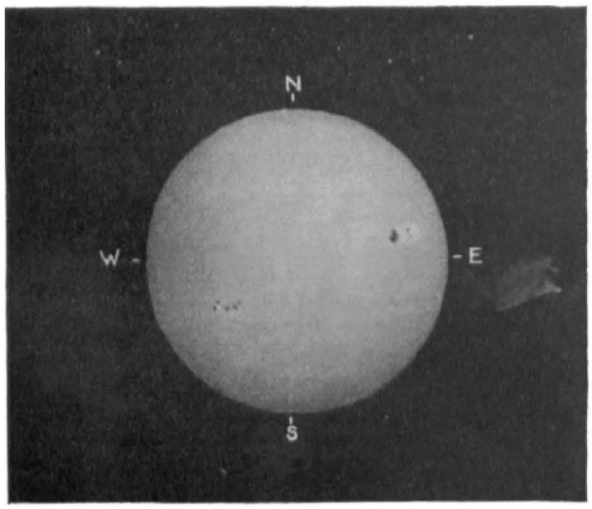
OUR ASTRONOMICAL COLUMN.

THE SOLAR ACTIVITY.—The "maximum" character of the present solar-activity epoch is being well maintained by the frequent appearance of large groups of spots. Observations made on July 6 showed two medium sized spots coming round the eastern limb, and as this group travelled across the visible disc it developed considerably. On July 13 it formed a large and somewhat scattered group of which the roughly estimated extent was about 100,000 miles, and which could be readily seen by the properly protected naked eye. On July 10 this group was followed by a much more striking, although somewhat less extensive, group, consisting of two exceedingly well defined and large nuclei surrounded by well marked penumbræ and smaller spots. On July 14 both groups were readily observable with the naked eye, this being the second occasion during the present year on which two naked-eye groups have been on the solar disc simultaneously.

Single groups of this character have occurred four or five times since the first appearance of the large group in February. The accompanying reproduction shows the



forms and positions of the spots at 11.45 a.m. on Thursday last, and has been taken from a photograph secured with the photospectroheliograph of the Solar Physics Observatory, South Kensington, the primary slit being adjusted on the continuous spectrum instead of on any special line.

A PROJECTION ON MARS.—A telegram from Prof. Pickering, published in No. 4030 of the *Astronomische Nachrichten*, announces that on July 2 Mr. Lowell discovered a projection on the terminator of Mars. The object was situated near to Propontis, its position angle being 19°.

It may be remembered that in the first Bulletin issued from his observatory Mr. Lowell described a projection on the terminator of Mars, discovered by Mr. Slipher on May 25, 1903, its position angle varying from 204° to 200°. In that case the observations led to the suggestion that the projection was in reality a cloud of dust some 300 miles in extent which was travelling over the planet's surface at about 16 miles per hour (see NATURE, No. 1763, vol. lxviii., p. 353, 1903).

OBSERVATIONS OF PERSEIDS.—Intending observers of the coming Perseid shower will probably find Mr. Robert Dole's account of his 1904 observations, published in No. 6, vol. xiii., of *Popular Astronomy*, of interest. During a total watch of 6h. 41m. on the nights of August 6, 9, 10 and 12, Mr. Dole, observing at Flagstaff, Arizona, saw 123 Perseids and 100 shooting stars, the horary rate of the Perseids being about 18.5. August 11 and 13 were completely cloudy, and consequently the observer was unable to determine the period of maximum of the shower. Some thirty of the apparent paths of the Perseid meteors were plotted, and are shown on a chart accompanying the paper.

THE FRENCH ECLIPSE EXPEDITIONS.—Thanks to the liberality of the French Government and the activity of M. Loewy and his colleagues, French astronomy will be worthily represented amongst the expeditions which are going to Spain, Algeria, and Tunis to observe the coming total eclipse of the sun.

Observers from the Paris and Besançon observatories will establish themselves near to Cistierna, in Leon, MM. Deslandres and Rayet are going to Burgos, whilst M. André (Lyons) will observe the eclipse at Tortosa.

The munificence of M. Bischoffsheim will enable the observers from Nice to carry out their programme on the coast near to Alcala, a station selected by M. de la Baume Pluvinel.

