Public Examinations, 1935

EXAMINER'S REPORTS.

By permission of the Department of Education, the reports of the examiners in Science subjects in the recent Leaving Certificate and Intermediate Certificate examinations will be published in this magazine, so as to make them available to teachers and students during the current year, prior to the publication of the official handbook of the Department.

In the last issue the reports on the Physics papers were printed. Other reports now available (Chemistry, Geology and Botany) are printed below.

LEAVING CERTIFICATE CHEMISTRY.

GENERAL.

The answers to this paper were generally quite up to the usual standard, and several candidates obtained very high marks. Quite a number, however, were inaccurate in their statements and displayed a very superficial knowledge.

PASS PAPER.

Question I.—Give the names and formulæ of the principal oxides of lead. State how they may be prepared from the metal, and what reactions can be used to distinguish them from each other.

Most candidates gave the names and formulæ of the common oxides of lead. Quite a number did not know how to prepare lead peroxide and failed to give a satisfactory method of distinguishing the oxides.

Question II.—What is the composition of each of the following : (*a*) hydrated lime, (*b*) cement, (*c*) plaster of Paris, (*d*) superphosphate ?

State briefly how each may be made.

Generally well answered. Technical details were not required for cement manufacture, though some candidates showed an unusual knowledge of the practical details. The amount of water of hydration in plaster of Paris was often wrongly given. Many candidates did not understand that the reaction concerned in the formation of " superphosphate " is not always complete.

Question III.—What is the action of chlorine on sodium hydroxide solution ?

What is bleaching powder, and how is it made ?

What is the action of carbon dioxide on bleaching powder ?

The reaction between chlorine and the alkali hydroxides seemed to be quite well understood. Bleaching powder is *not* made by passing chlorine into a solution of calcium hydroxide, as a number of candidates suggested. The action of carbon dioxide on bleaching powder giving rise to hypochlorous acid was not much understood.

Question IV.—What do you understand by (*a*) acidic oxide, (*b*) basic oxide ?

In this connection, classify the following oxides, giving reasons for your conclusions : (*a*) calcium oxide, (*b*) ferrous oxide, (*c*) ferroso ferric oxide, (*d*) litharge, (*e*) zinc oxide, (*f*) aluminium oxide.

This question was generally fairly well answered. The great majority of those who attempted the question were aware of the amphoteric nature of the oxides of zinc and aluminium and lead (litharge). Few, however, classified ferroso ferric oxide correctly. Surprising blunders in classification were made by the weakest candidates. It is difficult, for example, to understand why, after four years' study of chemistry, some students classify calcium, zinc and aluminium as non metals.

Question V.—Define each of the following : (*a*) atomic number, (*b*) strength of an acid, (*c*) neutral solution, (*d*) salt hydrolysis, (*e*) valency. Arrange the following acids in order of strength : hypochloric, acetic, nitric, sulphuric, phosphoric, carbonic.

The definitions were fairly well done, although more examples by way of illustration could have been given in many instances. Atomic number was occasionally confused with atomic weight. Neutral solution was generally defined by reference to indicators ; few mentioned the relation $[OH]=[H']=10^{-7}$. Hydrolysis was surprisingly often confused with electrolysis.

Question VI.—What is meant by (*a*) the basicity of an acid, (*b*) an acid salt ?

1·18 gramme of dibasic acid dissolved in water required 20 cc. of a normal solution of sodium hydroxide for complete neutralisation. Calculate the molecular weight of the acid. Also what weight of the acid would be required to convert 2·8 grammes of calcium oxide into the normal calcium salt of the acid ?

$$(H=1,\ O=16,\ Ca=40.)$$

This question was generally well answered.

Question VII.—Describe what happens when (*a*) hydrogen sulphide, (*b*) sodium hydroxide solution is (separately) added to a solution of each of the following : (i) lead nitrate, (ii) cadmium chloride, (iii) ferric chloride, (iv) zinc chloride, (v) mercuric chloride.

This question was attempted by practically all candidates, most of whom showed a fair knowledge of the reactions involved. Candidates should learn to describe reactions succinctly and to eliminate irrelevant data. The following points were frequently overlooked : (1) The necessity for giving the name as well as the formula of the reaction product. (2) The consideration of whether the solutions used were dilute or concentrated or both should have been considered and whether one or the other resultant was in excess.

Question VIII.—State how you would distinguish between the following pairs of substances :

(*a*) Lead chloride and silver chloride.

(*b*) Mercuric sulphide and copper sulphide.

(*c*) Magnesium oxide and zinc oxide.

(*d*) Copper chloride and nickel chloride.

(*e*) Barium carbonate and strontium carbonate.

(*f*) Lead nitrate and barium nitrate.

Over 90% of the candidates attempted this question, answers to which were badly arranged, with much irrelevant data. When it was found necessary to bring the substances into solution for differentiation, many candidates failed to indicate the method of doing so. Equations, illustrative of the reactions considered, should have been given more freely.

HONOURS PAPER.

The papers submitted were not nearly as good as the Pass papers, due to the fact that many candidates do not realise that a higher standard is expected in the Honours paper.

Question I.—Discuss present-day fuels with reference to the economic utilisation of coal and the industrial application of by-products.

Some candidates gave a remarkably fine answer to this question. Others who attempted it should never have done so. A discussion of the nature and application of the by-products obtained in coal gas manufacture was not a complete answer to the question. Hydrogenation and low temperature carbonisation were seldom mentioned.

Question II.—An anhydrous acid ammonium ortho-phosphate gave the gollowing results on analysis :

(*a*) 1·0 gramme was heated in a distilling flask with excess of sodium hydroxide solution, and the evolved gas absorbed in 50·0 cc. of semi-normal sulphuric acid. The excess of acid was then titrated with semi-normal sodium hydroxide solution requiring 32·6 cc.

