Proposal for a Pakistan College of Mines

By

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Introductotry Remarks.

The College is designed to be a complete service centre in the mineral sciences and emphasize equally teaching, research, and extension to both government and private industry.

Two levels of instruction, both based on a balance of academic and practical training, are proposed ; a three-year diploma in mining course, demanding matriculation for admission, and a four-year degree course in mining, petroleum, geology, and metallurgy, demanding intermediate science for admission.

In the Diploma in mining course, the student can qualify as a certified mine surveyor in eighteen months. After an additional year at the College he can become a certified overman. On completing the full three-year course, the diploma holder can join a mining company and in six months become qualified to act as the manager of a small mine or the assistant manager of a large mine. Or he may join the degree classes of the College of Mines or any engineering college or university.

After the first two years of the four-year degree course, a student receives the B.Sc. degree and can elect to remain at the College of Mines or he may join any other engineering college or he may pursue a university M.Sc. course in any of the science fields. At the completion of the four-year course, the student is qualified to accept employment in his chosen branch of the mineral sciences. For those completing the course in mining engineering, only six months of experience are required to qualify as a Second Class Mine Manager (First Class Mine Manager for those holding both the diploma and the degree.) An additional year of experience qualifies the degree holder as a First Class Mine Manager, legally authorized to be in sole charge of the largest mine.

Thus the courses are so designed that if, at any time, a student is forced by circumstance or desire to cease his work at the College, he will

have completed at least some step that insures his economic betterment with usable and recognized qualifications.

To tap the vast human resouroes that are often blocked from the opportunities of higher education by economic considerations, the College offers a scholarship programme from matriculation through university that embraces one-third of the enrolled students, including special opportunities for the dependents of mining personnel.

The Need for a College of Mines.

Every increase in mining production of no matter what material is an immediate gain in foreign exchange. Either the mineral replaces an imported material or it can be exported. And all industrial development is based on mineral raw materials.

For many years past there has been apparent an increasing need for mining personnel of higher training and qualifications than mere mining experience, relatively undirected, can produce. Higher mineral prices for imported raw materials, increasing industrial and economic development and therefore higher raw materials demand, increased need for national self-sufficiency after independence, coupled with a growing interest in, and knowledge of, the mineral wealth of Pakistan have resulted in an urgent need for the trained personnel in the mineral industry.

In 1954 a department of mining engineering was established at the Government (at that time the Punjab) College of Engineering and Technology, Lahore. Twenty students have been admitted each year and to date forty-nine students have successfully completed the full three years course of study. Of the other three years of study mentioned above, no facilities exist in Pakistan for training petroleum engineers or metallurgists, and the university departments offering geology are not in a position to stress the engineering and mining aspects so necessary to mining geologist.

As proved by the many students sent abroad in the past on government, foreign aid, and private company scholarships in mining geology, metallurgy, and petroleum engineering, the need definitely exists for trained personnel in these fields.

The production of mining engineers alone will supply personnel only for existing mines or presently known deposits. To expand the industry by enlarging the geologic knowledge of existing mines and to find and delineate new deposits, mining geologists are essential. Again, the utilization, marketing, and treatment of mineral products is the work of metallurgists. Little can be done, for instance, to improve the grade or the efficiency of utilization of Pakistani coal unless trained metallurgists working in well-

equipped laboratories are available. And such planned industrialization as steel mills will certainly require metallurgists.

It is therefore readily apparent that existing facilities are inadequate for the requirements of Pakistan.

At present Pakistan produces somewhat less than half of the nearly 1,500,000 tons of coal annually consumed in the country ; the remainder being imported against foreign exchange. Even the existing mines are poorly staffed and inadequately developed.

It is the opinion of both foreign and Pakistani experts that the known coal deposits can be developed to the extent that—together with the planned expansion of existing mines—Pakistan can be made self-sufficient in this very necessary commodity. Each expert, however, bases this promise on (1) availability of trained personnel, (2) the existence of applied research facilities, and (3) assistance to the small mine owner in the form of expert technical advice.

The present government income from coal royalties (not including special cases for welfare, inspection, etc.) is approximately :

7,00,000 tons @ Rs. 50 @ $7\frac{1}{4}$%	...	Rs. 26,25,000
The future increase in government income if the national needs are to be met with domestic production would be approximately :		
8,00,000 tons @ Rs. 50 @ $7\frac{1}{4}$ %	...	Rs. 30,00,000

The total annual cost of establishing complete facilities, including depreciation on buildings and equipment and interest on the invested capital, is estimated at approximately Rs. 20,00,000 with something over half of this amount presented by the annual budget.

It should be remembered that the preceding figures do not include income from chrome ore, oil or gas production nor any of the newly developing phases of the minerals industry such as steel mills, iron ore deposits, lead, antimony, and beryl deposits, nor do they include such existing allied fields as cement, fertilizer and chemical works utilizing mineral products, nor the production and building materials.

The justification is based purely on the predictable and normal increase in efficiency and production in only one existing phase of the minerals industry that can be made possible by well-trained personnel together with the necessary research and extension facilities.