M. Trépied (Algiers) intends joining MM. Stéphan and Borrelly (Marseilles) at Guelma, Algeria, where MM. Nordmann and Salet (Paris) and MM. Bourget and Montangeraud, of the Montpellier Observatory, will also be located. M. Bigourdan will go to Sfax, where he intends to make actinometric observations with a Violle actinometer.

The director of the Paris Municipal Observatory, M. Jaubert, will also endeavour to make actinometric observations from the balloon *Centaure*, which is to ascend from Constantine, and a second Violle actinometer will be set up at that place for taking readings on the ground. Thermometric observations will be made on the ground and from a balloon at the Eiffel Tower, whilst actinometric observations will also be carried out at the Pic du Midi Observatory.

A REMARKABLE METEOR.—An unusually splendid meteor was observed by Dr. G. Johnstone Stoney on July 13.

The object was seen to traverse the eastern sky at oh. 56m. a.m., and presented the appearance of an intensely bright and pure white globe having a diameter equal to about one-sixth of that of the moon. The meteor travelled in a N.E. direction along a path which sloped downwards, and which was nearly parallel to a line joining a point midway between α and β Andromedæ and β Persei at a distance from that line of about 12° measured along a great circle towards the south.

Dr. Stoney was not able to see the whole of the path followed by this brilliant object, but he saw it for some 30° or 35°, and estimates that his determination of the direction may be 2° or 3° in error, and of the distance of the apparent path from the reference stars, perhaps ±2°.

THE SOCIETY OF CHEMICAL INDUSTRY.

THE annual general meeting of this society was held at University College on Monday of last week. The council reported a total membership of 4326, an increase of 192 compared with the same period last year. It referred to the very successful meeting of the society in America last year, and to the pleasure felt at the visit to England of its American president, and a considerable contingent of American and colonial members. Statistics were furnished as to the number of original papers read before the various sections of the society, and reference made to the efforts of the society and its members during the year in connection with the use of duty-free alcohol for manufacturing and other trade purposes. The report of the hon. treasurer, Mr. S. Hall, indicated the continued prosperity of the society, though the cost of the journal had appreciably increased.

Mr. Gordon Salamon, chairman of the London section, next offered a welcome to the members of the society, and especially to the American and colonial members, on their assembling in London. The president then delivered his address.

Dr. W. H. Nichols, after expressing his obligations to Prof. Edward Divers, F.R.S., who had acted as deputy president during the greater portion of the year, alluded to the extension of the American membership of the society, which had been marked during his year of office by the

establishment of a New England section at Boston. He spoke of the advantage which resulted from the holding of regular meetings within reach of members as being a considerable addition to that ensuing from the possession of the valuable journal of the society, which he described as in itself worth many times the cost of membership.

Sir William Ramsay's presidential address of the previous year dealt with the results of thirty years' experience in the education of chemists, education being understood as the production of an attitude of mind rather than the imparting of definite knowledge, though the latter could not be neglected. Dr. Nichols considered the "attitude of mind" undoubtedly the pith of the matter. The young chemist fresh from college was only, after all, just prepared to learn how to apply the knowledge he had acquired, and to build on it by his daily experiences. As to some extent taking up the question where Sir William Ramsay laid it down, he proposed to discuss the question of the management of a chemical industrial organisation. The plan he proposed to outline, though it might differ widely from the views held by others as the result of their experiences, was the outcome of many years of observation and work, and had stood the test of years in a company operating more than a score of plants, widely separated and yet all working as a unit.

Below the board of directors, with its officers and executive committee, the following departments were necessary, viz. :—purchasing, sales, transportation, finance, construction, operating, research or investigation, and statistical. To harmonise these, two committees were requisite :—(1) a manufacturing committee, consisting of the managers of the operating, construction, purchasing, and investigation departments, the chairman being the chairman of the executive committee; and (2) a sales committee, composed of the managers of the sales, operating and purchasing departments, with a member of the executive committee.