(*b*) The phosphoric acid from 0·5 gramme of the salt was precipitated in the usual way as magnesium ammonium phosphate and ignited to constant weight, giving 0·484 gramme.

From these results, calculate the percentages of ammonium and phosphate radicles present in the original salt, and ALSO deduce its formula.

(H = 1, N = 14, O = 16, Mg = 24·3, P = 31.)

Only a few attempted this question. Those who knew that magnesium ammonium phosphate ignited to magnesium pyrophosphate found no difficulty.

Question III.—How is methane prepared ?

A certain sample of gas was known to be a mixture of hydrogen and methane only ; 20 c.c. of this gas and 100 c.c. of oxygen (measured at room temperature) were exploded over mercury, and the volume of gas again measured at the same temperature and pressure as before. The reading indicated a contraction of 38 c.c. What was the composition of the original gas ?

This question was very well answered. The preparation of methane is usually carried out in a metal container, a point which very few were aware of.

Question IV.—What are the properties of iron that make it so important industrially ?

Starting with metallic iron, state how you would prepare (*a*) ferrous sulphate, (*b*) ferric chloride, (*c*) ferric alum.

The first part of this question was generally well answered except that only a few candidates knew of the chemical properties of iron which make it so useful in the alkali and acid industries. The preparations were disappointingly answered. Many apparently were unaware that iron will dissolve in both dilute sulphuric and hydrochloric acids.

Question V.—What do you understand by "electrolysis" ? In what ways are electrolytic processes employed in industry ? Give examples.

Practically all candidates who attempted this question showed a good understanding of the theory of electrolysis, but wasted much time in elaborating their answers by references to theoretical or laboratory examples instead of using the industrial section to that end. In consequence the latter was a mere statement such as "caustic soda, aluminium, *et cetera*, can be prepared electrolytically". Faraday's Laws were unnecessary, and the storage battery was mentioned in very few cases.

Question VI.—Why is sulphuric acid regarded as one of the most important commercial chemicals ?

Review briefly its preparation and purification, the source of materials employed, the nature of the vessels used in its manufacture and transport, and the disposal of by-products that are obtained in its use in industrial chemistry.

The section of this question devoted to the preparation and purification of sulphuric acid was answered quite well by those candidates who attempted it. Only a few had any broad ideas as to the uses of sulphuric acid. Quite surprising were the answers of those candidates who said that the sulphur dioxide used in the manufacture of the acid was obtained from the action of sulphuric acid on copper. The statement that sulphur dioxide and oxygen react with one another slowly without a catalyst *because the reaction is exothermic* is misleading, and students of chemistry should not be allowed to think on these lines.

Question VII.—"In 1815 Prout suggested that the atomic weights of the elements are exact multiples of the atomic weight of hydrogen." Discuss this statement with reference to subsequent discoveries in connection with atomic structure.

About 45% of the candidates probably attempted this question, and of these probably more than half failed to appreciate the main point of the quotation. A very few only handled the subject of isotopes, admittedly a difficult one to handle in detail at this stage, with any confidence. Of those who did realise that the question called for a discussion of isotopes many failed to distinguish clearly between atomic weight and the mass of an atom. The discussion became more difficult for those who realised that, using a standard of mass $O^{16} = 16 \cdot 000$, $H^1 = 1 \cdot 00778$. However, candidates were not expected to go into the question of deviations from the whole number rule, packing fractions, the occurrence of O^{17}, O^{18} and H^2.

Question VIII.—State exactly how you would carry out the following transformations :

(*a*) Cupric sulphide to cupric chloride.
(*b*) Sodium nitrate to potassium nitrate.
(*c*) Manganese dioxide to potassium permanganate.
(*d*) Chromium hydroxide to lead chromate.
(*e*) Potassium hydroxide to potassium chlorate.

(Candidates are expected to state in each case how the desired salt is obtained in the solid form.)

In answering this question many candidates showed that they were uncertain of the relative solubilities of the different compounds in ordinary solvents. For example, very many did not realise that sodium chloride is less soluble in water than the other salts concerned in the reaction between sodium nitrate and potassium chloride. Some excellent answers were given, showing that the question was not beyond a good Honours candidate.

NOTE-BOOKS.

The note-books generally were quite satisfactory, and call for little comment. Every candidate should be instructed to index his experiments, and to see that any alterations to results in volumetric or gravimetric estimations are initialled by the teacher. In quite a number of cases the quantitative work, left till the very end of the course, gave the impression that it was just rushed through.

INTERMEDIATE CERTIFICATE CHEMISTRY.

ELEMENTARY SCIENCE CHEMISTRY.

On the whole the marks gained by candidates in this paper were fairly high. At the same time the answers in very many cases would have been improved if they had been more definite.

Question I.—Why is air regarded as a mixture ?

Describe an experiment for determining the composition of air.

In many cases the answers to the first part were not satisfactory, candidates stating that air is regarded as a mixture because the oxygen may be removed by combustion, leaving the nitrogen. The answers to the second part were very good.

Question II.—State exactly how you would prepare and collect carbon dioxide.

Describe two tests that could be employed to distinguish carbon dioxide from sulphur dioxide.

This question was attempted by the vast majority of the candidates. The method of preparation of carbon dioxide seemed to be well understood, and showed that the candidates had had practical experience of it. In describing tests for distinguishing CO_2 and SO_2, it is not sufficient to give merely positive reactions for CO_2. It must be indicated that these reactions do not take place with SO_2.

