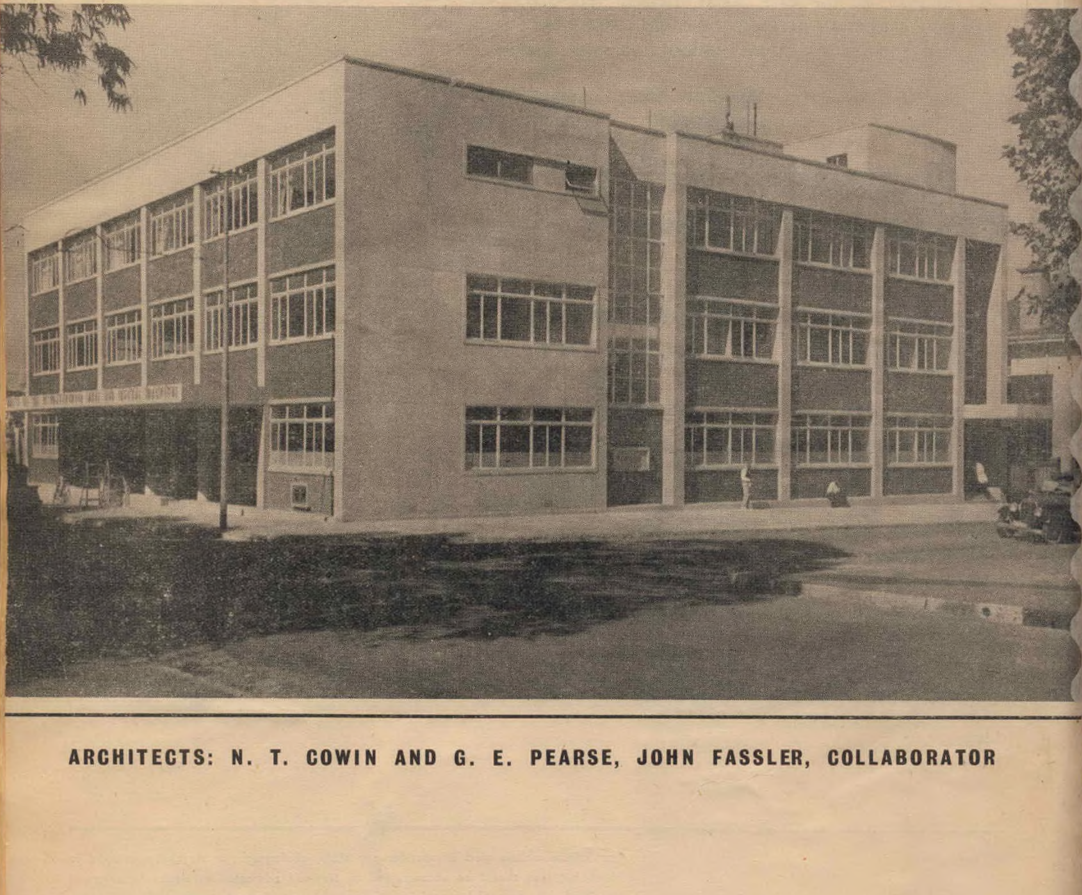
SOUTH AFRICAN ARCHITECTURAL RECORD

THE JOURNAL OF THE CAPE, NATAL, ORANGE FREE STATE AND TRANSVAAL PROVINCIAL INSTITUTES OF SOUTH AFRICAN ARCHITECTS AND THE CHAPTER OF SOUTH AFRICAN QUANTITY SURVEYORS.

611, KELVIN HOUSE, 75, MARSHALL STREET, JOHANNESBURG.
PHONE 34-2921 VOLUME TWENTY EIGHT. NUMBER ONE.

CONTENTS FOR JANUARY 1943



ARCHITECTS: N. T. COWIN AND G. E. PEARSE, JOHN FASSLER, COLLABORATOR

THE DENTAL SCHOOL AND HOSPITAL UNIVERSITY OF THE WITWATERSRAND

by John Fassler, B.Arch.

The Dental School and Hospital was designed to house the Department of Dentistry of the University of the Witwatersrand, and is erected at the corner of Bok and Loveday Streets, Johannesburg, about a mile away from the main buildings at Milner Park. This separation arose from the necessity of siting the institution as closely as possible to the community it serves. The building is conveniently situated for patients in Braamfontein, Vrededorp and Fordsburg, and is also in close proximity to Johannesburg station. The hospital in addition is thus brought within easy reach of patients travelling in from all parts of the Reef. It must be noted at the outset that treatment is only available for indigent or semi-indigent members of the community. Both Europeans and Non-Europeans are catered for, and the range of treatment available includes extractions under local or general anaesthetic, prosthetic and conservation work. Facilities are also available for oral and Maxilla-facial surgery.

The course in Dentistry is spread over five years, and, after having completed the required ground work, students commence to treat patients in the fourth year of study. Experience is thus gained in the various operative processes, and it should be noted that all work is supervised by the staff of Dental Surgeons who check and approve each step in the operations as they are carried out. The standard of service rendered under this system is consequently very high, and the usual fears expressed by members of the public about being "experimented on" by students are quite unfounded. The Dental Hospital therefore performs a dual function. In the first place it houses laboratories, lecture theatre, museum, common rooms, etc., serving the purely academic aspects of the curriculum, and in the second place, accommodation related to the public such as surgeries and waiting rooms, the latter group partially duplicated for Non-Europeans. Provision had also to be made for the permanent and visiting teaching staff, caretaker, native employees and plant rooms.

The building occupies a site of one quarter acre in extent. On the South is a service lane, and to the West the building occupied by the Dental Hospital since 1923. A condition governing the final solution to a great extent, required an arrangement which would need as small a staff as possible to run the building efficiently. The solution provided by the Architects reflects the conditions of the problem. The accommodation for academic training has been located at second floor level, while that for the public occupies the ground and first floor levels. Entrances serving these separate zones have been disposed as follows: staff and students in Bok Street, Europeans and Non-Europeans in Loveday Street, and the service entrance and garage from the service lane. Advantage has been taken of the fall of the ground on the South side to provide a basement housing the plant rooms. The caretaker, resident nurse and natives' quarters occupy a portion of the third floor level. The accompanying floor plans with their legends indicate in detail the disposition of elements at each floor. The possibility of future extensions ever present in institutions of this type has been allowed for, by designing the structure in accordance with local town planning regulations to give a maximum of seven stories along the whole of the Bok Street front, returning half way along

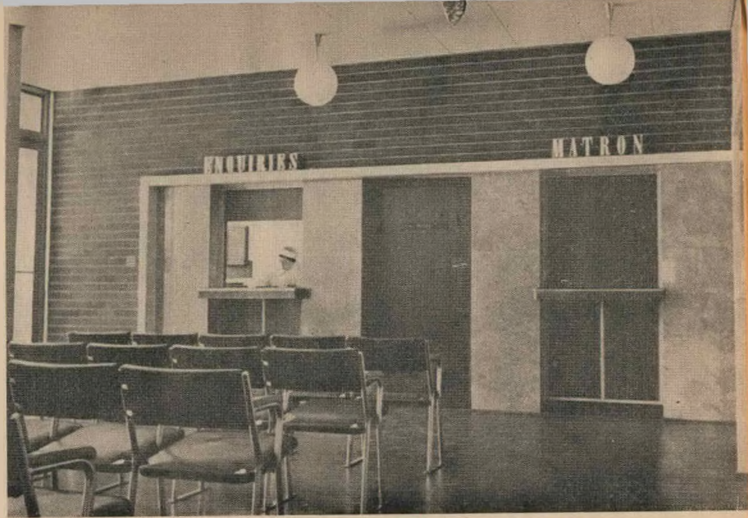
Opposite: VIEW FROM NORTH-EAST

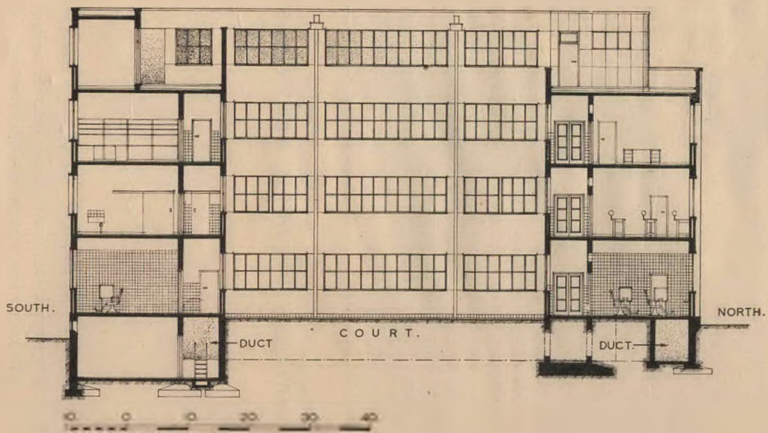
Right: DETAIL OF MAIN FACADE

Cream, waterproofed, sand-faced precast concrete casing to columns, with purple face-brick in spandrils. Lettering, thin sheet steel pinned to face of cantilever slab and painted pale green. Steel windows painted cream.

