trace is clearly shown. From 11.35 to 11.38 there was a very rapid easterly movement of about 4′ in the declination trace, of a non-oscillatory character. The close agreement in time of this movement with the arrival of the preliminary tremors is very likely a purely accidental coincidence; but the movement is of an unusual character, and it would be interesting to know what was being recorded at the time at other magnetic observatories. The movement may, of course, have been due to some purely local source, *e.g.* abnormal electric-tram currents.

C. CHREE.

Kew Observatory, Richmond, Surrey, January 7.

Singularities of Curves and Surfaces.

THERE is a distinction between *multiple* points and what, for want of a better word, I have called *singular* points. The curve $au_p + u_{p+1} = 0$ has at A a *multiple* point of order p, but not a *singular* point. The latter points are defined in § 169 of my "Geometry of Surfaces," reviewed in NATURE of December 22, 1910 (p. 231), and the definition may be illustrated as follows. Let multiple points of orders p. q, r . . ., where p is not less than q, r . . ., move up to coincidence along a continuous curve; then the compound singularity thereby formed is a singular point of order p. The curve of lowest degree, which can possess a singular point of given order, depends on the way in which the singularity is formed. Thus if four nodes move up to coincidence along a conic, the resulting singular point is of the second order; but a quintic is the curve of lowest degree which can possess such a singularity. Also, if three nodes move up to coincidence along a straight line, the singular point is still of the second order, but no curve of lower degree than a sextic can possess such a point.

The reviewer's statement in the second paragraph is misleading, and calculated to convey a false impression, since the investigations referred to are applicable to surfaces of any degree. The fact is that a quartic surface is capable of possessing most of the simpler singularities. The principal exceptions are triple lines, which cannot be completely discussed without the aid of a surface of the seventh degree, and cuspidal twisted curves, which necessitate the employment of a quintic surface, since a quartic surface, which possesses a cuspidal twisted cubic curve, is a developable surface, and is therefore not sufficiently general for the purpose in question.

As science advances, the introduction of new words is essential. Thus lithotrity, ovariotomy, scleroderma, &c., have been introduced during the last century to designate operations and diseases of which our ancestors were ignorant, whilst algebra has been enriched by such words as catalecticant, evectant, protomorph, &c. The choice of suitable words requires care, but I adhere firmly to my opinion that Latin and Greek are the best languages to employ.

A. B. BASSET.

December 23, 1910.

IT is unfortunately impossible to give a very brief rejoinder to Mr. Basset's letter; and it is perhaps as well to take the opportunity of giving a further statement of my position in reference to singularities on a plane curve.

In the first place, the distinction drawn in Mr. Basset's letter between *multiple* points and *singular* points of order p does not seem to be in agreement with the practice followed in his book, where the two terms appear to be used indiscriminately: thus in §§ 171–4 and § 181 the term *multiple* point is invariably applied to singularities which, according to his letter, he would now call *singular* points. At any rate, the singularities considered in these articles cannot occur (in their general forms) on curves of degree $(p+1)$, and, as I understand Mr. Basset's letter, he intends the use of the term *multiple* points to be restricted to those singularities which do occur on curves of degree $(p+1)$. Naturally such a restriction would justify the assumption made in § 165, which was criticised in my review; but no modification of terminology will answer the question as to whether *all* types of singularity can be obtained by Mr. Basset's treatment of the subject.

The singularities which were in my mind when I raised this question were those considered by Zeuthen (*Math. Annalen*, Bd. x.) and Jordan ("Cours d'Analyse," t. 1, chap. v.); a fairly simple example is given by the origin on the curve $x = t^6$, $y = t^{12} + t^{15} + t^{16}$.

Zeuthen's method enables us to determine the Plücker-equivalents of the singularity, and Jordan shows how to find quadratic transformations which reduce the singularity to a simpler character. But I do not see that Mr. Basset's limiting process (as briefly indicated in his letter) would enable us to handle any singularity of this type (called a *cycle* by Jordan), nor have I found any reference to the existence of such types in Mr. Basset's book.

T. J. I'A. B.

Scottish Natural History.

I SEE that NATURE of December 29, 1910, refers to two statements made before a natural history society by Mr. Symington Grieve, viz.:—

(1) That half a century ago white-tailed eagles were more abundant than golden eagles, or words to that effect.

(2) That Mr. Grieve is of the opinion that wild cats are on the increase in Scotland owing to the instructions issued by proprietors and factors for their protection.