To train abroad the number of annual graduates planned from the proposed college would entail a cost of approximately Rs. 15,00,000 annually

considering 60 graduates per year at a total cost (in foreign exchange) of Rs. 25,000 for each student for a three year course. Not only would these students have little or no opportunity for practical experience during this period but they would return to Pakistan totally lacking in first hand knowledge of the problems, conditions and requirements inherent in the Pakistani mining industry. Thus, not only would the cost for training the students abroad be a considerable loss in foreign exchange, establishing a college of mines, on the other hand, would represent equivalent expenditures of local currency for local supplies, personnel and labour. Besides, the additional training of 60 diploma students each would not be possible nor would there be a centre for research and extention, both of which, essential to any development programme, would otherwise require foreign exchange to ship and test samples and to employ foreign technicians as consultants.

REQUIREMENTS OF TECHNICAL PERSONNEL

The technical skills required in the industry can be divided into four basic areas :—

1. The search for valuable minerals ; Mining Geology.
2. The exploitation of valuable minerals ; Mining Engineering.
3. The production, marketing and utilization of metals and minerals, including coal ; Metallurgy.
4. The production of natural mineral oil and gas and their derivatives : Petroleum Engineering.

Superimposed on this horizontal division is a vertical separation by the degree and nature of the skill and training required. In mining, for instance, there are necessary (1) sardars and overmen, (2) second class mine managers, (3) first class mine managers, and (4) chief mining engineers and senior mining executives.

These classifications are set out in the Mining Laws of Pakistan and mining personnel are awarded certificates in each class based on education, mining experience, and the results of a series of examinations supervised by the Chief Inspector of Mines.

From the remarks of Dean S. P. Spielman (see Appendix I), Dean of the School of Mines and the College of Engineering, Washington State University, who has been in constant touch with the minerals industry of Pakistan since early in 1954, it is apparent that not only is a centralized institution desirable from a training standpoint but it is imperative that

it be developed as a complete service centre to industry and to government in research and assistance in the solution of technical problems. There are many reasons for such advice. First, to be a properly staffed and equipped institution for training a technical college must have all of the experts and the laboratory facilities needed for research and extension services. Only in the most advanced and developed areas can expansive duplication of these facilities be afforded. Second, to train engineers of the required standard, research facilities and practical experience in actual problems must be provided. Too often without such integrated training the students fail to realize the inter-related naturc of basic theory and practical work problems and become purely "chalk and talk" engineers with few or no useable abilities. Third, a schedule of only lecture hall and teaching laboratory holds little attraction to the mineral scientist with initiative, imagination, and enthusiasm, the qualities desired in a college staff member. Even though posts might be otherwise attractive, the relative monotony of continuous and repetitive instructional duties will tend to dull the qualities of the best teachers.

COURSES OF STUDY

General

The courses of study and outlines of tests for the Pakistan College of Mines, as approved by the Syllabus Sub-Committee, are designed to train personnel for the minerals industry of Pakistan on four levels. In view of the country's present requirements, the emphasis has been placed on mine personnel particularly coal mine managers. This is not to imply, of course, that the very necessary allied fields are to be neglected. Two levels of instruction are included; professional degree courses requiring four years training after Higher Secondary, and a diploma course in mining requiring three years training after Matriculation.

The professional degree courses include mining engineering, petroleum engineering, mining geology, metallurgical engineering, and mineral dressing. It is preposed that 60 admissions be granted each year, 30 in mining, 10 in potroleum, 10 in geology, and 10 in metallurgy and mineral dressing, to be varied as the demands of the industry dictate. Each graduate will have completed four full academic years of study as well as 12 full months of practical field experience in his speciality. It is proposed that the degree holders in mining engineering receive a provisional Second Class Mine Manager's Certificates on completion of the course by sitting only for the paper on Mine Legislation. At the end of one year of experience in the industry they will receive the regular certificate and be eligible to sit for the examination for First

Class Mine Manager's Certificate, which they will receive at the end of a second year of experience. In the degree course, the year is divided into three terms, two academic terms of 16 weeks each, and one practical training session of 13 weeks.

The Diploma in Mining course is designed to fulfil four purposes ; (1) to train mine surveyors, (2) to train sardars and overmen, (3) to train second class mine managers, and (4) to fulfil the entrance requirements of an engineering college and the College of Mines. At the end of the first eighteen months of the course the student will be given a Certificate in Mine Surveying and be eligible to sit for the Certificate of Proficiency in Mine Surveying examination given by the Chief Inspector of Mines. At the end of the second year the student will receive a Certificate in Mining and be eligible to sit for the Sardar's Certificate of Proficiency examination. At the end of the full three-years course the student will be granted a Diploma in Mining and after six months additional experience will be eligible to sit for the Second Class Mine Manager's Certificate of Proficiency examination; he will as well be eligible to sit for the Higher Secondary examination given by the Board of Secondary Education and thereby qualify for admission to university courses. Each year of the course is divided into two sessions, on practical and one academic, of approximately six months each. The course begins with a practical session designed to familiarize the student with mining terms, conditions, and problems before embarking on a course of study leading to a career in the mining industry. The second practical term qualifies the students as a mine surveyor and the third practical session offers further training in the practical aspects of mine operation and management as well as first aid and mine rescue work.