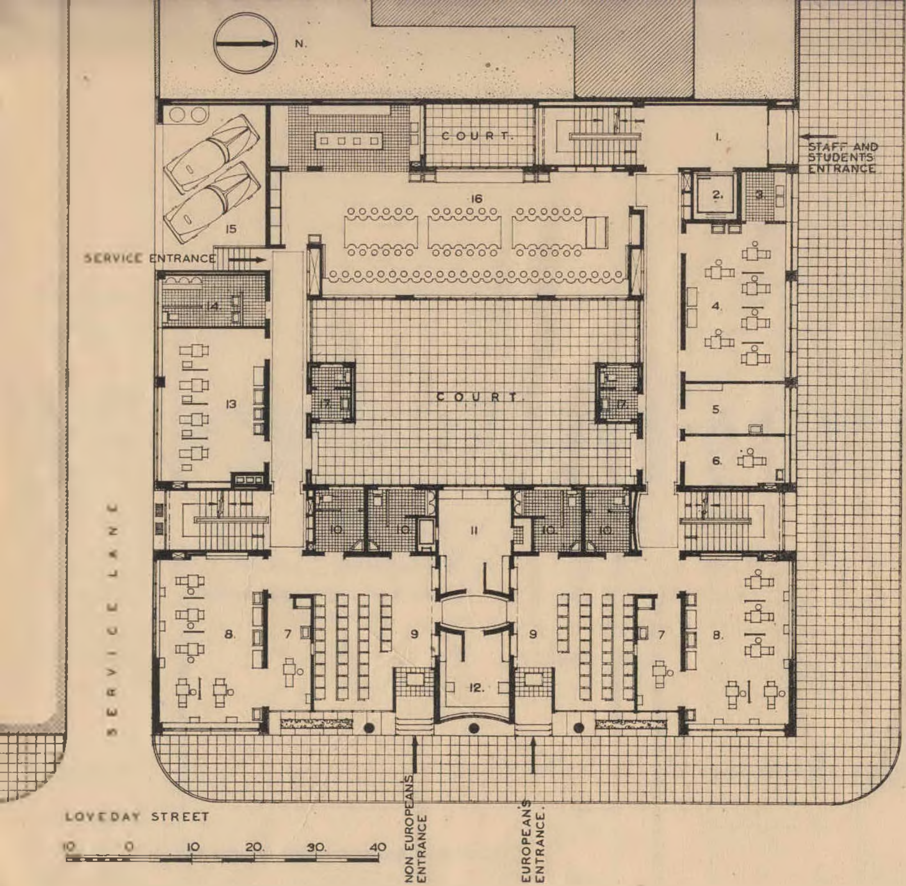
DETAIL OF EUROPEAN WAITING SPACE

South wall of purple face-brick with square recessed cream joints. Hatches in teak and birch and " Chiampo Onice " marble panels finished against brickwork with white plaster surround. Free-standing white letters of 1 inch hardboard. False ceiling of " Masonite " in small panels fixed with cups and screws for access to services above. Tip up seats with chromium plated frames and maroon upholstery. Flooring of Kejaat wood blocks.





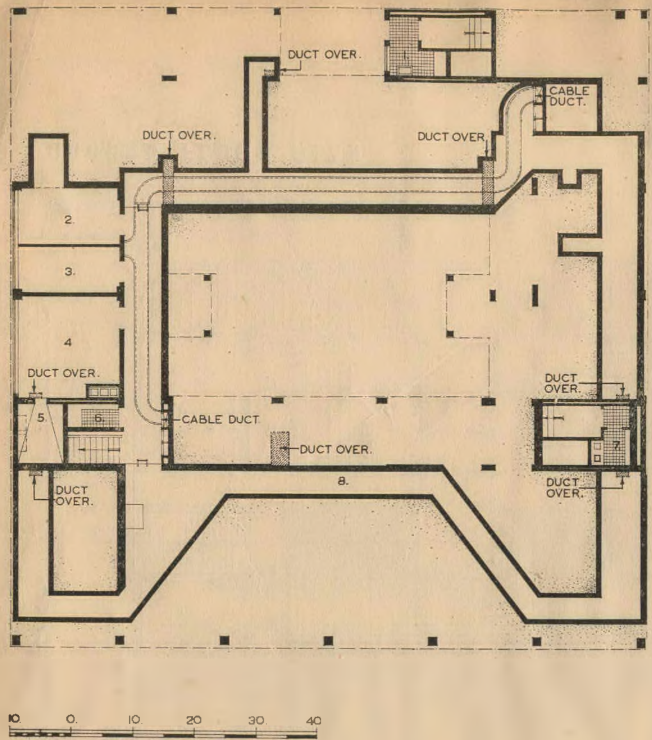
CROSS SECTION



GROUND FLOOR PLAN

LEGEND

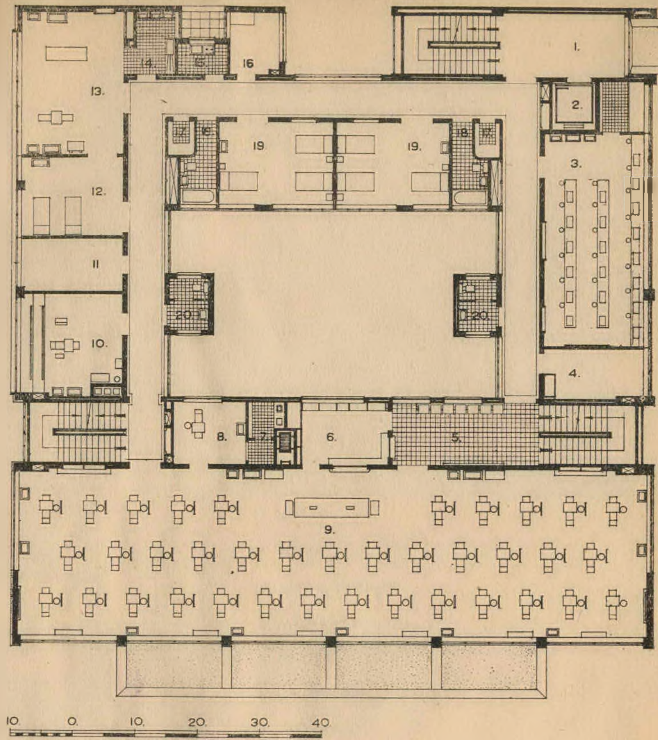
1. Entrance Hall.
2. Lift.
3. Plaster Room.
4. Prosthetic Surgery.
5. Staff Room.
6. X-ray Surgery.
7. Pre-Examination Surgeries.
8. Extraction Surgeries.
9. Waiting Rooms.
10. Patients' Lavatories.
11. Matron.
12. Almoner.
13. General Surgery.
14. Students' Lavatory.
15. Staff Garage.
16. Mechanics Laboratory.
17. Staff Lavatories.



BASEMENT

LEGEND

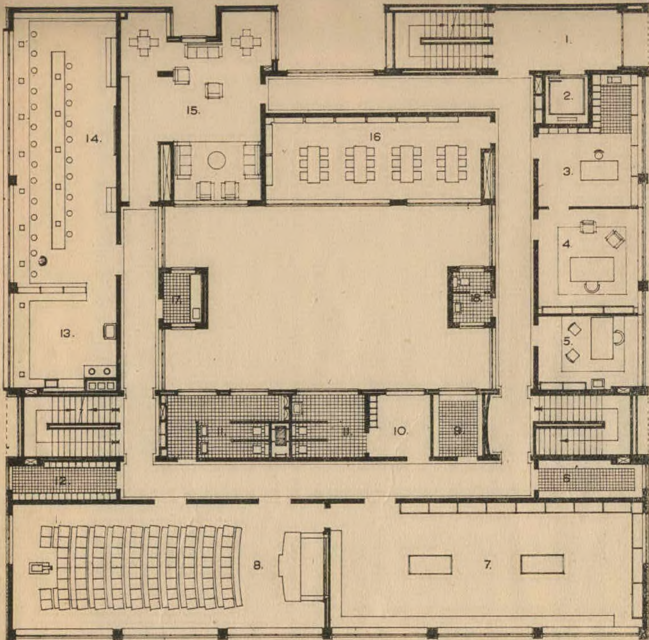
1. Sink Room.
2. Transformer Chamber.
3. Switch Room.
4. Boiler Room.
5. Coal Bunker.
6. Store.
7. Dark Room.
8. Access Duct.



FIRST FLOOR

LEGEND

1. Stair Hall.
2. Lift.
3. Phantom Head Room.
4. Staff Room.
5. Waiting Space.
6. Almoner.
7. Dark Room.
8. X-ray Surgery.
9. Conservation Surgery.
10. Demonstration Surgery.
11. Waiting Room.
12. Recovery Room.
13. Operating Theatre.
14. Scrub Up Room.
15. Sink Room.
16. Duty Room.
17. Clothes and Linen Cupboards.
18. Bathrooms.
19. Wards.
20. Staff Lavatories.