With regard to the first, naturalists would like to have further data. It is certainly true white-tailed eagles *were* then vastly more abundant than now, and that they are now verging on extinction as an existing species. But that they were "far more numerous half a century ago than the golden eagle" requires more exact statistics. Forty years ago there were quite eighty eyries of golden eagles occupied over all Scotland, but I cannot find any *evidence to prove* that white-tailed eagles at any time anywhere in Scotland even approached that figure, and during at least forty years I have paid considerable attention to all statements made as to their distribution and their subsequent decrease. Locally in some few districts white-tailed eagles were more numerous than golden eagles, but not generally, and I believe all occupied eyries could at any time have been easily counted.

As regards the increase of wild cats, that is also quite undoubted, but the true reason is not the direct instructions given by proprietors or factors generally, though that may have some local value also, but to the protection afforded by the increased area of lands devoted to deer afforestation.

T. A. HARVIE BROWN.

Dunipace, Larbert, Stirlingshire, N.B.,
December 29, 1910.

The Origin of Man.

THE following extract from a review in "Dodsley's Annual Register for 1767" of Dr. Adam Ferguson's essay on the "History of Civil Society" may be of interest:—

"Many of the authors who have written on man, and those too, some of the most ingenious, have set out by considering him as an animal. . . . Nay, one in particular has thrown out doubts of his having been originally a monkey or baboon." (The reviewer goes on to speak of this theory as "too ridiculous for serious animadversion.")

Could any of your readers say who was the "one in particular"?

CHARLES E. BENHAM.

Colchester, January 7.

COLLIERY WARNINGS.

WHEN an appalling colliery disaster, like that at Hulton Colliery, happens to coincide with a "colliery warning," public attention is naturally attracted to the fact, and the warning at once becomes invested with an appearance of importance that is out of all proportion to its true value. There appears to be an impression that these colliery warnings are issued by some central responsible authority, such as the Meteorological Office might be, and that they are based upon sound scientific principles, but as a matter of fact they are issued by the Press Association, and are

apparently issued in defiance of all the dicta of science and all the teachings of practical experience. All these warnings are based on the assumption that a high barometric pressure indicates a condition of danger for the coal miner; for example, the warning published on December 19 last states:—"While the glass remains at about its highest level, miners are advised to beware of escapes of firedamp from the strata." The entire falsity of this assumption has been repeatedly pointed out in the technical press, but as the warnings are still being issued on the same lines, it may be worth while to place the main data on the subject before those interested in the matter.

Firedamp occurs occluded in coal, and also contained under pressure in cavities and fissures in the coal seam itself and in the strata adjacent to it. Furthermore, in every colliery there are larger or smaller areas from which the coal has been removed, and which are more or less loosely filled with debris, either deliberately thrown or packed in to fill up partly the empty spaces, or due to the breaking down of the roof of the coal seam. Such a partially filled space is known technically as the "goaf"; the ventilating current in a colliery traverses the various roadways and workings, passes along the working faces of the coal, and may sweep along the edge of the goaf, but the goaf itself is never ventilated. Hence in a fiery colliery the goaf gradually fills with a mixture of firedamp and air. The object of the ventilating air current is to dilute the firedamp given off gradually from the coal faces, or coming off more rapidly from cavities (firedamp escaping in this way being known as a "blower"), to such an extent as to produce a non-explosive atmosphere in all accessible parts of the mine.

A gas explosion can only occur in a properly worked colliery when an evolution of firedamp takes place in excess of the normal, and the question directly before us is how this rate of evolution of firedamp can be affected by changes of atmospheric pressure. It is an obvious truism that increase of pressure must tend to prevent the escape of firedamp from the coal or the strata of rock. In the case of gas contained in cavities, this is often under very great pressure, as high as 30 atmospheres having been recorded by actual measurement, and in such circumstances, even a considerable change in the height of the barometer, say 3 inches, amounting to only one-tenth of an atmosphere, would have but little influence. On the other hand, blowers sometimes give off gas at pressures not greatly above that of the atmosphere, and then fluctuations of atmospheric pressure may have a decided effect. Thus in the *Colliery Guardian* of December 13, 1907, Mr. D. S. Thomas gives a record of his observations on a blower extending over a twelvemonth, in which he found that the flow of gas from the blower increased quite regularly whenever the barometer fell, so much so that "the slightest change in barometric pressure was shown more delicately than the barometer itself could record it."

As regards occluded gas, it is quite certain that this comes off more readily when the coal is placed under diminished pressure. Numerous investigations have been made on this point, and it has been found that whilst a small reduction of pressure causes the occluded gas to commence to come off, yet even after many hours' exposure in a vacuum at ordinary temperatures, a considerable proportion of the gas is still retained. As regards therefore the gas contained in the coal and the surrounding rocks, it appears to be beyond controversy that a low barometer must necessarily correspond to a somewhat increased evolution of firedamp.