Question III.—What do you understand by " an acid " ? What are the chief properties generally possessed by acids ? If you were given five unlabelled bottles containing (separately) a solution of ammonia, a solution of common salt, a solution of caustic soda, concentrated sulphuric acid, and dilute nitric acid, how could you quickly tell which was which ?

This question was very badly answered. Very few candidates could think of a systematic method of readily identifying the contents of the five bottles. It was evident they did not understand the chemical properties of the individual substances and even their most obvious physical properties.

Question IV.—What happens when each of the following substances is heated in air : (*a*) sulphur, (*b*) phosphorus, (*c*) magnesium, (*d*) potassium chlorate, (*e*) a temporarily hard water ?

(*a*) A large number of candidates merely stated that sulphur, when heated, forms sulphur dioxide. (*b*) The inflammability of phosphorus did not seem to be very well known. (*c*) This section was satisfactorily answered. (*d*) Not a few candidates thought $KClO_3$ combined with the oxygen of the air when heated. (*e*) Practically every one knew that temporarily hard water, when heated, becomes soft, but not so many knew the nature of the substances present in temporarily hard water and the effect of heat on them.

Question V.—What is the action of hydrochloric acid on (*a*) zinc, (*b*) iron, (*c*) sodium hydroxide solution, (*d*) manganese dioxide ?

A solution containing 10 grammes of sodium hydroxide is treated with excess of hydrochloric acid and then evaporated to dryness. What would be the weight of solid obtained ?

(Atomic weights : $H=1$, $O=16$, $Na=23$, $Cl=35 \cdot 5$.)

Sections (*a*) and (*b*) were done better than (*c*) and (*d*). The problem was generally correctly answered ; the chief source of trouble in the cases of failure was inability to write down the equation for the reaction.

Question VI.—What do you mean when you say that a substance is soluble in water ? What is the usual effect of increase of temperature on the solubility in water of (i) a gas, (ii) a solid ?

State whether each of the following is soluble or insoluble in water : (*a*) oxygen, (*b*) ammonia, (*c*) common salt, (*d*) calcium carbonate, (*e*) slaked lime, (*f*) nitric oxide.

The answers to the first part of this question showed that candidates did not possess the power of expressing themselves. Numerous answers consisted of " A substance is said to be soluble in water when it dissolves in water ".

INTERMEDIATE CHEMISTRY.

Many of the candidates appeared to have found this paper difficult, although excellent marks were obtained by others.

Question I.—How may sulphur dioxide be conveniently prepared ? What are its properties and uses ?

Many candidates described a satisfactory method of preparing sulphur dioxide, and were familiar with its properties and common uses. Quite a few, however, confused its uses with those of sodium sulphite.

Question II.—What do we mean when we say that a substance is " reduced " ? Illustrate your answer with reference to each of the following reactions :

(*a*) Action of heat on mercuric oxide.
(*b*) Action of copper on nitric acid.
(*c*) Action of hydrochloric acid on manganese dioxide.

The answers to this question were fairly satisfactory. The more advanced definition of reduction dealing with changes of valency seemed to confuse most of the candidates who used it, especially when referring to the action of hydrochloric acid on manganese dioxide.

Question III.—State exactly how you would determine experimentally the equivalent weight of either magnesium or zinc.

Many excellent answers were given, both with respect to the understanding of " equivalent weight " and to the detail involved in the experiment. However, it was all too evident in many cases that the candidates had memorised the experiment without realising its significance, and were obviously unable to use the results for the calculation of equivalent weight. The complete answer should have started with a definition, followed by a description of a method, and illustrated by an example.

Question IV.—What happens when concentrated sulphuric acid is added to water ?

What is the action of dilute sulphuric acid on (*a*) zinc, (*b*) iron, (*c*) sodium carbonate ?

Some extraordinary results were obtained by adding concentrated sulphuric acid to water. Most candidates omitted to give any physical changes that occurred in the various reactions.

Question V.—What do you understand by (*a*) Avogadro's Hypothesis, (*b*) " relative density of gas " ?

Write down the formula and the density (relative to hydrogen) of each of the following gases : nitrogen, argon, nitric oxide, acetylene, ammonia.

(Atomic weights : $H=1$, $C=12$, $N=14$, $O=16$, $A=40$.)

While most candidates could state Avogadro's hypothesis correctly, few could satisfactorily define the relative density of a gas. The chief mistake was a failure to stipulate that masses of equal volumes of a gas must be compared under identical conditions of temperature and pressure. It was not generally realised that argon is a monatomic gas.

Question VI.—State exactly how you would prepare carbon monoxide from carbon.

Give three tests that could be used to distinguish carbon monoxide from carbon dioxide.

This question was generally well answered. Some candidates lost marks by giving a preparation in which air instead of oxygen was passed through a long column of red hot carbon.

Question VII.—What gases are found in ordinary atmospheric air, and what are their main uses ? How may oxygen be obtained from air ?

The list of gases given as found in atmospheric air too often included ones which only occur to an infinitesimal amount. The uses of the atmospheric gases were not well known ; only a few of the better candidates mentioned the fixation of atmospheric nitrogen. Carbon dioxide is not prepared commercially from atmospheric air.

Question VIII.—Starting with iron, sulphur and hydrochloric acid, how would you proceed to prepare sulphuretted hydrogen ?

What volume of sulphuretted hydrogen, measured at 0° C. and 760 mm. pressure, could be obtained (theoretically) from 16 grammes of sulphur ?

(Atomic weights : $H=1$, $S=32$; 2 grammes of hydrogen at 0° C. and 760 mm. pressure have a volume of 22,300 cc.)