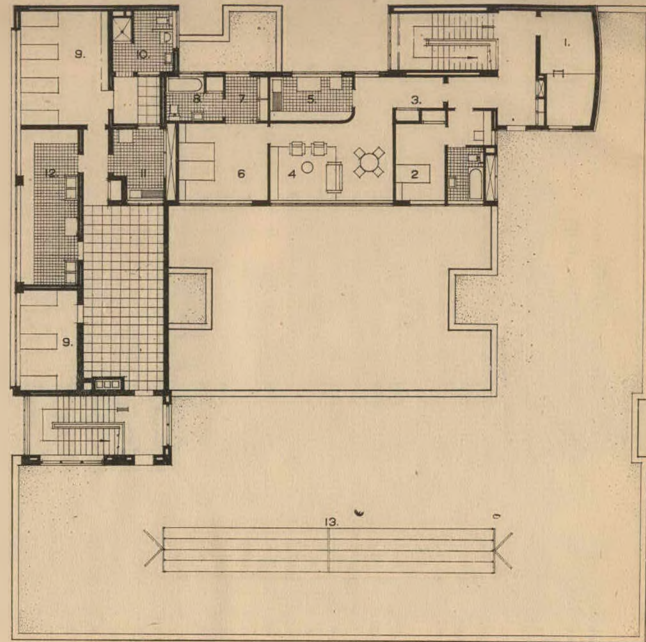


10. 0. 10. 20. 30 40

SECOND FLOOR

LEGEND

1. Stair Hall.
2. Lift.
3. Secretary.
4. Director.
5. Staff Room.
6. Store.
7. Museum.
8. Lecture Theatre.
9. Store.
10. Women Students' Retiring Room.
11. Students' Lavatories.
12. Locker Room.
13. Preparation Space.
14. Histology Laboratory.
15. Students' Common Room.
16. Library.
17. Tea Kitchen.
18. Staff Lavatory.



10 0 10 20 30 40

THIRD FLOOR

LEGEND

1. Lift Motor Room.
2. Suite for Resident Nurse.
3. Entrance to Caretaker's Flat.
4. Living Room.
5. Kitchen.
6. Bedroom.
7. Dressing Space
8. Bathroom.
9. Boys' Rooms.
10. Boys' Lavatory.
11. Kitchen.
12. Laundry.
13. Hanging out space.

Loveday Street, and five stories over the whole of the remainder of the site. For the present only three floor levels and a portion of the fourth have been erected.

The circulation for patients, staff and students has been carefully worked out. Europeans and Non-Europeans enter the building directly into their respective waiting rooms where they are attended to by the Matron at the enquiry counters fronting the waiting spaces. Particulars are taken to ascertain whether they are eligible to receive treatment. If accepted they next proceed to the pre-examination surgery on their first visit where the Dental Surgeon on duty discusses individual cases with groups of senior students. The condition of patients and recommendations for appropriate treatment are noted on special charts. Should extractions under local anaesthetic be necessary, patients continue into the adjoining extraction surgery, later leaving the building by the same entrance. Should prosthetic treatment be required, patients proceed to the prosthetic surgery on the North front. The mechanics laboratory across the corridor serves this surgery, and also the Non-European surgeries in the South wing of the building.

Times for extractions and conservation work have been so arranged that after 10.30 a.m., when the extraction surgeries close down, the conservation surgery at first floor comes into operation. The Almoner who is located in the office next to the Matron, then proceeds upstairs to the office and materials store adjoining the conservation surgery. This office also controls the waiting space at the head of the stairs. Patients requiring conservation treatment visit the hospital by appointment, and proceed from the main waiting space on the ground floor under the control of the Matron, to the smaller waiting space referred to at first floor level, immediately prior to the arranged time. Any X-ray photographs required during treatment are made in the X-ray surgery opening directly off the conservation surgery. It will be seen that the same staff under this system controls the three main branches of the hospital's service for Europeans and Non-Europeans. Should the volume of work necessitate simultaneous operation of the extraction, prosthetic and conservation surgeries, this may be done with a slight increase in staff. The circulation for Non-Europeans at ground floor level, South wing, is similar. All X-ray work on this floor will be carried out in the X-ray surgery at the foot of the North stair, and Non-Europeans may approach it across the courtyard without interfering with the circulation of European patients.

The operating theatre and wards at first floor are arranged for extractions under general anaesthetic. Further the comprehensive equipment installed makes possible all types of oral and Maxilla-facial surgery. A suitable waiting space has been arranged for relatives, and a recovery room for patients returning from the theatre. The ward units have been provided with attached bathrooms, equipment and linen stores, sink room and duty room. Convenient to the conservation surgery is situated the phantom head room, which is used for preliminary instruction in conservation technique, before students are permitted to work on patients in the conservation surgery. The demonstration surgery in the South wing is used to demonstrate to small groups of students the various types of filling and operative procedures. Here, too, cases exhibiting unusual conditions are discussed and treated.

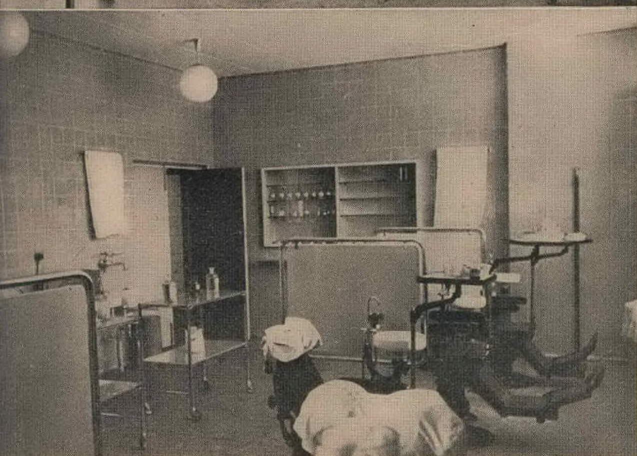
The second floor level as mentioned previously, is used purely for academic training. The offices administering the Faculty of Dentistry are situated here. A large lecture theatre and museum planned en suite occupy the East front. The museum houses a collection of specimens to illustrate the structure of teeth and jaws of all types of animals. Specimens and models illustrate different stages in the evolution of the teeth of man and various other species. The histology and attached preparation room occupy most of the South wing. Here sections of teeth and the related structures of mouth and jaws are prepared for microscopical study. A library adjacent to the administrative offices, students' common rooms, locker room, store rooms, etc., completes the accommodation at this floor.

The third floor houses the caretaker's flat, the kitchen of which can serve the wards below when patients are required to remain in the building over night. A suite is also provided for the nurse on duty on these occasions. A laundry and native quarters occupy the South wing, and hanging out space has been arranged where shown on the roof over the East wing.

The technical aspects of the building presented some interesting problems, the most important of which concerned the organisation of the services required in different parts of the structure. In approaching the problem initially it was found that the large number of drainage points, and the multiplicity of the services related to these influenced the planning to a considerable extent. Some idea of the difficulty involved may be gauged from the fact that on the ground and first floors alone there are one hundred and forty points. Where dental units occur the services to be connected comprise water, electricity, gas, compressed air and drainage. The crux of the problem was to conceal the network of pipes and cables necessary, and at the same time to develop an arrangement which would give ease of access to all parts. Further, the layout had to be such that, if required, additional services needed in the future, arising from new developments in operative technique, could be provided without difficulty. A solution was arrived at by arranging a duct seven feet high and varying in width from three feet six inches to six feet in the basement which completes a circuit of the building, and opens into the corridor serving the boiler and transformer rooms. This main horizontal duct was made large enough for tradesmen to work comfortably in it, and very little excavation was involved in construction due to the fall of the ground, and the excavations from adjacent column footings. The main duct referred to forms the starting point for a system of vertical ducts which may be seen by referring to the ground floor and basement plans. These have been arranged on either side of the North and South staircases, and of the mechanics laboratory and in the recess opening off this

CONSERVATION SURGERY

OPERATING THEATRE



EUROPEAN EXTRACTION SURGERY

laboratory, a cable duct at the side of the lift, another in the South stair hall, and a large duct between the patients' lavatory and matron's office. The high tension supply has been brought to the transformer chamber in a channel let into the floor of the main duct and covered with removable slabs shown in the basement plan. The low tension supply then branches out of the switch room following the line of the incoming cable and connects to the two vertical cable ducts. These rise up through the respective floor levels. The cables then connect to the main switch boards at each floor, and from here the supply is continued to subsidiary distribution boards conveniently placed. Telephone cables use the same ducts vertically and hollow skirtings horizontally. All heating pipes to radiators and the hot water supply to basins rise and fall in the remainder of the ducts described and are looped horizontally in hollow skirtings. The services for the dental units in the conservation surgery are sleeved through the beams on the underside of the floor, and are fed by shallow ducts at both ends of the room. The large duct near the centre receives the waste water. Each half of the room is drained separately so that in the event of blockage only half of the units will be affected. The entire area on the underside of the conservation surgery is finished with a false ceiling comprising hardboard screwed to suspended framing in panels approximately one foot six inches square. Every panel is removable. At ground floor level all services supplying dental units circulate horizontally in the main duct, and are connected directly to the underside of pedestals in the surgeries above. As may be seen from the drawings, the large ducts on either side of the mechanics' laboratory, and at the side of the matron's office, receive the soil and waste water from a number of fittings which have been grouped in their vicinity. Large folding doors in the corridor on either side of the mechanics' laboratory enclose the ducts. When open the whole system is exposed. The third duct is accessible from the matron's room. Internally a cat ladder and wrought iron platforms at each floor render access and maintenance an easy matter. All shallow ducts are covered with one inch thick laminated board panels screwed to cottage section steel window frames set flush with tiles or plaster. The whole of the basement duct system is ventilated by air bricks immediately above plinth level on the street fronts, and by carrying the North duct to the mechanics' laboratory above roof level and filling in the exposed side with louvred doors. It should be noted that distinctive colours have been used in painting the service pipes throughout. Whenever any duct cover or ceiling panel is removed therefore, the function of all pipes disclosed is immediately apparent. To keep the wall surfaces free from obstructions in the surgeries, radiators have been recessed flush with glazed tile walls in heavy gauge sheet steel boxes double backed, and insulated with asbestos. In offices, etc., radiators are set on the top of hollow skirtings enclosing the supply pipes.