The gas contained in the goaf is under somewhat different conditions; so long as the air in the airways of the mine is under the same pressure as that in the goaf, there is no tendency for the latter to flow into the former once the condition of equilibrium has been attained, whether this be under a *régime* of high or of low barometric pressure. A rapid fall of the barometer would necessarily affect the airways first, and would therefore cause the foul air from the goaf to flow out into the airways of the mine, and it is quite conceivable that a series of rapid alternations of high and low pressure, bringing about a considerable interchange between the air in the roadways and in the goaf, would promote diffusion, and thus help to increase the proportion of firedamp in the airways; in the main, however, it is the falling of the barometer that will bring about this result. This reasoning, based upon elementary physical laws, appears to be incontrovertible, and points conclusively to a falling barometer as the condition to be dreaded, and that this is the case is well known to all mining engineers, and apparently to everyone except the Press Association. It seems probable that the firedamp of the goaf plays a greater part in fouling the air of a mine than does that evolved from the coal, as a general rule, and that therefore a rapidly falling barometer is more dangerous than a continuously low barometer in most cases.

Numerous observations have abundantly confirmed this reasoning; the Prussian and Austrian Firedamp Commission showed conclusively that the percentage of firedamp in the air of mines was greater when the barometer fell, and the British Commission of 1886 came to the same conclusion, though they attached less importance to the subject; it may be advisable to quote their words:—"While we recognise that variations of atmospheric pressure exert influence on the escape of gases which have accumulated in the cavities, and possibly to a slight extent on that of gases emitted directly from the coal, we entertain great doubt as to the wisdom of placing reliance on the issue of meteorological warnings."

In addition to the work of the various commissions, there are in existence numerous reports of investigations carried on in this country and on the Continent, notably in Westphalia and the north of France, and all agree in showing that an increase of firedamp in the air of mines attends a fall of barometric pressure. It is thus inexplicable why the Press Association should still continue to look upon a high barometric pressure as a source of danger, unless on the reasoning that a high barometer must fall before very long, and it may be charitably assumed that the warnings are issued on this hypothesis. Nevertheless, the statement of the recent Royal Commission on Mines respecting these warnings (second report of the Royal Commission on Mines, 1909, p. 175):—"They are misleading, and, as far as we can see, their publication serves no useful purpose," deserves most emphatic endorsement.

Seeing that a barometric change cannot, of course, *per se*, bring about a colliery explosion, but can only produce conditions under which an explosion is liable to occur, the explosion itself being determined by the coincidence of several more or less accidental circumstances, it is hardly to be expected that statistics of explosions would be of any great value. In order, however, to get as much light as possible upon the facts of the case, I tabulated some time ago all the explosions that occurred in the year 1905, and compared them with the state of the barometer at Kew; parenthetically, I may remark that I took the Kew readings because the news agency bases its warnings upon it, although it is, of course, the state of the local barometer and not of the Kew barometer that really affects the question. The results were as follows:—

Out of 138 explosions there were:—

21	explosions when the barometer stood between			29·0 and	29·49 in.
56	,,	,,	,,	29·5 ,,	29·99 ,,
54	,,	,,	,,	30·0 ,,	30·49 ,,
7	,,	,,	,,	30·5 ,,	30·8 ,,

Furthermore, there were:—

48	explosions when the barometer was			rising
70	,,	,,	,,	falling
20	,,	,,	,,	steady or slightly fluctuating.

I also compared the colliery warnings issued in the first half of 1905 with the explosions that took place. There were in those six months 62 days on which explosions took place out of about 155 working days, so that if a date should be selected at random, the probability that an explosion would occur on that day or the day following would be about 4 to 1; during those six months there were fifteen warnings issued, only six of which were followed within forty-eight hours by an explosion, so that the Press Association only hit upon a dangerous date once in less than ten times. Obviously it could do better if it trusted to chance alone, and if the matter were not such a serious one, I should be tempted to advise the newspapers concerned to turn over the subject of colliery warnings to their sporting tipsters. Over a series of years the average number of explosions was about 150 per annum, and the average number of warnings about 25, so that even if every warning were followed by an explosion, only one explosion in six would have been foretold.