Few candidates mentioned the glow which spreads through the mass in the combination of iron and sulphur to ferrous sulphide. The problem was generally well answered.

LEAVING CERTIFICATE GEOLOGY.

HONOURS PAPER.

Question I.—Describe, classify and name specimens numbered 1 to 6.

Draw a geological map as large as your paper will allow to show the probable relationships of the rock formations from which such a suite of specimens might have been collected.

Construct a sketch geological section along some selected direction on your map, and discuss the geological history of the region represented.

The determination of the specimens was quite satisfactory in general, but their representation on a geological map was disappointing. Students should have more work in the interpretation of geological maps and sections, and should study both stratigraphical relations of rocks and their relation to intrusive igneous rocks.

Question II.—Explain, with full details, the instruments used and the methods employed in making a geological survey by the use of :

(*a*) Prismatic compass and chain or tape.
(*b*) Plane table.

Discuss the relative merits of these methods in the case of :

(i) A rugged and heavily forested region.
(ii) An undulating mature landscape with grassland and few trees.

Well answered on the whole.

Question III.—Name the chief minerals which you might expect to find associated with an ore body in which the chief metallic metal is copper.

Briefly refer to the position of such minerals with regard to the shallow and deep parts of the ore body.

Describe the chief physical properties of the minerals mentioned, and in each case state the chemical composition.

What simple blowpipe tests would be sufficient to determine each mineral ?

The discrimination between the weathered and primary zones in the ore bodies was not generally appreciated.

Question IV.—Construct a series of three contour maps, each occupying a full page, to illustrate the following physiographical features :

(1) A waterfall.
(2) A youthful valley with overlapping spurs.
(3) A fiord region.
(4) A mature valley with river terraces.
(5) A volcano with a breached crater.

The subjects represented on the same map should be such as occur naturally together. Not more than three subjects should be shown on the same map.

Few candidates submitted contour maps that were satisfactory. More attention should be given to the representation of detailed topographical features by contour maps.

Question V.—Write an essay on the chief changes in climate which have taken place in Australia in past geological time, and explain how the study of the rocks has revealed such changes.

Most students confined their attention to the evidences of glacial epochs and ignored the consideration of pluvial climates, arid climates, and tropical conditions.

PASS PAPER.

Question I.—Write a short essay on the origin and characteristics of the igneous rocks. Discuss the features which enable these rocks to be grouped for the purpose of classification.

Place the following rocks in your classification, and give a short description of each, naming, but not describing, their essential minerals : diorite, rhyolite, basalt.

The chief fault was a lack of attention to the origin of the igneous rocks. Some simple statement of the chief processes of magmatic differentiation was required.

Question II.—Sketch, describe fully, and classify six of the following fossils : Vertebraria, Lepidodendron, Orthoceras, Trilobite, Productus, Crinoid, Monograptus, Zaphrentis.

Well answered on the whole, but more care in the sketches is desirable.

Question III.—Name and describe three iron-bearing minerals and two copper-bearing minerals, all of which are different.

State their chemical composition and, if possible, where they occur in Australia.

This was misinterpreted by some candidates, who included ordinary rock-forming minerals.

Question IV.—Draw a sketch map of New South Wales as large as your sheet of paper will allow, and mark on it the distribution of the rocks of Carboniferous age.

Give a general account of the geological history of the State in Carboniferous time, and explain how this history has been established.

The few candidates who attempted this question gave satisfactory answers.

Question V.—Write a short essay on volcanoes, explaining their origin and distribution over the earth's surface.

Give also an account of the chief features of a volcanic eruption, and of the materials which may be ejected from a volcano.

Special credit will be given for an accurate description of some well-known volcanic eruption.

The descriptive part of this question was well answered, but few candidates gave a satisfactory account of the origin of volcanoes.

Question VI.—Write brief accounts, not exceeding twenty lines for each, on *three* of the following :

(*a*) The origin and significance of unconformities.

(*b*) The chemical decay of rocks.

(*c*) The characteristics of a young coast line.

(*d*) Earthquake phenomena.

Well answered on the whole.

Question VII.—Give an account of the Pleistocene earth movements in Australia and of their effects upon the initiation and subsequent development of rivers in Eastern Australia.

Few candidates attempted this question. More attention should be paid to physiography and tectonic movements.

Question VIII.—Write an essay upon the wind as a geological agent in the process of erosion and deposition.

Not well answered. Little attention appeared to have been given to desert erosion.

Question IX.—Explain how plains are formed, and discuss the characteristic features of the drainage systems associated with them.

Or

Write an essay on the building of the mountains of Eastern Australia and their relations to peneplanation at an earlier period.

The answers to the origin of plains were generally good, but the alternative on mountain building in Eastern Australia was poorly answered. Many candidates dated the present mountain systems as far back as the Carboniferous period.

NOTE-BOOKS.

On the whole the note-books were of good standard, and showed that in many schools satisfactory courses of practical work are being given. Without reflecting upon the good work which undoubtedly many teachers of geology are doing, the examiners desire to call attention to weaknesses shown in some books.

Far too much general theoretical matter was included by some candidates in their practical books.

Descriptions of individual minerals were in nearly all cases satisfactory ; a few candidates described too few minerals.

Rocks were usually well selected and well described, but some of the descriptions given, particularly of the igneous rocks, were too brief and scrappy, individual minerals being only named, without any comment upon physical properties.

Descriptions of fossils were usually good, and drawings satisfactory, but in a few cases sketches were very poor.

Many good excursion essays were submitted, showing that candidates were interested in the field work. In some schools, however, this aspect of the practical work had been neglected and should receive more attention, some teachers having taken their pupils on only one or two field trips. The essays should represent the individual work of the candidate, based upon notes and sketches made in the field. The marked similarity in all essays from certain schools was striking, suggesting dictation of the matter by the teacher : such work is of little value.

