finished iron have declined to the extent of 36% since the same date. Instead of finished iron absorbing 40% of the Cleveland pig-iron made as in 1872, in 1891 it absorbed only about 23%. The quantity of ore raised in Cleveland in 1872 was about 6,300,000 tons, and the quantity of pig-iron made in the north-east district about 1,920,000 tons. During the year 1891 there were produced in the north-east district 795,487 tons of steel ingots. In the latter year 2,260,000 tons of ores other than Cleveland were smelted and of these about 2,100,000 tons were imported chiefly from Spain. On the whole, there has been produced in this district about 36% more pig-iron than in 1871.

It is rash indeed to prophesy in industrial matters, which are influenced by many complex problems, but it would seem that the great change which is impending over Middlesborough is the adoption of a new process in steel making. To bring ore from Spain—the greater part of which is converted into slag, simply to encumber the ground; whilst a smaller percentage ultimately finds useful application—seems an artificial proceeding. At first it was forced upon English steel-makers, from the fact that our native ores, with few exceptions, are phosphoric and therefore unfit for the pneumatic process of steel-making. Later discoveries have removed this disability and by the basic process phosphorus can be eliminated, and good steel made. The Cleveland district is richer in iron ore of high quality than any other in England, but this ore is not suitable for steel-making by the old acid process. It is therefore the manifest duty of Cleveland to foster and perfect the basic system of steel-making, and so use the phosphoric ores of her native hills. The problem is chiefly a commercial one. Happily the stagnation of trade will quicken the ingenuity and enterprise of steel-makers, and we shall no longer depend so fully on a foreign source for the raw material of the most important industry in the kingdom.

The discussion on Mr. Head's paper turned chiefly on the respective merits of Yorkshire iron and mild steel. Mr. Windsor Richards said that best Yorkshire iron was better than the best mild steel made. The statement is too sweeping, and those who use this material will be more likely to agree with Dr. White, the Director of Naval Construction, who spoke in praise of mild steel, laying emphasis on the lower price it costs compared to Yorkshire iron. Mr. Aspinall, the chief Locomotive Engineer to the Sheffield, Manchester, and Lincoln Railway, and one of the best mechanical engineers in the country, also spoke strongly in favour of steel, traversing Mr. Windsor Richards's statement that the mildest descriptions could not be case-hardened. The subject, however, is somewhat antiquated, and were it not for the high authority of Mr. Windsor Richards, would hardly be worth reopening. The difficulties that stood in the way of steel for engineering purposes have been overcome years ago.

The next paper on the list was a contribution by Mr. Richard Grigg, and dealt with the newest industry of Middlesborough, namely, that of salt manufacture. The late John Vaughan, boring for water, came upon salt, and the result has been that quite a brisk industry has sprung up. At first the wells were made by the diamond drill, but the process was so expensive that the industry would have been strangled in its birth, had it not been that American ingenuity came to its aid. The salt in the Middlesborough district is at a considerable depth below the surface; in some places 1700 feet. The strata that have to be bored through are difficult, and it was thought at one time that the salt was too deep to win with profit. Some shrewd person, who had travelled in Pennsylvania, remembered how the Americans make their oil wells, and the system has been transplanted to Middlesborough, so that in some parts one might also fancy one's self in the neighbourhood of Pittsburg, so closely have the characteristic timber derricks been copied in this heart of the iron country. The chief point of interest raised by Mr. Griggs's paper was whether the brine-pumping is going to lead to subsidence or not. On the other side of our island, in the salt districts of Cheshire, brine-pumping has led to most curious and, to those on the surface, unpleasant results. The houses in Northwich bear evidence of this; the house-line presents most devious and irregular courses; the houses themselves are iron strapped or wooden bound, so that they may be "jacked" to lift them, as the earth upon which they stand subsides, and it is no uncommon thing for a Northwich landlord to be called on to the rescue of his buildings, which are in process of disappearing beneath the surface. In one place a house has so far settled down that what was the first-floor bed-room has become the basement, and the front door has been cut off between the two upstairs bed-room windows. Northwich Bridge has been lifted several times, or it would have been transformed into a dam; whilst large tracts of land have subsided bodily, and in one place there is, or used shortly ago to be, a line of rails which ended abruptly at the edge of a cliff, the remaining part being on a plain beneath. At one time these rails were continuous, and were only broken through subsidence caused by the abstraction of salt beneath. Probably, however, Middlesborough will not be served in this way. The salt there is deeper, and is surmounted by a stratum of rock. As the brine-pumping goes on, and large cavities are formed by the abstraction of salt, the roof of rock is left unsupported. The superincumbent mass of earth may, or may not, break this down. It is hoped that should a fall of the rock take place, the pieces descending will form themselves into a dome shape, and, therefore, be well calculated to resist the weight above. The hope appears too sanguine, for the rock would be more likely to give way over the centre of the cavity than at the sides, where it is nearer the supporting salt not dissolved; indeed, the dome would more likely be an inverted one. In the Cheshire district we believe the subsidences have invariably been of a gradual nature, so that inconvenience rather than danger has been the result. In Middlesborough the results may not be of the same gentle kind. It is true that the cavities are deeper in the earth, and that is an element of safety in one respect, but should the stratum of rock below give way suddenly serious results might follow, especially if some of Middlesborough's ponderous furnaces were above the spot affected. Near Nancy, in France, a subsidence of earth took place which was so sudden that it caused a report which was heard 12 miles away. Middlesborough is pumping salt close to the town, and what is, of course, worse, in the near neighbourhood of the docks. Authorities, however, differ as to what will be the result; time alone will prove; it may be in a manner more convincing than pleasant. Mr. Griggs's paper contains an excellent description of the machinery used, and illustrations of the same were exhibited on the walls of the Town Hall, where the meeting was held.