The structure of the building presents no unusual features A simple ferrocrete frame has been employed with adequate provision for future extensions vertically as outlined previously. The North and South wings west of the staircases have been designed without cross beams. The underside of the slab is thus continuous and avoids the complication of partition wall positions being governed by beams: Considerable difficulty was experienced in deciding on the safe bearing load of the ground as its nature varied a great deal over the site. Eventually each column footing was determined separately on the site, and excavation depths were adjusted to make the best use of the ground. This method slowed up the work but the time lost however was made good later.

Mention has already been made concerning factors of circulation, staffing, etc., which influenced the planning. Here it is necessary to refer to the need for flexibility and its bearing on the solution. It is evident that flexibility is the primary necessity of any modern building used for medical services. They must be capable of easy alteration and reorganisation to be able to adapt themselves to changes in treatment, and thus inevitably in accommodation as these are developed. It will be seen by referring to the plans that windows generally extend the full width between columns externally. They are divided up into approximately four foot units alternately opening and fixed. This arrangement makes it possible to introduce partitions at intervals of eight feet throughout the facades. Steel plates secured to window mullions and contacting partitions form the finish against the windows. All services as mentioned are looped vertically and horizontally, and are thus available at any point in the structure. Future alterations consequently will be a simple matter.

In conclusion it remains to outline the materials employed. On the whole in spite of difficulties caused by the war, the architects were fortunate in being able to employ most of the materials specified at the commencement of work. Compromises were necessary here and there, but the principle of providing the maximum of impervious surfaces internally and externally was adhered to. Externally the ferrocrete frame is faced with cream, waterproofed, sandfaced precast concrete slabs. The panels between columns and beams are filled in with steel windows and purple face-bricks with square recessed cream horizontal joints. On the East front the free standing columns are encased in mosaic to match the precast slabs. All steps and landings are in deep grey terazzo with non-slip nosings. The plinth is of grey precast concrete slabs to match. Internally the courtyard is finished with natural colour cement plaster above a quarry tile plinth. Steel windows generally have been fitted with steel cills projecting well clear of wall surfaces. Internally surgeries throughout are tiled. They are pale green in the European surgeries and operating theatre and white in the Non-European surgeries. Surgery floors throughout are of "Ruboleum" in green and fawn. Joinery in surgeries is enamel painted to match tiles but elsewhere is in teak. Corridors have white glazed tile dados with quarter inch green tinted cement horizontal joints and cork linoleum floors. Floors to offices, etc., are of wood blocks, and to lavatories, quarry tiles. Seats in waiting spaces

LECTURE THEATRE

Equipped with sliding blackboards, screen for epidiascope, Kejaat lecterns on chromium plated steel supports and tip up seats upholstered in green.

HISTOLOGY LABORATORY

and the lecture theatre have chromium plated steel frames with tip up upholstered seats. Staircases are in black granolithic with non-slip nosings. The external lettering to the North and East facades is cut out of thin sheet steel pinned to the face of the cantilever slab and welded to steel supporting frames over the entrances. Internally lettering has been cut out of hardboard.

The Architects for the building were Messrs. N. T. Cowin and G. E. Pearse. Mr. John Fassler collaborated in the design and Mr. P. Aneck Hahn was the chief draughtsman. The General Contractor for the work was Mr. J. E. Morren, Dr. E. O. Baumann was the consulting Structural Engineer, and Mr. Goldsmith, of the Department of Electrical Engineering at the University, was the Electrical Consultant. The whole of the electrical installation was carried out under the supervision of Mr. F. K. White, of the Electrical Engineering Department. The heating system was installed by Messrs. F. A. Sharman, Ltd.

VIEW FROM SOUTH EAST

THE PRESIDENTIAL ADDRESS OF PROFESSOR CHARLES EDWARD INGLIS, O.B.E., M.A., LL.D., F.R.S., DELIVERED TO THE INSTITUTION OF CIVIL ENGINEERS, NOVEMBER 1941

I desire, in the first instance, to testify my deep appreciation of the honour in becoming President of the Institution of Civil Engineers. It is a position which justifies feelings of pride, but it likewise carries with it a vivid and sobering sense of heavy responsibility. I intend to spare no effort in shouldering this honourable burden, and I shall strive to maintain the high tradition of Presidential devotion to duty, set by my predecessors, with all the energy I possess, and with all the ability which Nature in one of her moods of strict economy saw fit to provide.

It is customary for a President, in his inaugural address, to deal with that specific branch of Engineering about which he possesses first-hand knowledge. Consequetly I propose to set forth my views on some aspects of engineering education, more particularly University engineering education, which has been my primary preoccupation for the past forty years. It is many years since the Institution last had an educationalist for its President, and for a precedent to my case it is necessary to go back to the year 1911, when Dr. Unwin was installed. It is easy to account for this wide spacing, since in the past engineering education was given little scope for establishing contact with the outside world. Teachers had few opportunities of practising what they preached, and in respect to the realities of engineering enterprise and progress most of them lived a life of almost monastic seclusion. With industry in Great Britain becoming increasingly research-minded, this state of isolation is rapidly disappearing; but it is only recently that teaching or research in an engineering school has ceased to be an almost insurperable barrier blocking the pathway to corporate membership of the Institution. A more enlightened spirit now prevails; more and more, industry is seeking guidance from academic engineers and utilizing the research laboratories at the Universities and Technical Schools to solve the problems of urgent practical importance. Consequently, in these days, if a young engineer decides to take up an academic career, he does not of necessity cease to be a practical engineer; he can still be of direct and immediate use wherever engineering progress is taking place, indeed he finds himself most favourably situated in the forefront of the fight. That his services should thus be kept available is of real importance to the profession, since an academic career nowadays attracts an increasing number of the ablest engineering recruits. Competition for such positions is so keen that only applicants of outstanding ability and character are successful and, no matter how true it may have been in the past, it is now erroneous to imagine that the rising generation of engineering teachers is being drawn from those who, in the field of practical engineering, have been tried and found wanting. Many of these able young recruits, their light no longer hidden under a bushel, will later on inevitably make their mark; and that is why I venture to predict that in the future to have as your President an engineer whose qualifications are mainly academic, will not be regarded as an anomaly calling for explanation or apology.

I am glad to take this opportunity of voicing some opinions on engineering education, and to do so under conditions where, like a preacher in the pulpit, the most provocative heresies can be pronounced without fear of interruption. For ideas on engineering education can be very provocative and, whereas education for most of the professions is generally accepted with resignation, the training of an engineer is an unending and chronic subject of controversy which is always so near the boiling-point that unless provision for relieving pent-up pressure is periodically provided explosions are likely to occur. With this relief in view, The Institution organised a conference on engineering education, which was to have been held in March, 1940, but, like so many of our activities, had to be cancelled. For that occasion I had been invited to give an address on the University Education of engineers; and, now that the chance has recurred, I propose to inflict on you some of the conclusions I have reached as the result of many years of teaching experience involving much trial and error; abundance of trial and probably still more error.

At the outset let me say that my conception of the primary duty of a University is that it should cater for the needs of those who, without any suggestion of class distinction, are expected to become the future officers in the army of civilian engineers—men who are destined ultimately to hold positions of high and varied responsibility. To fulfil this duty education in the broadest and most liberal interpretation of the term is required. On the other hand, the main preoccupation of technical schools should be to give the specialized training so essential for those who in that army will occupy the no less important and far more numerous positions of non-commissioned officers. These two tasks differ fundamentally in technique and although they overlap to some extent, any attempt to reduce them to a common denominator can only result in an unsatisfactory compromise. Education rather than specialized training should be the University ideal, and in this connexion it cannot be too strongly emphasised that education is something much wider and more profound than mere instruction. Just as culture and civilization are not synonymous terms, so instruction must not be confused with education. Instruction is certainly one of its ingredients, but an overdose of instruction may well stultify intellectual development and check that widespread formation of mental roots which is the all-important function of education. Expounding his views on education, Dr. Arnold of Rugby stated a great truth when he said, " I am increasingly convinced that it is not knowledge but the means of gaining knowledge, which I have to teach." Engineering education must aim at something more than cramming a student's mind with facts and formulas. It must strive to emancipate him from the tyranny of ready-made rules and slavish reliance on the potted and predigested form of nutrition contained in engineering pocket-books ; so that he acquires the confidence to think independently and to trust his own judgment based upon a proper understanding of scientific principles. Education must aim at giving him a healthy mental digestion and that keen appetite for knowledge which a healthy mental digestion promotes, and it is hardly an overstatement to say that the soul and spirit of education is that habit of mind which remains when a student has completey forgotten everything he has ever been taught.