The operating department was one of great complexity and importance, and needed a manager and assistant manager. Of the chemists employed, evidence is required not merely that they have received a good education and have completed a technical course of instruction, but that they are of good judgment and capable of assuming responsibility. It is desirable that they should have some knowledge of mechanical engineering and the general principles of construction, though in his experience so rare was a complete combination found that it was usually necessary to engage good chemists with but a moderate knowledge of engineering, or good engineers with only an elementary knowledge of chemistry. It was to be hoped, however, that as a result of the improved instruction in technical chemistry now being given, men would be turned out better prepared in this respect than had hitherto been the case. The great thing, however, was that the man should be practical, trustworthy, hard-working, and possessed of natural ability and the capacity for development and advancement, or, as Sir William Ramsay puts it, "have the right attitude of mind." The beginner should be kept long enough on one subject to make rapid and accurate analyses and at the same time be encouraged to make himself familiar with all the different methods of analysis bearing upon his particular work, and to be sure that he thoroughly understands the basic principles and theory upon which the work rests. After a sufficient experience along these lines, he arrives at a position where he may be able to improve existing methods or even invent new ones; but of course all new methods must be tested by rigid experiment.

In a works laboratory a variable degree of accuracy is required, depending upon the object for which the analysis is made. In some cases a tenth of 1 per cent. variation would not be serious. In other cases a ten-thousandth of 1 per cent., or even much less, is highly important, and as the object is to turn out analyses of the required accuracy in the least amount of time, it is of great advantage for the chemist to have such general knowledge of the use to be made of each analysis as will enable him to avoid waste of time in unnecessary accuracy. For routine work it is becoming more and more the custom to employ in works laboratories bright young men, graduates of high schools. Such young men are, of course, useful, but unless they pursue their scientific studies outside, as, for instance, at night schools, they are not likely to make great advances. In every laboratory there must be a chemist in control, who in turn shall be supervised by the chief chemist of the company. Unnecessary duplications being avoided, a force thus organised becomes capable of doing an enormous amount of work in a given time and with great accuracy.

The beginner confines his duties for a number of months, and frequently for years, to a works laboratory, and incidental to his analytical work he gains a certain knowledge of the general routine which obtains at that plant. After the laboratory service, if the chemist has displayed ability to advance, he is promoted to a position which will bring him into direct contact with the manufacturing processes, and his duties will gradually change from those of analyst to those of a manufacturing assistant, until he has become proficient enough to warrant promotion to the position of assistant superintendent, to which he is thereafter advanced at the earliest opportunity, either at the works at which he has received his tuition or at another works where such a position has become vacant.

The assistant superintendent is under the direction of the superintendent, and from him should receive a regular training in all the various duties pertaining to the position of superintendent, and when such a position becomes vacant, the assistant who, in the judgment of the department, is best qualified to fill the advanced position, is recommended for the promotion. The ability to administer chemical works can be obtained only by experience, and realising this fact the most efficient superintendents should act as teachers to the younger men in their development from one position to another.

Chemists who are not attracted by outside or works positions, but who prefer research work, naturally gravitate in due time from the works laboratory to the research laboratory. Occasionally one is found whose ambitions lie in the direction of mercantile affairs, for which he thinks the experience of the chemical laboratory will best qualify him. As a rule, however, the educated chemist does not select advancement in the sales department, or other business parts of the organisation, nor does it often happen that he is qualified.

The chemist, to succeed in technical work, must strive for material results. It has been my experience that the post-graduate course seems to incline him towards the search of learning rather than to its application. He must have a clear, logical mind, a singleness of purpose, and he must be able to separate the essential from the non-essential. This is true of all professions, but it is particularly true in chemical work, where the essential must be selected from an unusually large assortment of non-essentials.

The efficiency of a navy depends very largely on the "man behind the gun." So with chemists in a works or laboratory. The personal equation has much to do with the results. There is no "royal road" to success here. The rewards are for those who are willing to pay the price, and that price includes constant and intelligent work. The habit of study is rarely acquired after college days, and if the undergraduate does not develop it he should seek a less exacting profession than that of chemistry, unless his ambitions will be satisfied with the daily grind of routine work.

The investigation department is that part of the manufacturing organisation which deals with all the new propositions of a technical nature. Its work, which is entirely distinct from current manufacturing, has to do with new, and the improvement of old processes. A new proposition remains under the control of the investigation department from the time of its inception until sufficient data have been obtained to enable the construction department to design the necessary plant, if one be authorised by the executive committee. It is turned over to the operating department only after the process is working smoothly and the results considered satisfactory.