A paper by Mr. A. L. Steavenson, entitled, "Description of the Electric Rock-Drilling Machinery at the Carlin How Ironstone Mines in Cleveland," was next read. After briefly referring to the various means of drilling holes for blasting purposes, the author proceeded to describe the electric drill. We could not give a description of this without the illustrations which were exhibited on the walls. Mr. Steavenson, who is a mining engineer, has tried all kinds of drilling—hand, compressed air, hydraulic, and petroleum engine, but he gives preference to electricity as a means for transmission of power in this work, although he says that petroleum engines have done good work.

The last paper read at the meeting was a contribution by Mr. George J. Clarke, engineer to the Tees Conservancy. In this he describes briefly some of the works which have been done in making the harbour at Teesmouth and improving the navigation. Dredgers, training-walls, and breakwaters have been combined in this work which has proved of such signal value to the district; in fact they have made its large commerce possible.

During the meeting a number of excursions to various iron-works were made, and members had an opportunity of seeing the colossal proportions to which the machinery for the production of iron and steel has been carried in the present day.

THE WILLIAMS COLLECTION OF MINERALS.

A FEW words relative to the collection of minerals which has just been distributed among various museums by Mr. J. C. Williams, M.P. for the Truro Division of Cornwall, will be of general interest. This collection had been gradually brought together by the father and grandfather of Mr. Williams; it was removed nearly thirty years ago from Scorrier, where Mr. Michael Williams formerly lived, to Caerhays Castle, nine miles from the nearest railway station (St. Austell), and it has since been too remote from the ordinary line of travel to be of easy access to visitors. It was in this collection, while it was still at Scorrier, that my predecessor, Prof. Maskelyne, F.R.S., noticed in 1863 the specimen of connellite from which it seemed to him

that the first crystallographic measurements might be obtained: the specimen was presented by Mr. Michael Williams to Mr. Maskelyne for the British Museum, and has ever since been on exhibition in the Gallery. As the crystals were only $\frac{1}{200}$th of an inch in thickness, the determination of their form was a noteworthy piece of scientific work; and it may be observed that the more recent discovery of larger crystals of the same beautiful mineral in another Cornish locality has only served to confirm the remarkable accuracy with which the form of those acicular crystals was then determined.

A short time ago, Mr. J. C. Williams, whose open-handed generosity is well known in Cornwall, perceiving that the continuance of the collection in so isolated a museum as that of Caerhays Castle prevented its utility both to students and the general public, decided to select some of the specimens for preservation in the family, and to present the remainder to public museums. Accordingly, in a courteous letter, he invited me to Caerhays to select any specimens which would be useful in completing the series preserved in the British Museum, and I immediately went down, accompanied by my colleague Mr. Miers, to examine the collection and remove the specimens which should be selected.

The collection, which amounted to about 10,000 specimens, was exhibited in numerous glazed wall-cases and table-cases in a large hall well lighted from the roof. The specimens were from various parts of the world, but as a rule only those of local origin could be of service for an old-established collection like that of London: the Cornish specimens, however, formed a series which, owing to the closing of so many mines and the change of mineral conditions in others, it would be quite impossible to reproduce in the present day: for the acquisition of such specimens the successive owners of the collection, by reason of their interest in Cornish mining enterprise and its products, have had excellent opportunities of which they have not failed to make use. In all, nearly 300 specimens were reserved by Mr. Williams for continued preservation at Caerhays; 510 specimens have been selected for the British Museum; the collection formed by the late Mr. John Taylor (to whom the British Museum was indebted for the donation of some excellent mineral specimens), and acquired at his decease by Mr. Michael Williams, has been given, with the exhibition-cases containing it, to the Camborne Museum; the remaining specimens and exhibition-cases have been divided between the museums of Redruth and Truro.