You will not be surprised that, holding clear convictions about the necessity of depth and breadth rather than height in engineering education, I am strongly opposed to premature specialization. Show me a youngster who has had his foundations of belief well and truly laid and I will back him at long odds to overtake and soon outrun over any line of country, one of equal natural ability whose breadth of vision and mental root formation have been cramped by premature specialization. The foundations of engineering knowledge are growing wider and yet more wide, and branches of engineering are becoming more and more closely interlocked. As an example, radio-electricity was formerly regarded as a highly specialized engineering subject, but recently its applications have penetrated to such an extent into nearly every department of engineering that it must now be treated almost as a basic subject in any curriculum which aspires to give a liberal engineering education.

Assuming that an engineering course at a University extends over a period of three years, that is none too long for establishing the basic principles common to all the main departments of engineering—Civil, Mechanical, and Electrical. In his third year the more receptive student should be given the opportunity of pursuing one or two subjects to a more advanced stage ; but, just as branches of engineering are becoming more and more interlocked, so (to change the analogy) the subdivision of engineering education into a number of watertight compartments is to be avoided. Except for the option provided in the third year of delving more deeply into one or two specialities selected from a variety of subjects, the courses provided should be the same for all.

The primary duty of a University is to give a student the the opportunity of absorbing those particular forms of knowledge which, if not acquired then, probably will never be acquired, and his activities should be directed in accordance with this plan. Following this principle, it becomes almost reasonable to suggest that if a student is destined, let us say, for an electrical career, the subject he can most afford to neglect when he is at the University is Electricity, since he will get all he wants of that commodity in his subsequent experience. Unexpected knowledge is the surest means of obtaining differentiation from the common herd. A beginner in an electrical firm will get little credit for his knowledge of electricity, for in that particular direction he will be surrounded by others far more knowledgeable. But if perchance a problem involving stress calculations comes along, which he alone is capable of solving, seen against a black background of ignorance he will gain credit quite out of proportion to his merits.

Whether or no some new subject should be introduced into the educational system should, in general, be decided by the test, does it or does it not involve important fundamental ideas which, if not assimilated at that stage, never will be acquired ; and, bearing in mind that the educational machine is always overloaded, the further question arises what item, if any, can be jettisoned to make room for the new activity.

If this non-specialized form of engineering education is accepted, employers, when they take on a University graduate, must not expect him to be a finished tool available for immediate use. His potentialities may be great, but at that stage he can be regarded only as a raw product, and the principle of concentration on the fundamental and less readily acquired forms of knowledge will have fashioned him, for the time being, into a lop-sided creation with many ungainly bumps and hollows. It must be left to his employers to mould him into shape, and it is to be hoped that this will be effected by fillling the hollows rather than suppressing the bumps. These bumps are the indications of self-confidence and knowledge, and to operate on them will reduce the patient to a state of mental mediocrity.

In this moulding operation the students of highest quality are the most difficult to handle and the most exacting to train, since their independence of mind may cause them to ask awkward questions and to rebel against the time-honoured conventional methods difficult to defend. On this account I have to my regret, even encountered cases where employers have deliberately shown preference for young men of a lower order of intelligence, knowing that such will be more content to accept the status quo and more prepared to conform to the description of the practical man propounded by Disraeli, who defined the mere practical man as " the man who is content to perpetuate the mistakes of his predecessors."

Nevertheless, engineering firms are with increasing persistence asking for young men of exceptional ability, but having got them, not infrequently they have no idea how to utilize and develop this latent talent. A lengthy treatise might be devoted to this subject—indeed a text-book dealing with this topic is badly needed—but all I will say now in this connexion is that razors are poor implements for cutting bricks, and a chisel, if used as a screw-driver, is apt to lose its edge. To develop the potentialities of high-class but inexperienced engineering students, they must be set problems calculated to stretch their brains and at the earliest possible stage they should be given tasks which involve real responsibility; perhaps the most valuable part of this stage of their education being the lessons they learnt from their own mistakes when such mistakes really matter. There is a saying that lilies, when they decay, smell worse than weeds, and the better the brain the lower its fall when degeneration sets in owing to repeated frustration or chronic disuse.

In many engineering organizations there exists at the top an upper stratisphere of conspicuous ability and mature judgment and at the bottom there is a ground layer of youthful enthusiasm and fresh ideas, unbalanced though these may be by lack of experience; but in between there is apt to be a stratum of high resistance and poor permeability, the abode of those who have risen as high as their limited natural ability enables them to rise, and where, bereft of ambition, they are content to remain perpetuating in a painstaking manner the mistakes of their predecessors. It is this middle layer which clogs the wheels of progress and devitalizes the enthusiasm of those young men who started their engineering careers with such high hopes and aspirations.

Whilst it is easy to point out a defect, it is more difficult to prescribe a remedy; but the solution I now propose, even as I have done in the past, is to stir up this stagnant middle stratum with more posts in the nature of personal assistants to managers or directors. Young men of proved ability, after they had completed their practical training, could thus be set to study special problems calculated to develop their originality and brain power and, vested with authority from on high, their initiative would not be thwarted as is all too likely if these efforts are not backed by influential support. The existence of such posts would also have the good effect of inducing men of exceptional ability to remain on the technical side; bringing them into close contact with managerial activities would fit them for subsequent positions of high responsibility, and might even thereby tend to discredit the prevalent and pernicious doctrine that the mentality of the technical man is too narrow for the highest positions industry has to offer.

MATHEMATICS.

Since mathematical ability, if not acquired at an early age, will never be acquired, mathematics must occupy a prominent position in any University course of engineering education. Mathematics has been termed the "handmaiden of Science," and with the rapid developments taking place in engineering science, the services of such a handmaid are becoming an increasing necessity. But even now, these advances are seldom the direct result of mathematical analysis, and perhaps the most valuable service this science renders to engineering is the explanation of difficulties encountered by the consolidation of a position already won, so that a further advance can with confidence be undertaken. Here I am speaking of mathematics of a really exalted character. To the real expert the type of mathematics utilized by engineers in their everyday work appears hardly worthy of the name, but only a degraded form of his art, debased by utilitarian considerations. Speaking in analogies, I would refer to the routine calculations practised by engineers as mathematics of the "tin-opening variety," and in contradistinction to real mathematicians, we engineers are more interested in the contents of the tin than in the beauty and precision of the implement employed. But some form of mathematical tin-opener is essential, since it is the only means whereby fundamental truths can be incontestably established, and empirical formulas replaced by those of a rational variety.

Mathematics is a subject which differs from almost any other form of knowledge in that to most individuals it presents a ceiling above which it is impossible to rise. When a student is endeavouring to master a particular subject, lack of natural ability can usually be overcome by extra effort; but my teaching experience leads me to believe that this does not apply to mathematics, and the fact that most students in this subject possess a definite limitation and are unable to rise above it, does not necessarily betoken a lack of effort.

Fortunately the mathematical ceiling for most engineering purposes is not very lofty and against this barrier the majority of engineering students need not bump their heads; but its existence must be recognized in any system of engineering education, and a student's analytical ability should be tested at an early stage. Even if this ceiling is below normal he may yet have the makings of a first-class engineer; but engineering principles must be expounded to him in language of a less advanced mathematical character; otherwise, at the best, he will be in the condition of "faint but pursuing," and at the worst, thoroughly dispirited, he may abandon the chase.

The most widely used tools of engineering mathematics are the differential and the integral calculus, including some of the simpler species of differential equations. Modern mathematicians are exceedingly scrupulous about the legitimacy of the operations they employ, but engineering students should not have their minds burdened with an overload of philosophical doubts. For instance, elaborate investigations relating to the convergency of series are quite unnecessary, since the direct application of simple arithmetic will soon reveal whether or no a series is numerically intelligible. Engineers in their mathematical excursions should not allow themselves to be intimidated by notice boards which say "Fools step in where angels fear to tread." The eminent French mathematician D'Alembert gave much the same advice when he wrote "Allez en avant; et la Foi vous viendra." The validity of a mathematical process may well be defended by the fact that it yields no obviously absurd results.

In teaching mathematics to students of normal ability, experience has shown me that an illogical method is often the best, and that a thorough drilling in the technique of a process can with advantage be given before the reasons underlying the process are fully understood. Thus, in teaching the art of differentiation, although the teacher, for his own satisfaction, may be permitted to give a preliminary explanation of the processes and principles involved, at that stage his explanation is not likely to make much impression with the majority of his audience. But if, after a student has practised the technique and worked out numerous examples, the reason and purpose of what he has been doing more or less automatically and blindly is once again explained, the scales will fall from his eyes and the light of true understanding will enter and remain therein.