Of course, it is every explosion that must be taken into account, and not only serious explosions or those attended by loss of life. Whether a small gas explosion occurs doing no damage at all, or whether the explosion extends throughout the whole of a colliery, killing its hundreds, is obviously determined by the circumstances of the case, and is independent of barometric fluctuations; indeed, modern researches are forcing us very near to the conclusion that in present-day colliery practice every serious extensive explosion is a coal-dust explosion rather than a gas explosion, though the latter may, and very often does, originate it. In fairness to the news agency, I may point out that when the barometer is high there is a likelihood that the coal-dust in a mine may be drier than when it is low, and it is possible, though not proved, that in these circumstances the risk of a coal-dust explosion may be somewhat greater. This consideration, however, does not affect the general conclusion that the colliery warnings as issued by the Press Association, which pointedly refer to firedamp, are misleading, and would be harmful but for the fact that most colliery managers know too much about the subject to pay any attention to them.

I hold that it would be a real service to the mining community if the Meteorological Office would send out notice whenever an area of considerable barometric depression is approaching our shores as long in advance as possible, so as to warn colliery managers to be on the look out for a fall in the barometer.

I understand that similar predictions are furnished to farmers at harvest time for a small fee, and surely if this can be done where material interests alone are involved, it is not too much to ask for the like assistance where men's lives are at stake. It is not at all certain that the influence of barometric changes upon the possibility of colliery explosions is of any great importance, but in matters of such supreme gravity, no precaution, however trifling, should be neglected.

HENRY LOUIS.

SOURED MILK AND ITS PREPARATION. LACTIC CHEESES.

IN a former article[1] the nature, preparation, and uses of soured milk were dealt with. It was pointed out that the consumption of sour milk is widespread in the East, that in all the sour milks a peculiar micro-organism is present, with artificial cultures of which it is possible to prepare soured milk in imitation of the natural product, and that soured milk tends to lessen intestinal putrefaction and seems to be beneficial in many complaints. The micro-organism (*Bacillus bulgaricus*) present in all the natural sour milks is one possessing distinct and special characteristics, though exhibiting marked variation or "pleomorphism," and Makrinoff,[2] who has critically studied the question, believes that all the varieties which have been described are referable to one species. Two more or less distinct *races* seem to exist, namely, one that produces a somewhat viscous product, another that does not, and for the preparation of soured milk the latter is to be preferred as yielding a more palatable product. The morphological and staining characters of the *Bacillus bulgaricus* are so distinctive that

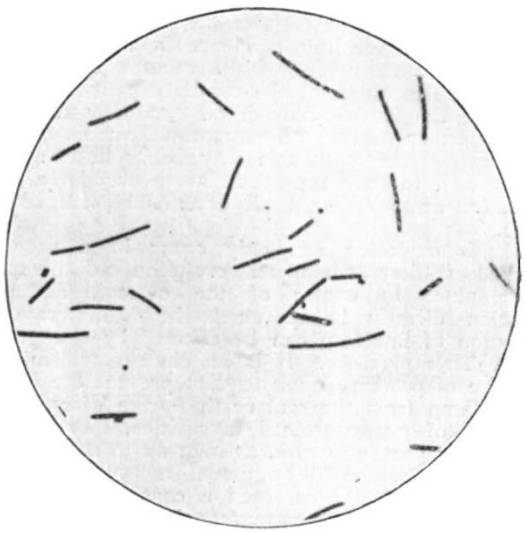

FIG. 1.—Film of properly soured milk, showing presence of the *B. bulgaricus* only (Gram, ×1200).

a microscopical examination, combined with the Gram staining process, of the soured milk, enables us to judge to what extent the *B. bulgaricus* has developed, and whether there is contamination with other organisms (Figs. 1 and 2).

For the preparation of soured milk it was pointed out that the milk must be properly sterilised by adequate boiling, inoculated with a proper "starter," that is a culture of the *B. bulgaricus*, and incubated for from 12 to 24 hours at a temperature of 105° to 110° F. Starters may be obtained in the liquid and solid (tablet) forms, but unquestionably the liquid are far superior to the solid ones. Thus Quant[3] examined certain tablet preparations, and compared them with a liquid culture as regards flavour of, and production of lactic acid in, the soured milk produced. The liquid culture produced 2·34 per cent. of lactic acid *B.P.*,[4] the tablets yielded only 0·07 to 0·42 per cent. of lactic acid *B.P.*; moreover, the curd and flavour were unsatisfactory with the latter. Quant also

[1] NATURE, April 7, 1910, p. 159.
[2] *Centr. f. Bakt.*, Abt. ii., Bd. xxvi., 1910, p. 374.
[3] *Brit. Med. Journ.*, 1909, ii., p. 1738.
[4] *B.P.* = British Pharmacopœia.