Some teachers are giving excellent courses in mapping, but in spite of comments in previous reports, many are still neglecting this important part of the work, which is very necessary to a complete understanding of the subject. A few candidates showed no mapping in their books ; others copied geological sections from standard text-books. Some candidates did not include the field notes and plotting of a compass traverse in connection with the mapping course.

Some excellent collections of pictures and newspaper clippings of geological interest were submitted, with suitable comments upon outstanding points of interest in the pictures. A few candidates did not comment at all upon the pictures.

The courses in elementary blowpipe analysis of minerals, given to candidates for Honours, were usually very satisfactory. In some cases, however, full chemical tests were recorded for minerals apparently without any tests having actually been applied ; in fact, internal evidence showed that the results as recorded could not actually have been obtained. In this as in other sections of the work, the note-books should record practical work actually carried out by the candidates.

In most cases the practical work was well arranged and indexed.

INTERMEDIATE CERTIFICATE GEOLOGY.

Question I.—State, in not more than six lines of writing for each, what you know of any *five* of the following : atoll, parasitic cone, spheroidal weathering, terminal moraine, trough fault, porphyritic structure.

Quite satisfactorily answered on the whole, but a number of candidates did not know the characters of a parasitic cone.

Question II.—Give a short account of what can be seen in hand specimens of the following rocks. Name (but omit detailed descriptions of) any minerals which may be present. Give also a short account of the origin of each of these rocks : Basalt, diorite, schist, limestone.

Satisfactory.

Question III.—Select *four* from the following fossils. Describe and sketch each fossil. Briefly state the conditions under which each lived.

Thinnfeldia, Ammonites, Crinoid, Favosites, Spirifer, Aneimites (Rhacopteris), Fenestella, Graptolite.

Satisfactory.

Question IV.—Write a short essay dealing with the effects of earth movements on horizontally-bedded sedimentary rocks, noting particularly the results of horizontal pressure and stretching on the earth's crust.

Effect of tension in producing normal faulting was not appreciated by many candidates.

Question V.—State briefly how rocks may become metamorphosed, and describe the changes which take place when sandstones, shales and limestones are affected in this way.

While most candidates were aware of several characters of the rocks resulting from metamorphic action, many failed to discuss the causes of these changes and the processes taking place.

Question VI.—How are lakes formed ? What becomes of them during a long period of erosion ? Illustrate where possible by examples.

Generally well answered, but few examples were quoted by way of illustration.

Question VII.—Describe the work of rivers in building up accumulations of sediment. Where possible, give illustrations from Australian rivers.

Not well answered, very little attention being given to the development of alluvial fans or piedmont plains.

Question VIII.—Write a brief account of your studies on one of the field excursions which you attended. What interested you most in this work ?

Well answered on the whole.

NOTE-BOOKS.

Some candidates failed this year because of unsatisfactory practical work as recorded in the note-books. Some books included mostly theoretical material, and in some cases the examiners were doubtful whether any practical work had really been carried out by describing minerals, rocks or fossils from inspection and handling of actual specimens, or attempting any mapping work other than merely copying diagrams of various structures from text-books. The note-books should include the candidate's practical work, and not matter dictated by teachers.

Some candidates submitted excellent books, and it is clear that in most schools the courses given in practical geology are very satisfactory.

Minerals and rocks were satisfactorily described by most candidates, although in some instances the notes on the rocks were too brief. Unnecessary sketches of minerals and rocks were included by not a few candidates.

In the case of fossils, sketches are necessary, but were omitted from some books, and in others the sketches were decidedly poor ; while elaborate drawings are not needed, reasonably accurate diagrammatic sketches are desirable, preferably with essential parts named on the sketch. Elaborate classifications such as are being given in some schools are not necessary.

Excursions to places of geological interest should form an important part of the course in practical geology, and in assessing the value of the note-books the examiners place a good deal of emphasis upon the records of this work. Some teachers are giving excellent instruction in the field, and many of the essays were well illustrated by sketches and photographs, showed originality, and proved that the candidates were interested in this aspect of the subject. It is necessary to point out, however, that this part of the work is being neglected in some cases, quite a number of candidates showing evidence of having attended one excursion only, while others showed no evidence of having done any field work. In at least one school the exact correspondence of all accounts of field work indicated that the essays had been dictated by the teacher : such work is of no value.

In spite of comments by the examiners during the past few years, mapping is still a weak part of the practical work in many schools, although some teachers are giving excellent courses in this important aspect of the practical work. Some candidates did no mapping at all, others a few simple contour maps and profile sections only. Quite a number copied geological sections from the standard text-books, without any comments, and in some cases quite evidently without understanding the structures represented, and probably without understanding how such sections were originally constructed.

Some excellent collections of pictures of geological interest were submitted, with suitable comments upon features of special geological interest.

The arrangement and indexing of the practical work were generally pleasing, but could have been improved in some cases.

LEAVING CERTIFICATE BOTANY.

GENERAL.

Most of the note-books reached a sufficiently high standard ; in the best cases the range of material and method of treatment was at a very high level. Certain schools are still much below the standard expected. In these the range of material studied is poor, the method of treatment out of date, and the drawing lamentable. Curiously, many of these schools spend much time on work outside the scope of the Intermediate and Leaving Pass syllabus, studying (very badly) anatomical details and skimping the work of the syllabus proper.

In a few cases ink drawings persist. Bold outline pencil work is required. Shading should rarely be used, even by those whose artistic gifts are high ; it obscures detail, and makes for inaccuracy.

