of the material of a comet. On the other hand there can be as little doubt that Sir John Herschell, though nearer the truth, somewhat overstated the case in the opposite direction, when he hazarded the assertion that the whole mass of a great comet might possibly not weigh more than a few ounces. For however attenuated may be the material of a comet's tail, there

is reason to suppose that the nucleus is composed, if not of solid matter, at any rate of matter in a state of considerable condensation. Nor have we altogether got rid of a comet when we have disposed of its nucleus and its tail. We know that many, if not all, comets are followed by trains of meteoric matter, for it is the collision of portions of this meteoric matter with our atmosphere, that gives rise to the phenomena of shooting or falling stars as often as the earth passes through a part of its orbit which is intersected by the orbit of a comet, at or near the time when the comet's train is going by. And if we grant for the sake of argument that the effect of the rush of the comet's tail into the sun, even at the enormous velocity possessed by it at its perihelion passage, would be insignificant, we can hardly suppose that the impact of the nucleus of the comet as it plunges deeper and deeper into the sun's surface at each successive approach, and that of the meteoric train, can fail to have some effect in raising the temperature of the sun. For heat, according to the well-known definition, is only "a mode of motion." In other words, the sudden arresting of a mass in rapid motion develops an amount of heat proportioned to the velocity with which it is moving. And if a few scattered particles of a comet's train, entering our atmosphere with a velocity of thirty or forty miles in a second, develop sufficient heat to cause a blaze of light that will illumine the whole landscape on a dark night, and that has been known in some cases even to outshine the sun at noonday, what must be the effect produced by the nucleus of a comet (that of Donati's comet was estimated to be 1,600 miles in diameter) or by the whole mass of its train plunging into the sun with a velocity of more than 300 miles in a second? The answer to this question would involve considerations which would lead me far beyond the scope of the present article, and indeed the problem is too complicated to be disposed of in a few concluding sentences, even if we had the materials—which we have not—for arriving at a complete and satisfactory solution.

G. T. Ryves.

ON "THE CLAIMS OF THE CONVOCATIONS OF THE CLERGY."

To the Editor of The Churchman.

Sir,—I have considered the answer which Dr. Hayman has done me the honour to make, in your number for November, to my article on the Claims of the Convocations of the Clergy, which appeared in your numbers of July, August, and September.