The organisation of the investigation department should be sufficiently broad to permit the consideration of a manufacturing proposition from the points of view of the business man, the chemist, the engineer, and the patent attorney. It consists of the manager, a chemical council composed

(in addition to the manager) of the chief chemical engineer, the chief chemist who is director of the research laboratory, and such consulting chemists and engineers as the company employs. The appointments in this council are intended to cover the most varied field of theoretical and technical chemistry, and the manager is permitted to consult outside experts if the company has not the necessary talent at hand. A corps of chemists on research laboratory work, an abstractor of current chemical literature, patent experts, and a small office force complete the department staff.

In the research laboratory a body of chemists, under the supervision of the chief chemist, is employed on research work connected with investigations in hand. A limited number of men are permanently retained on pure research work.

The research laboratory reports weekly the progress on all work in hand, and at the completion of each investigation sends in a statement of the steps taken, accompanied by the chief's recommendation as to further action. These reports are passed upon by the chemical council at its regular meetings.

All the analyses required are made by the analytical laboratory, which is specially equipped for turning out quick and accurate estimations. Each works has its own analytical laboratory, but there is a central laboratory for the work of the head office. This laboratory critically examines and selects all analytical methods, which are adopted as standards and furnished to all works laboratories.

The work of the investigation department originates from sources which may, in a general way, be divided into three classes :—

(*a*) The probability of reducing manufacturing costs.

(*b*) A decision to produce well established products not previously manufactured by the company.

(*c*) New applications of science to industry.

(*c*) The largest field is perhaps that of improving the processes at present in use at the different works, and is one which usually yields very profitable results. Aside from the chronic aim of the operating department to secure uniformly low costs, a decision to investigate a process in use may result from a drop in the market price of a product on account of trade conditions, or because the process is technically unsatisfactory. There may be developed, therefore, new methods or important modifications involving reconstruction or even new plants.

(*b*) Consideration of the manufacture of products not previously produced by the company is usually given as a result of market conditions or special wants of customers. Where a large consumption of a product of interest is developing, and the raw materials prove to be available, an investigation may be undertaken with a view to the selection of a process and the construction of a plant.

(*c*) The third source of investigation originates in the distinctly new processes so frequently offered to the world. Such processes, whether for a product manufactured by the company or of prospective interest, are always given the attention which their merits seem to warrant. No one who has a sensible process to offer is refused a hearing, and the treatment accorded the inventor soon becomes public opinion. As a rule, the inventor is retained to direct the development of his process under the management of the department.

As an investigation of a new manufacture includes a thorough examination of both the commercial and technical sides of the proposition, the commercial side, in which the assistance of the manager of the sales department and other commercial branches is invoked, calls for consideration of the following :—

(1) Its relation to the interests of the company; (2) the market; (3) manufacturing costs; (4) investment necessary; (5) source of raw materials; (6) transportation.

On the technical side a study must be made of :—

(1) The process; (2) other processes; (3) raw materials; (4) quality of product required.

These topics indicate the method of working out or testing the practicability of the process. This phase of the proposition is entirely a chemical and engineering one, and calls for most of the work of the investigation staff.

In the usual order of procedure, a proposal reaching the investigation department is subjected to a preliminary consideration, and is entered for record if it is to be made a subject for investigation. It is then submitted to the chemical council, which decides on the method of investigation to be pursued. A *résumé* of the literature is generally made and a report obtained from foreign representatives on the latest European developments. We may soon have to add the Japanese. As the inquiry progresses, the chemical council, which meets weekly, is kept informed of the progress made.

The thorough consideration given at this early stage frequently prevents useless laboratory expense and much loss of time.

Where an investigation of a process in use is being made, a member of the investigation department is sent to each of the works using it, to study the methods and management and analyse its defects. His reports thereon are considered by the chemical council in the manner indicated above.

If the final result of the investigation of a new process be favourable, an experimental plant may be recommended and an appropriation asked for. This may be advisable not only to assist in reaching a decision regarding the wisdom of adopting the process, but also for furnishing data for the designing of a manufacturing plant, if one be ultimately decided upon.