For higher flights of modern mathematics I have a profound admiration mingled with awe and, though it may be sacrilegious to say so, this awe is now and then tinged with a slight feeling of mistrust; for as a famous mathematician has said, "Mathematics is sometimes more intelligent than the people who use it." For my own part I am only happy with the findings of mathematics when I am not more than two or three steps away from my starting-point. A greater distance is seldom necessary; elaboration of mathematics in relation to engineering problems often betokens a paucity of physical conceptions and is apt to suggest that perhaps before being placed in the mathematical machine the problem had not been reduced to its simplest possible form.

Some such simplification or idealization is always necessary before an engineering problem is susceptible to analytical treatment. This preliminary simplification calls for careful discrimination and sound judgment; otherwise factors may be left out of account which are of vital importance. As a case in point, I may mention that when the Bridge Stress Committee was investigating the oscillations set up in railway bridges by the impact of locomotives, it was only revealed at a regrettably late stage of the experimental work that the factor which really dominated the problem was the damping induced by the spring movement in the locomotive, and that a mathematical analysis which left this out of account could not be trusted to give predictions of any practical value.

This, and many other cases which might be cited, point the moral that mathematical conclusions in relation to engineering problems can be accepted only after experimental verification, preferably on a full scale, since in default of this verification influences of the first order of importance may have been idealized out of existence and analysis may have been indulging in that futile form of exercise known as "barking up the wrong tree."

Although analytical dexterity is an admirable quality in any engineering student, this form of ability should not be overmarked in assessing his merits. Mathematics is merely a means to an end, and not a culminating glory. In preliminary examinations it is well to have separate papers on this subject to probe a student's depth of knowledge in this direction and to detect the shallows; but in the final examination, mathematics should be put in its proper perspective and viewed as a means to an end, this end being the solution of engineering problems and not a display of mere analytical dexterity.

Before leaving the subject of mathematics I will just touch on that oft-debated question whether it should be taught by a man who is primarily an engineer or mainly a mathematician. It is very similar to the consideration whether French should be taught by an English-speaking Frenchman or a French-speaking Englishman. My own experience is that, in a teacher of mathematics to engineers, first-hand experience of its application to practical engineering problems is more important than superlative mathematical brilliance. You want for this purpose a man who has been all the way there and back again. The real mathematical artist has doubtless been all the way there, but his roots will have a tendency to come out of the ground, and he may find it difficult and irksome to descend to that level where, earth-born, the majority of his audience are constrained to shuffle along.

THE HUMANITIES IN RELATION TO ENGINEERING EDUCATION.

I will now put in a plea for leavening an engineering education with some measure of the humanities.

There is much truth in the saying that the proper study of mankind is man, and this precept should receive recognition in any liberal system of engineering education. Exclusive concentration on the materialistic and scientific aspects of his profession tends to produce in a student a certain narrowness of vision which subsequent experience may never wholly rectify. Too often one encounters the young man who assimilates with meticulous diligence every scrap of knowledge imparted to him, and in consequence passes all examinations with inevitable precision. His immediate advancement is thereby assured, and it is an absolute certainty that his diligence will carry him up to a certain level; but it is more than likely that lack of humanity and breadth of outlook will put a limit to any further advancement. At the time when his mind was most susceptible to treatment, his root development has been stunted by an over-indulgence in an ill-balanced diet and a lack of those essential vitamins which the humanistic side of education alone can provide.

It is good to have communed with the great minds of the past, but that form of culture known as literae humaniores is a luxury which, in the case of an engineering student, must be left to individual enterprise, and the humanistic side of engineering education must perforce relate mainly to the present and the future. Engineering is now shaping the destiny of civilization; it has vast potentialities for both good and evil and, side by side with his scientific training, a student should have his interest stimulated towards the humanitarian, the economic, and even the ethical responsibilities of the profession he is about to enter.

To this aspect of engineering education the Council of The Institution are now giving earnest consideration. They have voiced their hope that engineering education of the future will stress more fully the economic aspects of engineering undertakings, the general principles of management, the organization of works of construction, industrial psychology, and aesthetics in engineering design; and, as tangible evidence of this educational ideal, the University of Cambridge has been given a subsidy to provide special teaching in these subjects.

In addition to its cultural value the study of aesthetics in engineering design is particularly appropriate to present circumstances, with such a vast vista of reconstruction work looming ahead. In this particular direction engineering education in the past has taken little or no interest. Students are taught to design structures which are reliable and economical, but it is very unlikely that they are given the faintest indication that in beauty of form and harmony with surroundings there are other problems to be solved of almost equal importance. When accused of indifference towards aesthetic considerations, engineers have been prone to take refuge behind the plausible but pernicious doctrine that if a structure is properly proportioned for the duties it has to perform it must be automatically pleasing to the eye. That doctrine is one of those half-truths which can be very dangerous. For mingled with truth it contains an element of complacent self-sufficiency which, if allowed to remain unchallenged, will inevitably debase the whole status of the Civil Engineering profession.

Education will have performed a valuable service if it merely indicates to the rising generation of engineers that in their designs beauty of form as well as strength must be taken into account. Reasons why some structures please and other fail to do so, when pointed out, are fairly obvious; and, once a student's eyes have been thus opened and his interest aroused, an appreciation of beauty will, in most cases, grow up by personal observation. But good taste is not determined by a mathematical equation, and artistic treatment cannot be standardized by a code of practice. The most education can do is to sow the seeds. The cultivation of these is an individual responsibility, and it cannot be expected that all the seed sown will fall on fertile soil.

EXAMINATIONS.

So far I have avoided the subject of examinations, but no talk on education can ignore completely this somewhat painful topic. A sweeping condemnation of the whole examination system is an easy way of gaining the approbation of one's audience; but whilst I share the widespread mistrust of examinations as the ultimate test of mental ability, I mistrust even more the intellectual capability of the young man who fails with monotonous regularity to surmount every examination obstacle placed in his path, and in spite of all special pleadings, I consider the inference to be drawn from oft-repeated examination failures is all too obvious. It is easy to condemn the examination system, but even its most bitter critics have no clear-cut alternative to suggest. Written testimonials are of value, but only if one is in a position to assess the veracity of the writer, since writers of testimonials have this in common with those who inscribe epitaphs on tombstones, that they are not on their oath. Unless a testimonial is almost fulsome in tone it is apt to be interpreted as damning with faint praise; consequently there is a tendency to depict all geese as swans or, at any rate, birds with very elongated necks.

There is no doubt, however, that education, particularly in Great Britain, suffers from a surfeit of examinations. Teachers have their merits assessed by the examination successes their pupils achieve; consequently they tend to keep their eyes focussed on the examination syllabus, education degenerates into mere instruction, and instruction in its turn sinks to the yet lower depravity of cramming. But examinations, provided that they do not persistently obscure the view and terrorise their victims, do serve a useful purpose, and if they were eliminated, although a few ardent spirits would doubtless continue to seek knowledge for the joy of doing so, I fear that, on the part of the majority, the pursuit would be but a half-hearted and poorly attended hunt. The main purpose of examinations is to find out if a student's knowledge has become available for export. It is all too easy to satisfy oneself in this respect, but mastery over a subject has been attained only when one is able to expound its meaning and applications to someone else. Viewed from this standpoint, examinations cease to appear as vindictive impositions, to be circumvented with the minimum of effort. When one has reached that regrettable state of seniority which confers freedom from this particular infliction, the need of an examination substitute often becomes apparent and, for my own part, if I want to acquire a working knowledge of some unfamiliar subject, I put myself down to give a course of lectures thereon. On the same principle, students of ability can derive great advantage by coaching their less gifted or less advanced brethren. The consolidation and clarification of their ideas resulting therefrom will be an ample reward for the expenditure of time and effort incurred. With the same end in view, undergraduate societies at which students read papers and discuss engineering subjects deserve every support. To encourage the timorous, variety and simplicity should be aimed at rather than depth and originality. A lively exchange of ideas on subjects within the comprehension of all, and opportunities for developing clarity in verbal explanations, should be their main purpose, and the conduct of these societies may well be guided by the dictum of a learned judge that "a restatement of the obvious is often more valuable than the elucidation of the obscure."

In connexion with such societies, senior members of the profession can help greatly by giving talks about works which they have carried out, or engineering developments to which they have devoted special attention, and providing on these occasions an opportunity for students to converse with men of mature practical experience. In education apathy can almost always be converted into explosive energy if only the right detonator is found, and such conversations may well kindle an enthusiasm which academic training has failed to arouse. With this object in view, The Institution is collecting a panel of its members who in this manner would be prepared to help the cause of engineering education. A list of possible helpers has been prepared and invitations have been sent out, but such a list must inevitably be incomplete, and I hope that any who feel a generous impulse to participate in this scheme will not hesitate to offer their services, although they may not have been formally approached to do so.

WORKSHOP TRAINING.

The prominence which should be given to workshop practice in the case of a University student has often been the storm-centre of heated controversy. Most certainly some such training of a preliminary character is essential, but it is not the primary duty of the Universities to turn out skilled mechanics; they have neither the facilities nor the time for doing so, and the major part of this training must be post-graduate. Before a student takes his final examination he should, however, have achieved some familiarity with and some dexterity in the use of tools, and this qualification can be attained by workshop courses in the University or, alternatively, by experience in commercial workshops during vacations; usually a combination of these two alternatives is advisable. There is also much to be said for a short workshop training sandwiched into a period between leaving school and entering the University. The manual dexterity a student acquires in such a course is of secondary importance; its primary value lies in the lessons in human psychology which this experience will consciously or subsconsciously provide. The student may be too young to appreciate fully at the time the value of these lessons, but nevertheless youth to him at that stage is a great asset. He will in consequence, find the workmen fatherly and helpful, and he will discover that they have a kindly and generous side to their nature which he may perhaps never fully appreciate if his first contacts with British workmen are delayed to a later stage.