Several candidates have this year included herbaria in their note-books. This practice must cease. There is no reason why candidates should not make herbaria if they wish and have time, but these are not to be submitted for examination. In many cases it was found that a scrappy specimen of a badly dried plant replaced a drawing of the flower and its dissection. This is inexcusable.

In germination studies seeds should be sown so that the radicle can grow straight downwards, producing a normal root system. It is ridiculous to draw pages of bean maize (*et cetera*) seedlings with roots and shoots all turning through 180° owing to geotropic curvature and producing a complicated pattern, when with a little care in planting a clear diagrammatic result can be obtained. Of course, some seeds must be planted upside down when studying geotropism, but to give a child any unnecessary complication when it is beginning germination studies only confuses it, and leaves a lasting impression on its memory. Thus in Question V (Intermediate) some candidates drew *all* their maize or wheat seedlings with roots and coleoptiles twisting through 180°, which was silly. But was the candidate wholly to blame ?

The treatment of the structure and work of flowers is excellent.

The attention of teachers is drawn to the museum of the Botany School, in the University. This is open to them daily (9 a.m. to 5 p.m.) and to parties of students by arrangement. Attention is also drawn to a new book : James and Clapham, " Biology of Flowers " (Oxford University Press).

PASS PAPER.

Question I.—What have you learnt from your observations upon different algæ about (i) conditions of life for plants when submerged, as compared with conditions on dry land, and (ii) the differences between the marine and fresh-water habitats so far as vegetative and reproductive processes are concerned ?

A considerable amount of irrelevant and poor matter was given in answer to this question. The essential point in the first part is the fact that algæ obtain all their food materials, mineral salts, gases (O_2, CO_2), in solution through their entire surface, while land plants have developed a bipolar condition—a root-system growing in the soil and a shoot system in the air. The land plant secures its raw materials for food synthesis from both air and soil. This has been responsible for the great differences in the mechanical, absorbing, conducting and photosynthesizing regions of the plant body. In part (ii) the outstanding point is the different reaction of fresh-water and marine algæ in regard to reproduction and particularly survival. The fresh-water algæ, in order to survive in an environment which is subject to extremes of temperature and water supply (as compared with the relatively uniform marine environment) develop resting spores (usually by a sexual process). All vegetative activity thus comes to an end for the time being.

Question II.—Describe the mode of life and life cycle of a parasitic fungus. What is the importance of a high spore production to such an organism ?

The first part of this question—describe the mode of life of a parasitic fungus—was seldom treated satisfactorily. Most candidates either ignored it or were satisfied by simply stating that "*Puccinia graminis* is a parasitic fungus which absorbs nourishment from the host ". The nature of the relationships of parasite to host, *e.g.* the method of securing foodstuffs and the effect on the host, were not mentioned.

Many candidates wrongly described *Mucor* as a parasitic fungus developing on bread, *et cetera*. A few excellent answers were provided on the life cycle of *Puccinia*, but many candidates made no reference to the significance of the pycnia in the life cycle. The cycle of *Puccinia* is very well treated in Scott, " Flowerless Plants ", revised by F. T. Brooks.

The significance of high spore output by a parasitic fungus was generally reasonably appreciated, but here again some candidates discussed spore output in fungi in general rather than in a parasitic fungus in particular.

Question III.—Compare the structure and methods of spore dispersal in the sporogonia of a liverwort such as *Marchantia* and a moss.

Some candidates irrelevantly described the vegetative structure of the thallus of *Marchantia* and of a moss, and the process of fertilization. The details of the sporogonium of a moss were reasonably well described, although quite a few candidates ignored the apophysis, the stomata, and the photosynthetic cells of the capsule. It is well for candidates to understand that the *capsule is not the sporogonium* as some seemed to think. Many candidates have quite a fair idea of the mechanism of spore dispersal in each case, although few emphasized the important point that in *Marchantia* spore dispersal is simultaneous, while in the moss it is intermittent. The examiners are disappointed with such an answer as the following : " When the weather is suitable, the peristome teeth open and the spores are freed ; when the weather is unfavourable the peristome teeth close and prevent them from being freed ".

It misses the point. Why not say *dry* and *wet* ?

Question IV.—Describe the microsporophylls of *Macrozamia, Pinus* and such a flower as *Lilium*. Show clearly how the microspores are set free in each case.

The chief errors in the question were :

(*a*) No indication of the soral arrangement of the sporangia in *Macrozamia*.
(*b*) Microsporangia in *Pinus* on the *upper* surface.
(*c*) The *anther* of *Lilium* corresponds to the *microsporophyll* of *Pinus*. Very few good descriptions of dehiscence of the anther were given.
(*d*) Some candidates had no idea how or where dehiscence occurred in the microsporangia of *Pinus* or *Macrozamia*.

However some of the best candidates provided excellent answers to this question.

Question V.—What gases does a leaf give off into the surrounding air during the course of 24 hours ? State shortly the physiological processes with which each is connected.

Most candidates indicated that CO_2 and O_2 are given off during the course of 24 hours, but very few realised that water-vapour is also given off, during transpiration (also during respiration, although the much greater output of water-vapour through transpiratory activity obscures this). Some candidates were not quite clear in their understanding of the nature of the gases evolved during the *day, e.g.* many state that CO_2 and O_2 are both given off in sunlight because the gases are set free during respiration and photosynthesis, which are both proceeding at the same time. However, it is not possible to demonstrate the evolution of respiratory CO_2 in sunlight, because of the much more active consumption of this gas during photosynthesis.

Question VI.—Describe a series of experiments to show the influence of gravity upon the growing organs of a green plant.