In the case of the adoption of a process and the designing of a plant, the work of the investigation and construction departments is very intimately connected. An investigation covers the inquiry regarding the proper design of the apparatus or plant, as well as the process *per se*

Investigations in connection with construction naturally differ, to a certain extent, and include consideration of methods for handling the raw material, the solids, liquids and gases involved in the process; furnacing, dissolving, filtering, evaporating, crystallising, distilling, subliming, drying, &c., and the packing and handling of the finished product.

The materials to be used in different parts of the construction are determined if an investigation into that important side be necessary, whether wood, cast iron, steel, lead, tin, aluminium, alloy, earthenware, porcelain, rubber, cement, &c. Any special data requested by the construction department in carrying out its work are furnished by the investigation department, such as the selection of fuel for special work, boiler and engine tests, consumption of steam, &c., and all chemical work.

The benefits resulting from organisation in the consideration of improvements and new processes are very evident. The results of experiments in one instance are applicable to others of distinctly different character. The full use of them demands a central bureau and clearing house of information.

The conferences held so frequently are not permitted to drag. Records are kept of all decisions, and even the local heads of departments present are notified in writing.

The routine work of the department consists in the collection and filing for easy access of technical and commercial data of all kinds connected with chemical manufacturing, for immediate and prospective use. Circulars containing useful information applicable to the works, and copies of research reports that may help operations, are transmitted to superintendents. Records of failure are just as important as those of success. Every encouragement is given superintendents to confer freely on any modifications, developments, or conceptions which may occur to them. The *esprit de corps* resulting naturally reaches the junior men and foremen, so that a keen sense of responsibility and importance is felt throughout.

The frequent visits of managers and superintendents to the head office, and the periodic meetings of superintendents which are called for conference and discussion enable the responsible men to continue in perfect familiarity with the technical resources of the company.

The research department would not be complete without a laboratory plant, large enough to work out processes on a small manufacturing scale. Such a plant should have all the standard appliances, and be so arranged that the results obtained in it are sufficient to form the basis for the engineering work resulting in the experimental plant to follow the successful investigation.

After all the organisation has been perfected and the machinery lubricated and put in motion, it would be apt to run wild if some trustworthy and absolute method of control should not be at hand. This I have found completely accomplished by a department which has to do with the compilation of facts and the deductions from them. It is absolutely essential, in a company operating a number of plants, that those in control should not only know what each one of its manufactured products costs, but what enters into making up that cost, so that if for any reason there is a drain going on it will be quickly known, located and stopped; or if, on the other hand, something advantageous shall have been accomplished, that will also be noted and imitated at other points. This may seem like an exceedingly difficult undertaking in an industry of such infinite variety, but a brief consideration will show that it is not so. The statistical department, to which I allude, is not only able to advise the officers within a reasonable time after the end of each month of the cost of every product and step, but also of the profit or loss on each article and the total profit or loss of the company. These results have been so exact that for several years the profits determined by public accountants at the end of the year have not varied 1 per cent. from those which had been worked up in this statistical department month by month. The importance of this information to those in control will be readily understood. For my own part, I do not see how it would be possible intelligently to run a large enterprise involving a number of plants without some such arrangement.

The exact plan which I would recommend is as follows:—

Each factory furnishes monthly the following reports:—raw materials received; raw materials used; shipments of finished products; stocks of raw materials; stocks of finished products. Productions and statement of statistical charges (including manufacturing labour, labour on repairs, material taken from the storehouse for repairs, all material taken from the storehouse for manufacturing except fuel and raw materials), packages, dry barrels, &c., included in the selling price and not returnable, manufacturing cartage (*i.e.* teams used around the works), steam and water.

The first shows the number of pounds of raw material received, together with cost of placing in the pile, and by adding the amount of bills, freight, &c., we get the actual cost per hundred pounds of each. These figures are used in obtaining the material cost of each hundred pounds of production, which, with sundries, labour, fuel, and repairs, makes up the total manufacturing cost, and in connection with that shows what each department has accomplished during the month.

As each of the factory sheets is checked and every pound of raw material and finished product accounted for, nothing escapes which should be considered in costs.