Apart from the foregoing considerations a short interregnum between school and University is excellent for character formation. It develops in a young man the knack of throwing out new roots in unfamiliar surroundings. Furthermore, it gives him the feeling that he has started his professional career and, in consequence, he does not enter the University regarding it as a school with a relaxed discipline.

To get the maximum benefit from this preliminary practical experience, respite from systematic tuition in theory may for the time being be permitted. But, if this is done, the time should not exceed six months; otherwise a student's sensitivity towards book learning may receive a set-back which is more than temporary. Here, however, it is wrong to generalize, for I can recall several instances of a super-successful University career which had been prefaced by a full practical apprenticeship, during which only a meagre substratum of theoretical engineering knowledge had been acquired. But these were all exceptional cases; young men with great force of character and outstanding natural ability, who could hardly be affected adversely by any irregularity or inversion of the educational system. For normal University students the serious part of their practical training must follow their University career, and, if education has achieved its purpose, the intelligent and orderly assimilation of this post-graduate practical training will have been greatly helped and expedited thereby.

DRAWING OFFICE TRAINING.

Drawing is another educational subject to which, in a University education, a time limit has to be imposed. The first-class draughtsman is the outcome of years of practice and experience, and a University course which specalized on this product would have time for nothing else. At a University, a grounding in drawing office methods and considerable practice in solving engineering problems by graphical processes should be given; but, though the technique of high-class draughtsmanship ought to be set before students as a goal to be subsequently attained, they cannot be expected to reach this standard of perfection in the limited time available. A taste for the actual process of drawing is a very valuable asset, and a engineer who has never developed that taste, or has allowed it to fall into disuse, places himself at a disadvantage. Handing over a rough sketch to a draughtsman may produce one solution of a problem, but there is no assurance that it is the best. Work on a drawing-board is a slow process which gives plenty of time for thought and, as the design begins to unfold, various alternatives will almost inevitably present themselves and, more often than not, the final solution has little resemblance to the original conception. Hence I would advise any young engineer to cultivate a taste for drawing; to regard it as a valuable accomplishment and not as a menial task associated with the less exalted stages of an engineering career.

RESEARCH AND POST-GRADUATE TRAINING.

The word Research in its application to Engineering can produce mixed emotions. It can conjure up the soul-stirring contributions to knowledge made by great scientists such as Newton, Clark Maxwell, Rutherford, and J. J. Thomson, whilst at the other end of the scale there is the dreary vision of research being basely used as a means of obtaining a cheap degree. Without any disparagement to the great pioneers of the past, it should be recognised that outstanding distinction in research is becoming increasingly difficult to achieve. The days are past when nuggets could be found lying about; the alluvial deposits have been worked out, and to add to our stores of knowledge deep-level mining is generally essential. Consequently, in engineering research, team-work is tending to replace individual effort, with the result that personalities have less opportunity of becoming conspicuous. This tendency must, sooner or later, be recognized in the training for research and in the granting of research degrees. Often the best approach for a beginner in research is to serve an apprenticeship in a team already at work, but under present circumstances this course may seriously jeopardize his chances of a research degree. For this particular hall-mark a premium is placed on individual effort and originality; consequently the young research worker who has his eye on a degree is generally forced to plough a lonely and often shallow furrow, instead of digging deeply into some problem of first-rate importance, guided and stimulated by a band of fellow-workers. Unless this trend is recognised, and the value of team work is taken into account in granting degrees, the training in research for University engineering students will become increasingly limited in scope and out of touch with modern methods.

At a University, research should, as far as possible, be of a fundamental and long-range character which may have no immediate or obvious practical value. Industrial research, where quick returns of a utilitarian character are called for, must in general be left to the research laboratories of commercial undertakings particularly since such research is often of the full-scale variety, involving specialized and costly apparatus which a University research laboratory can neither finance nor accommodate.

This question of the ever-increasing cost of engineering research is a serious consideration and suggests that in post-graduate training and research the Universities to some extent should pool their resources. At present their post-graduate activities overlap in a manner which is very uneconomical. After a student has graduated he should be free to migrate to some other University which specializes in the particular line of knowledge he wishes to pursue, and this change of environment will often be greatly to his advantage.

Instead of all Universities professing omniscience, one would like to see the subjects of post-graduate study apportioned to them, account being taken of their geographical position and the nature of their local industries. In this rationing process there are all the ingredients for a sanguinary dog-fight. It could be brought into effect only by invoking some high authority invested with dictatorial powers, but the gain would justify any temporary turmoil. Post-graduate teaching and research would gain strength by concentration, the channels of intercourse between industry and the Universities would flow more fully in both directions, and particular industries would know more definitely where to turn when seeking guidance, or bestowing gifts for the encouragement of that special form of post-graduate training and research in which they are interested.

TEACHING.

And now I will make a few observations on the technique of teaching. The accomplishments looked for in a teacher of engineering are two- and perhaps even three-fold. He is generally expected to be not only an accomplished teacher, but also distinguished in research, and to these qualifications, when a leading position is to be filled, administrative ability has to be added. These three attributes, teaching, research, and administration, are as widely separated as the corners of an equilaterial triangle, and to find them all embodied in their highest development in any one single individual is almost too much to expect. Even teaching ability and distinction in research are apt to be in conflict, and if, as a teacher, a man's qualifications are "A1," is it more than likely that in research he cannot be rated higher than "B," and vice versa. In making an appointment to a post which is primarily of a teaching character, though a candidate's research record should be taken into account, this qualification, in my opinion, is often overweighted. It is not always sufficiently recognized that first-rate teaching ability is a gift vouchsafed to only a favoured few, and that its comparative rarity gives it a value which can hardly be over estimated. It is all wrong to imagine that because a man is learned he can in due course become a good teacher, and this misconception applies with even greater force to ardent disciples of research. Consumed by a divine frenzy, the research enthusiast is apt to grudge every moment spent away from his beloved occupation, and a teacher who views his task as being of secondary importance is unlikely to be a success. Students pay their fees to receive tuition, and in return are entitled to receive the best teaching which can be provided; and, to satisfy their needs with the reluctant efforts of a man whose interest is mainly dedicated to research, is the perpetration of a flagrant breach of contract. Research is a vital necessity in any University Engineering Department, but it must not be subsidized out of the fees paid by students.

Thus, on the staff of a University Engineering Department, two categories should be recognized, those whose primary duty is to teach and those who are mainly occupied in research; and in making and financing appointments, this division should be clearly recognised. In practice, however, this demarcation should not be to rigidly enforced. Every teacher, though his natural aptitude for research may be limited, should strive to make his modest contributions to knowledge, and every research worker will derive benefit by endeavouring to expound his ideas to an audience, though the members of this audience may sometimes have their own views about the value of this infliction.

For success in teaching long experience is essential, and the teacher who has become self-satisfied with his efforts is already on the down grade. In addition to experience certain natural qualities must have been inborn; for instance, a clear and musical voice is a valuable asset. But the most important attributes are enthusiasm and sympathy; a teacher must face his class with the feeling that he has something perfectly splendid to tell them and they, above all others, are the young men whom he wishes to share his soul-stirring secrets. Enthusiasm and sympathy are very infectious and, if this atmosphere is created, a lecturer's task is more than half performed. For orderly arrangement of his material and clarity of exposition he must strive continuously without hope of finality; indeed the most stimulating incentive to progress in teaching lies in the fact that finality in technique never can be attained.

If a lecturer is unfortunate enough to find his class restless or unruly, the blame almost invariably lies with him. It is generally an indication that his lecture has been insufficiently prepared and is lacking in the virtue of clarity, without which he cannot hope to hold the attention of his class. Clarity in a lecturer is a form of good manners he owes to his audience; without it all his other excellencies are of no avail, and every teacher can with advantage study that sublime message of St. Paul to the Corinthians, substituting for "charity" the equally merciful and perhaps even more kindly virtue of clarity.

There is one important word of advice I feel impelled to give teachers. When examining a pupil's work in his presence always in the first instance seek for something you can praise. If this can be done, and it is not always easy to do so, a student will pay much more heed to the condemnations you may have subsequently to make; he will take them to heart and accept them without resentment. It is a British characteristic to bestow praise much too sparingly. Most of us, young and old, benefit from an occasional dose of this tonic, and it is only the thick skinned or entirely self satisfied who don't find it invigorating and a stimulus to renewed effort.

It is a mere truism to say that the best teachers are not necessarily those who possess the most brilliant academic records; indeed extreme mental acumen may almost be a drawback. A teacher is more likely to be in sympathy with his pupils if, in the past, he has encountered and surmounted by conscious effort just those same difficulties which confront the student of average ability; and the super-brilliant mind which has acquired knowledge almost subconsciously may have difficulty in appreciating the perplexities which beset those of lower intelligence.