This question (which ought to have proved the easiest of the paper) was generally poorly answered. Some of the experiments were badly described ; frequently no regard was paid to the necessity of conducting the gravitational experiments in *darkness* to eliminate the light factor in particular. Some of the experimental methods were not good ; instead of placing a sponge in the experimental jar, why not line it with moist blotting paper ? The experiments given ought to have included those which prove the regions of perception and response and transmission of a stimulus. It is quite clear that some candidates do not understand what is meant by the " action of gravity " on plant organs, otherwise they would not make such a statement as the following : " Stem and leaves are negatively geotropic, *i.e.* they do not respond to gravity."

As experimental material, it is not advisable to use such small seedlings as *mustard*.

Question VII.—From what substances do green plants obtain their nitrogen ? What is the importance of this element ? Mention any exceptional methods of obtaining nitrogen by green plants.

Most candidates understand that green plants obtain their nitrogen in the form of inorganic salts from the soil, *e.g.* as nitrates chiefly, but there are still a few who state that " the green plant obtains its nitrogen as a *gas* from the air ".

Many candidates did not adequately indicate the importance of nitrogen to the plant ; they referred to water-culture experiments and indicated that nitrogen starvation leads to stunted growth, but ignored its importance in protein and protoplasmic synthesis.

The last part of the question was quite well answered on the whole, but though some candidates gave a good scheme of the nitrogen cycle, they did not understand it, as was obvious from their comments.

The question specifically referred to *green plants*, so a discussion of the nitrogen metabolism of fungi was irrelevant. In insectivorous plants it should be noted that the nitrogen is absorbed from insects' bodies as organic nitrogenous *compounds*, which are rendered available by enzymes secreted by the plants' glands. This insectivorous habit provides a supplementary nitrogenous supply in habitats which are poor in nitrates (which readily leach away in wet soils).

Question VIII.—Give an account of the inflorescence, flowers and fruits of either the Epacridaceæ or the Rutaceæ. What is peculiar about the leaves in the family you select ?

Quite well answered by many candidates, although the *sequence of floral description* of some was not very logical, and might be improved.

In regard to leaf peculiarities, reference to the xerophytic characters was expected and in particular the parallel venation of the Epacridaceæ, and the oil glands of the Rutaceæ.

Question IX.—Describe three different organs of vegetative reproduction and draw and label them carefully. What are the more important advantages and disadvantages of vegetative propagation ?

Very few good answers were furnished to this question. It was expected that all candidates would know something about the structure of bulbs, corms, rhizomes, *et cetera,* and would have attempted this question. The examiners recommend very careful treatment of the vegetative organs of reproduction during the course ; a detailed study of the morphology of these organs should be made, as suitable material is easily obtained. Very few candidates have appreciated the advantages and disadvantages of vegetative propagation. The chief advantages, of course, are the maintenance of type, and its certainty. The chief disadvantage is the overcrowding of the plants, which results in the withdrawal of the same nutritional materials from the soil at the same season.

HONOURS PAPER.

Question I.—Make careful drawings of specimen A, and name the features shown on your drawings. Describe the specimen concisely and comment on any special features of interest that it shows.

Specimen A was a piece of a fresh thallus of *Marchantia* with antheridiophores. Many of the descriptive drawings were of good standard. Common mistakes were : failure to show the antheridial chamber openings in radial lines, omission of scales on the lower surface, failure to show double rows of scales. A section through the thallus should have been made to show the relative proportions of photosynthetic and storage tissues ; the last is by far the greater.

Question II.—What are meristematic cells, and where do they occur in such a plant as a sunflower ? Describe a meristematic cell and the way in which it divides.

Reasonably well attempted, and needs no comment.

Question III.—By means of diagrams, explain the arrangement of the tissues in a young root and a young stem. Do not describe or draw cell details. How is the arrangement of the mechanical tissues in the two organs correlated with their respective functions ?

Diagrams only were asked for, yet many drew all cell details, sometimes badly. The position of the protoxylem, an essential feature of such diagrams, was often not indicated. Many candidates had not thought about the mechanics of stem and root structure. The stem, with its peripherally placed fibres, is a girder system or a hollow tube. The phloem, xylem and pith (when present) are on the web of the girder or inside the tube, and thus relieved of most bending strains. The root, with the centrally placed fibre groups, is flexible, but has tensile strength.

Question IV.—Make a diagram showing a vertical section of a leaf passing through one of the bigger veins. Label fully, but do not describe. State briefly the functions of the various tissues.

Fairly well answered, though many candidates write at length even when the question is framed to obviate much writing.

Question V.—Two equal weights of wheat grains are planted in pots containing pure sand, and given the necessary water for germination and growth. One pot is kept in a greenhouse and the other in an entirely dark room. After three or four weeks the seedlings are carefully washed out of the sand, dried, and weighed. There is a difference between these weights and the weight of the original seeds. How do you account for these differences ?

Some very sensible answers were given discussing the effects of photosynthesis and respiration. All seedlings lose in dry weight during germination as a result of the latter process. It is only after subsequent growth, in light, that dry weight begins to increase again. Curiously, this was an unpopular question.

Question VI.—Make careful diagrams comparing the structure of the megasporophyll and ovule of a pine at pollination and at fertilization. Label fully, but do not describe. Describe the microspore of the pine and say how pollination is effected.

Usually badly done. Few candidates had any idea of what an ovulate cone of *Pinus* is like at the time of pollination. The ovules are minute, with wide, gaping micropyles, the nucellus is small, and the megaspore mother cell usually no bigger than the nucellus cells around it. The prothallus is not matured, and the archegonia do not develop till shortly before fertilization, more than fifteen months later. Once again a question framed to obviate writing led to pages of needless description.