In addition to the manufacturing cost are shown the cost per 100lb. of special factory charges (including such accounts as docks, dredging, fire equipment, laboratory, lighting, roads, maintenance of yards, watchmen, gatemen, &c.), and cost per 100lb. of goods produced due to salaries of superintendents and chemists, based on proportion of labour of each department and the total manufacturing labour.

The factory shipment sheets are checked with the accounting department as well as repairs and net selling prices obtained, lighterage, cartage, allowances, estimated freights, &c., being deducted.

By using the manufacturing costs and the net selling prices, we arrive each month at the gross manufacturing profits, and deducting taxes, insurance, office, and other general expenses, the net results are obtained.

All organisation, whether in the chemical industry or any other, would fail to attain the best and most permanent results if the personal equation be forgotten. We are not dealing with a collection of apparatus, but with an organisation of men, everyone an individual, with his own peculiarities and ambitions. The day has not come, if it ever will, when from purely altruistic motives a man will give his most efficient services. He must realise that while his best work must be done, it will not go unnoticed and unrewarded. He must be sure that he will receive just and proportionately liberal treatment. His proper ambitions must not be smothered, they must be directed. From an experience of many years, I believe the plan outlined above provides fully for this most important fact, and I can point with the greatest pleasure to many men as proof of my statement, and every one more enthusiastic than at the beginning. The places of the leaders will someday be vacant. Who, then, shall fill them? Those whose lives have been spent in preparation for the work, and who will enter into it without shock or derangement of existing conditions, but as naturally as the stream flows into the river. Thus will the natural ambition of the young man reach its fulfilment in due time, and thus will our beloved industry progress to points of attainment which some of us may dream of, but will never see.

A vote of thanks to the president for his address was then proposed by Prof. Divers and seconded by Sir Henry Roscoe, the first president of the society, in the course of which allusion was made both to the valuable character of the address to which the members had just listened, to the origin of the society some twenty-five years ago, and to the considerable growth in its membership which the council's report indicated. In responding, Dr. Nichols spoke of the advantage which ensued to the society as a whole as a consequence of the visit last year to America, followed, as it happily had been, by the present visit to England of a considerable number of members from the other side of the Atlantic. He said how much he and his fellow-countrymen appreciated the hospitality that had been already shown them, and the efforts that had been made in connection with the interesting and lengthy programme that had been arranged largely for their benefit. He said that in New York they had been anxious to provide some souvenir of their visit that they might leave behind them, and, on informing the meeting of the report of the scrutineers, which declared that Prof. Divers, F.R.S., had been elected president for the ensuing year, he desired to place in his hands the little thing that they had ventured to have prepared. This was a presidential badge formed of a medallion of Sir Humphry Davy surrounded by an emblematical device representing the union of England and America in the pursuit of chemical science. He trusted that the council of the society would authorise the wearing of the badge by all his successors in the office of president, and hoped it would help still further to cement the good feeling and cordiality which existed between members of this great society on both sides of the Atlantic. He concluded by announcing the names of the vice-presidents and ordinary members of the council who had been found to be duly elected to office.

Prof. Divers expressed, on behalf of the society, appreciation of the kindness which had dictated the offer of this valuable presidential badge.

On the motion of Dr. Bailey, seconded by Mr. Hübner, who on behalf of Manchester promised a very hearty reception, it was resolved that the next annual general meeting should be held in that city.

On the motion of Prof. Chandler, of Colombia University, seconded by Sir Boverton Redwood, the hearty thanks of the society were accorded to the senate and council of University College for granting permission to the society to meet in that building. This was responded to by Sir William Ramsay, who incidentally referred to the fact that University College as a separate corporation had just ceased to exist, having become absorbed in and an essential part of the University of London. The meeting then adjourned.

THE UNIVERSITY OF SHEFFIELD.

AS has already been noted in these columns, the new buildings of the University of Sheffield were on Wednesday of last week opened by the King and Queen, and by the act a new centre for research was created in this country.

Nothing seems to have been lacking to make the ceremony a success; all taking part, from the King downwards, entered into the proceedings with enthusiasm. In replying to the address of welcome presented by the city, the King said that he and the Queen were glad to be present to open the university buildings and to inaugurate a work which he was assured would tend to promote the