Finally, on this subject of engineering teaching, I would add that, as a foundation for such a career, some practical engineering experience is essential, of an amount not less than that required by The Institution as a qualification for Associate Membership.

A question which is frequently asked is, "how do engineering students nowadays compare in ability and diligence with those of the past?" My answer is that, in general, the present generation has become more studious. Owing to the increased tempo of the educational system, there are fewer opportunities than formerly for loitering by the wayside; a student must keep moving all the time. He realizes that his mental efforts cannot be reserved exclusively for the period just preceding an examination and, though to some extent diligence may be thus forced upon him, the serious-minded and vigorous manner in which the great majority of students now pursue their studies is a cheering indication of the backbone possessed by the rising generation in this country.

Concerning ability, a general up-grade is certainly apparent, though the high-water mark of intelligence of the very best remains sensibly constant. This, I conceive, may be in accordance with a law of nature which has set a limit to human intelligence, which few attain and none surpass, and I believe that, going back as far as historical evidence can take us, the outstanding examples of human intelligence have been of equal distinction quite irrespective of age or nationality.

ADVICE TO YOUNG ENGINEERS.

And now, in conclusion I will address myself more particularly to those young men who are still only on the lower rungs of their professional ladder, but with the glorious buoyancy and optimism of youth, are confident of rising ultimately to the top. That, at any rate, is the right spirit in which to start the ascent, and the vista of sustained effort which lies ahead should only add zest to your high courage. For sustained effort is essential, and the upper rungs of the ladder are not reached by those who put their faith in any doctrine of "least effort." Academic success may and should help you to make a flying start, but the initial propulsive force of postscripts such as "B.A.," B.Sc.," or even "Ph.D.," is soon spent, and your ultimate progress will depend on your own powers of propulsion and not on scholastic or even University distinctions. You will be judged by what you are, and not by what you have been. One of the early qualifications you should have acquired is the power of concentration, and in developing this faculty I think modern educational methods are somewhat defective. Although I would not wholly subscribe to the doctrine propounded by that semi-serious philosopher Mr. Dooly, that "it doesn't matter what you teach a boy as long as he hates it," nevertheless it contains a substratum of truth and is a bracing antidote to the flabby idea of "education without tears," and the doctrine that knowledge must always be served up in a palatable form. Having occasionally to concentrate on a task which at first sight may not appear attractive, provides that invigorating tonic of mental discipline which in an engineering education is such an essential ingredient. In most professions, and engineering is no exception, there is much work to be done which the mentally undisciplined may regard as a bore, but boredom in the young is a shame-making exhibition, indicating lack of grit and deficiency in powers of concentration.

In planning your life think more about what you can give than what you can get out of it, and don't place having a good time in the forefront of your objectives. If you do most certainly you will be disappointed. Happiness is as intangible as the ends of a rainbow; it is a commodity which you cull from the roadside as you run your course through life; it must be regarded as a by-product, and not as the main purpose of existence. The nature and location of happiness are so elusive that one can only define it in parables. Personally I visualize it as a flower which blossoms forth as the result of successful effort; much the same idea was put forward by that great historian William Lecky, who wrote "Happiness is a jewel which requires a setting of hard work." Both these metaphors bring in the conceptions of work and effort, and of this I am quite sure, that happiness is the natural outcome of hard work, just as good health is associated with vigorous exercise.

I have spoken of various attributes which you should possess and cultivate; but the most valuable of all is that form of courage which refuses to admit defeat and, if there is one factor which more than another makes for success in life, it is the ability to draw dividends from defeat. Defeats must come to all who live adventurously, but don't for a moment confuse defeat with failure; if you do, you are doomed to fail. Don't regard defeat as an irrevocable disaster, but rather view it as a valuable experience. Seek and you will find a way of turning your passing loss into a permanent gain, and from your temporary set-back, instead of bitterness, draw forth the conqueror's spirit so finely portrayed in that stirring old English ballad which runs:

> "Fight on my men," says Sir Andrew Barton,
> "I am hurt, but I am not slaine;
> I'll lie me down and bleed awhile,
> And then I'll rise and fight againe."

This ballad appears in a soul-stirring essay on courage by the late J. M. Barrie, from which I might, with advantage, have given you further quotations.

But I shall finish with another extract, culled this time from a different source and perhaps not inappropriate to a conclusion, since it takes the form of a prayer. It was written by a bishop whose identity I have been unable to discover, but it is obvious that he must have been a really human divine who saw life and the essentials thereof in their proper perspective. His petition includes all the qualifications I have emphasized you should possess, with several others I might have mentioned, and its sanity and sound common sense should have made it more generally known. It reads as follows:

> "Give me a good digestion, Lord, and also something to digest;
> Give me a healthy body, Lord, with sense to keep it at its best;
> Give me a mind that is not bored, that does not whimper, whine or sigh;
> Don't let me trouble overmuch, about that fussy thing called "I";
> Give me a sense of humour, Lord, give me the grace to see a joke;
> To get some happiness from life, and pass it on to other folk."

THIS ADDRESS IS REPRINTED BY COURTESY OF THE JOURNAL OF THE INSTITUTION OF CIVIL ENGINEERS, No. 1, 1941-42. NOV., 1941.

O B I T U A R Y

S I D N E Y W. W H I T M O R E

It is with deep regret that we record the death of Sidney W. Whitmore, L.R.I.B.A., one of the oldest members of the Institute, who died in Grahamstown on the 9th December, 1942.

He entered the service of the Transvaal Colony Government in 1903 as a draughtsman in the Architects Department. When he retired in 1927 he was Assistant Architect of the Public Works Department of the Union of South Africa.

He was later in private practice in Cape Town till 1939, when he retired to live in Grahamstown.

He was a man universally liked and respected in both private and professional life and was known and greatly loved by a large number of living Architects and Quantity Surveyors.

To his wife and family we desire to extend our deepest sympathy.

A TRIBUTE TO THE LATE DR. R. D. MARTIENSSEN

Rex Martienssen est pour moi un des espirits constructifs les plus clairs de notre temps. Je regrette de n'avoir pu etudier son œuvre personelle. J'ai connu l'homme, j'ai causé avec lui devant mes tableaux. Il est celui qui avait le mieux compris les rapports si difficiles à établir de la peinture et de l'architecture. —"Six sur dix de vos peintures sont des ' possibilitésm murales ' " me disait il, et c'était très vrai.

J'ai souvent pensé que c'était avec lui que la chance de réaliser enfin une harmonie architecturale en liaison avec la couleur serait possible. Ses travaux sur l'espace Grec sont remarquables. Il écrit là des choses qui n'avaient jamais été même presentées avant lui. Les Grecs ont le sentiment de l'architecture comme les Negres celui de la danse. C'est profondément populaire.

Nous promenant autour d' Athènes dans la campagne environnante avec Le Corbusier, nous sommes tombés en arrêt devant une niche àchien faites de pierres entassées les unes au dessus des autres. Le rapport entre le vide de l'entrée et le plein de l'entassement était d'une mesure parfaite qui nous évopuait certaines proportions Romanes.

Un instict du Beau, de l'équilibre domine encore ce pays chez les gens du peuple.

Martienssen a analysé tous ces problèmes d'une facon aigue.

La civilisation Crétoise qui relie l'Egypte à la Grèce est précisée comme jusque là aucun ne l'a écrit.

Personnellement, j'ai eu le grand plaisir d'avoir en lui un clairvoyant ami. Mon œuvre lui était familière. Nous avions beaucoup de points communs dans nos admirations.

C'est une grande perte pour nous tuos qu'un homme de cette qualité soit disparu si jeune. Son œuvre ne faisait que commencer. Son nom s'inscrit à coté de: Le Corbusier, Gropius, Mies van der Rohe, Oud, Alto, Wright, les grands pionniers de l'architecture moderne.

Fernand Leger.

Rex Martienssen is to me one of the most lucid and constructive minds of his age. I regret not having had the opportunity to study his individual work but I know him as a man and we have talked in front of my pictures. It was he who grasped as none other the intricate relationship between painting and architecture; " Six of ten of your paintings have ' mural possibilities,' " he remarked, which is true.

It has often occurred to me that he might be the one to succeed in combining the harmony between architecture and colour. His work on the Greek idea of space is remarkable ; the views he has expressed therein are entirely original. The Greeks have an instinct for architecture as Negros have an instinct for dancing ; it is rooted deep in the people.

Strolling through the country side near Athens with Le Corbusier we halted simultaneously before a dog's kennel built of stones piled one upon the other. The relation between the void of the entrance and the surface of stone layers was in perfect proportion, recalling certain Roman proportions.

An instinct for beauty and balance still reigns in Greece amongst the common people.

Martienssen has analysed all these problems with profound insight. Cretan civilisation, the link between Greece and Egypt has never been described in such detail.

It was my good fortune to have in him so discerning a friend. He knew my work well and we admired much in common.

The premature disappearance of a man of his calibre is a great loss to all of us. His work was just begun, yet he ranks with Le Corbusier, Gropius, Mies van der Rohe, Oud, Alto, Wright, the great pioneers of modern architecture.

Fernand Leger.