Question VII.—There are certain generally recognised principles of floral evolution and specialisation. Illustrate these by reference to flowers belonging to the following families: Ranunculaceæ, Cruciferæ, Solanaceæ, and Labiatæ.

Disappointingly answered. Often an example of each family was described, and no attention paid to general principles, *e.g.* cyclic as opposed to spiral arrangement, reduction in number of parts, radial and bilateral symmetry, *et cetera*.

Question VIII.—Describe carefully the prothallus of a fern, and state clearly how fertilization is effected.

Generally attempted, and reasonably well done, but the drawings were frequently very crude.

INTERMEDIATE CERTIFICATE BOTANY.

Question I.—Name all the plants you know which have (*a*) bulbs, and (*b*) corms. Distinguish between the two structures, and draw figures showing a median longitudinal section through each. Describe carefully how a corm acts as a means of vegetative reproduction.

Lists of bulbs and corms were generally poor, too short, and contained many m·stakes. The differences in structure were often badly shown in the diagrams. It was common to find a confusion between perennation (*i.e.* persistence of one bulb or corm plant from season to season) and vegetative reproduction (*i.e.* multiplication of the number of plants, owing to a " mother " bulb or corm forming two or more bulbs or corms, each of which grows independently the next season). Montbretia, with its chain of corms persisting for several years, is a less " normal " type for study than, *e.g.* gladiolus. *N.B.*—*gladiolus*, pl. *gladioli*; gladiola is incorrect.

Question II.—Describe as carefully as you can one of the following: *Loranthus, Cassytha* or *Exocarpus* (native cherry). From what sources does the selected plant gain the materials necessary for its growth?

Exocarpus is the least well known of the three common Australian semi-parasites. The root haustoria are small and numerous (see specimens in the Botany School). *Loranthus* was fairly well done, but many did not know that the leaves are opposite and the flowers in cymes. In too many cases the candidates had only read Yapp in the English edition, and so showed ignorance of a common Australian plant. *Cassytha* was confused with *Cuscuta* by many weak candidates, and an account of the latter drawn from Yapp was given. There is no excuse for this mistake.

It is too vague an answer to say that, because these plants have green leaves or stems, therefore " they can make food ". What food? A reference to photosynthesis is essential.

Question III.—What does an ordinary garden soil contain that is of importance to a green plant? How would you proceed to demonstrate, in a given sample of soil, the presence of the constituents that you have named?

Not well answered in most cases. Again attention is drawn to " Lessons on the Soil ", by Sir John Russell, a book based on talks to village school children.

Question IV.—" The fruits of plants are often variously and ingeniously contrived so that their contained seeds may be dispersed." Comment on this. Give examples.

Generally unintelligently answered. In most cases every type of fruit and seed dispersal that the child had heard about was listed, with the briefest description. The question called for a selection of " ingeniously contrived " fruits which should have been described carefully, *e.g.* the wonderful schizocarp of the castor oil plant, which can sling its seed 15 to 20 feet on a hot day, the schizocarps of Erodium or Geranium, or even the pappus of some composites, with a hygroscopic movement, securing an open parachute in dry weather only.

Question V.—What are the conditions necessary for the successful germination of seeds ? Describe with drawings the germination of wheat or maize grains.

Conditions usually correctly given, but many candidates insisted on dragging in light, if only to qualify the statement by saying that it is needful for " healthy " or " normal " germination.

Light is, in almost all cases, unnecessary, or even harmful to *germination*, though it is essential for subsequent healthy *growth*. Generally the wheat or maize grain germination was badly described. The examiner feels that while it is usual and legitimate to take germination studies early in the three years' course, they might well be revised again at the end, when the pupils' capacity for accurate observation has improved by further study. Even advanced University students could learn a great deal by examining a batch of germinating beans !

Question VI.—" The Compositæ is the largest and most successful family of flowering plants." Describe any structural features which might account for this.

This question proved too hard for most candidates, though the best gave very sensible answers. Most merely described—often very badly—a composite inflorescence and flower. The points expected were (*a*) massing of small flowers in heads ; (*b*) efficient pollinating mechanism, with self-pollination in many cases if cross-pollination fails ; and (*c*) fruit dispersal by pappus, *et cetera.*

Question VII.—State shortly and concisely how you would proceed to demonstrate the following by experiment :

(*a*) The region of greatest growth in a young root.
(*b*) Through which part of a woody twig water travels.
(*c*) The fact that a leaf loses water through its stomata.

Experiments under (*a*) and (*b*) generally correctly given, but (*c*) was beyond most candidates. It is not enough to show water loss through a leaf. The presence of stomata should be shown, either by blocking the petiole and plunging the leaf in hot water, or forcing air through the petiole or a submerged leaf (the dock is good material for this experiment). Then the experiment in which leaves with vaselined surfaces are compared with unvaselined controls is to be preferred, for it shows the effect of blocking the stomata.

Question VIII.—State shortly and concisely what is meant by each of the following :

(*a*) Endospermic seed.
(*b*) Root pressure.
(*c*) Lenticel.
(*d*) Pollination.
(*e*) Pith.
(*f*) Gynophore.
(*g*) Chlorophyll.
(*h*) Parietal placentation.
(*i*) Ovary.
(*j*) Floral diagram.

Proved to be an excellent general knowledge question. Some candidates gained full marks, while others found it hard to define more than one of the things correctly. Candidates should be warned against spending too much time on such questions. A simple definition of two or three lines, and an explanatory sketch is all that is expected. Some candidates wasted time by writing a whole page on each thing.