That the character and extent of the donation to the British Museum may be more readily appreciated by visitors, the selected specimens have been arranged in four window-cases of the Mineral Gallery, and will be exhibited together for a year or two before their distribution through the main collection. Special attention may be directed to two specimens of blende (sulphide of zinc) which for size and excellence are superior to any yet heard of, and in colour somewhat resemble those from Hungary. A remarkable specimen presenting crystals which are of an emerald-green colour and of unusual form, has been examined by Mr. Miers in conjunction with Mr. Prior, and will shortly be described by the former. He finds the crystals to be identical with spangolite (sulphate and chloride of copper and aluminium); of this species, described by Mr. Penfield three years ago, only one other specimen, found and preserved in the United States, is known to exist. There is a fine suite of crystallised specimens of cassiterite (oxide of tin). Special mention, too, should be made of the specimens of redruthite (sulphide of copper), the large series of specimens of chalcophyllite, clinoclase, and olivenite (arsenates of copper), libethenite (phosphate of copper), liroconite (phosphate of copper and aluminium), cupro-uranite (phosphate of copper and uranium), pyromorphite (phosphate and chloride of lead), cerussite (carbonate of lead), chalybite (carbonate of iron), and fluor.

The thanks of Cornish and London students are due to Mr. J. C. Williams for the generosity and self-denial he has shown in parting for their benefit with a valuable collection formed by the efforts of at least two preceding generations of his family.

L. FLETCHER.

PROPOSED NEW TELESCOPE FOR CAMBRIDGE OBSERVATORY.

IN order to complete the equipment of the Cambridge Observatory a public appeal has been made for funds. The appeal reads as follows:—

"It will be allowed that the Cambridge Observatory ought to be completely equipped for carrying on the most advanced work in modern astronomy. As celestial photography is the branch of astronomy in which the most important advance is now being made, it has been decided that a photographic telescope shall be obtained if the necessary funds be forthcoming. It is the opinion of those most competent to form a judgment that a photographic refractor of about 18 inches diameter would render it possible to attain results of the highest excellence. The new objective would be corrected for the photographic rays, and the present Northumberland telescope would serve as the guide when attached to the new tube. With such an exceptionally efficient instrument the director of the observatory would devote the attention of the staff (presently to be liberated by the termination of the international zone work on which it has been engaged for many years) to the investigation of stellar parallax. At the same time the telescope would be admirably adapted for other work. The twin instrument would be erected in the building at present occupied by the Northumberland equatorial, but a new dome, mounting, and driving clock would be required.

"The scheme sketched above has received the general sanction of the senate of the university, and the observatory syndicate are authorised to take the preliminary steps necessary to carry it out.

"The estimated cost for the new objective with the mounting, driving gear, and other adjuncts, is £2450. To this must be added £500 for the new dome, while the apparatus for measuring the photographs would cost £150. With the moderate allowance of £100 for extras, the total sum wanted is found to be £3200. The observatory syndicate have had under their consideration the means of providing this sum. There is a 'Special Sheepshanks Fund' available for the purchase of astronomical instruments for the Cambridge Observatory. This fund amounts at present to about £1500, of which about £1000 might be prudently expended. Accordingly about one-third of the money now required could be taken from the special Sheepshanks fund, whilst the remaining two-thirds would have to be raised otherwise. As the state of the university finances renders it hopeless to expect that any large sum could be forthcoming for this purpose from the university chest, it only remains to make an appeal to the public. The syndicate would therefore urge the friends of the University of Cambridge, and those interested in astronomical science, to render substantial aid in the furtherance of this project. They accordingly ask for donations towards the sum of £2200 which they have shown to be requisite for the full efficiency of the Cambridge Observatory.

Subscriptions will be received by Sir Robert Ball or by any of the following members of the observatory syndicate:—John Peile (vice-chancellor), G. G. Stokes, G. D. Liveing, G. H. Darwin, H. M. Taylor, and W. W. Rouse Ball. A list of subscriptions will be duly announced after replies to the appeal have been received.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE University Extension movement has hitherto received no assistance in the form of grants from the Government. But now that the movement is recognised as an educational power in the land it should be subsidised to a certain extent. As Prof. Stewart remarked in the course of a speech on the subject, delivered in connection with the summer meeting at Cambridge, "There was no sum of money that could be better spent by the State for educational purposes than a grant, say of £5,000 a year, to the university extension movement, because thereby they would render the £6,000,000 a year paid for elementary education so much more effective and productive, seeing that a very large proportion of university extension students were elementary school teachers." It was afterwards resolved: "That, in the opinion of this conference of university extension students, application should be made as early as possible to the Education Department for aid to university extension work, particularly for subjects not dealt with by the Technical Instruction Act."

UPRIGHT PENMANSHIP is rapidly becoming popular with the teachers and pupils in our schools, if we are to judge from the yearly growth in the number who send in copybooks to Mr. J. Jackson's annual competitions. The prize-list for 1893 just received contains four photographed specimens of prize-