It should be pointed out that the diploma course is limited in scope to the level of second class mine manager only, whereas the degree course in mining engineering is meant to produce, after additional practical experience, first class managers and other top management executives.

The programme has been designed with maximum economy of time and money as a foremost consideration. The degree and diploma time tables for instance, insure year around use of buildings, laboratories, equipment, workshops, and the experimental mine where the students gain practical experience. No additional equipment or building space will be required by the diploma course. The only expense involved will be for scholarships and nine additional staff posts.

Admision requirements.

Admissions to both the degree and diploma courses will be based equally on three criteria ;

First, preference will be given on the basis of previous academic standing, in either B.Sc., or F.Sc., in the case of the degree course, and matriculation in the case of the diploma course.

Second, preference will be based on a competitive examination given by the College.

Third, preference will be based on a personal interview with an Admission Committee ; a pre-determined numerical bias will be given to dependents of mining personnel in awarding marks for the interview.

Admissions will be allotted to residents of the various areas of Pakistan on the basis of government rules current at the time of admission. Seats not filled from the areas as allotted will be filled from the remaining areas.

Scholarships will be awarded to the top fifteen students in each class each year on the basis of entrance or annual academic rating. In addition five scholarships will be reserved for the dependents of mining personnel, each class each year.

Internal Control.

Internal marks will be awarded by the instructor in each course at the completion of each term on the following basis :

$33\frac{1}{3}\%$—Sessional and class work, theory and practical.
$33\frac{1}{3}\%$—Periodic one-hour, sessional examination, along with shorter sessional examinations, if the instructor desires.
$33\frac{1}{3}\%$—Final three-hour term examination.

Grades will be awarded in each subject and transmitted to the College Registrar by each instructor at the termination of each term on the following basis :

A	90 to 100%
B	80 to 90%
C	70 to 80%
D	60 to 70%
F	less than 60%, failure

Grades points will be awarded for the above grades as follows :—

A—Three grade point per term hour (on one-hour lecture per week or one three-hour laboratory period per week).
B—Two grade points per term hour.
C—One grade point per term hour.
D—Zero grade points per term hour.
F—Minus one grade point per term hour.

The student must maintain an overall grade point average of 1.0 or better and clear all failures with a grade of D or better to be eligible to receive the College certificates and degrees and to be recommended for the external examinations.

Students completing the first eighteen months of the diploma, course will be awarded the Certificate in Mine Surveying on completing two years of the diploma course students will be awarded the Certificate in Mining; and on completing the full three-years course students will be awarded the Diploma in Mining.

Students completing the second year of the degree course will be awarded the Licentiate of the Pakistan College of Mines (L. P. C. M.). Students completing the full four-year degree course will be awarded the Associate of the Pakistan College of Mines (A.P.C.M.)

External Examinations.

Students holding the Certificate in Mine Surveying will be eligible to sit for the examination given by the Chief Inspector of Mines for the Certificate of Proficiency in Mine Surveying. Those holding the Certificate in Mining will be eligible to sit for the examination given for the Sardar's Certificate of Proficiency. After six months additional practical experience, holders of the Diploma in Mining will be eligible to sit for the examination given by the C. I. M. for the Second Class Mine Manager's Certificate of Proficiency. The full course for the Diploma in Mining is so designed that the student is eligible to sit for the Higher Secondry examination given by the Board of Secondary Education. Successful completion of this examination will qualify the student for entrance to the degree classes of the Pakistan College of Mines or to any engineering or university course.

In the degree course, University examinations will be held at the end of the second and fourth years to agree with present University practice. The first University examination, common for all degree students, will cover papers in English, Economics and Social studies, Mathematics, Physics, Chemistry, Geology and Biology, Surveying, Drawing, and workshops. Candidates successful in this examination will be awarded the degree of Bachelor of Science, Engineering Science. The final University examinations will be held for the following professional degrees :

1. Engineer of mines (EM)
2. Petroleum Engineer (Petr. E)
3. Geological Engineer (Geol. E)

4. Metallurgical Engineer (Met. E)
5. Metallurgical Engineer, Mineral Dressing Option, (Met. E. Min. Dress).

The proposal for awarding professional degrees is advanced to differentiate from the present B.Sc., Engineering, degrees based on three or four 24-weeks academic terms (a total of 72 to 96 weeks) with one year of undirected practical in lieu of the fourth term. The College of Mines syllabus demands eight 16-weeks academic terms (a total of 128 weeks) and one full year (52 weeks) of directed practical training under College supervision. Although the two examinations proposed coincide with the University B.Sc. and M.Sc. Examinations, it is not deemed advisable to offer an M.Sc. in the mineral sciences because such a degree would not be recognized by foreign universities. Professional degrees in the mineral sciences on the standards proposed are offered by many foreign universities and are recognized throughout the world.

Administration.

It is proposed that the College of Mines be established as an autonomous body under the Ministry of Industries, Government of Pakistan, and administered by a Board of Governors consisting of the following members :

1. Director General, Bureau of Mineral Resources ; Chairman of the Board.
2. Deputy Director General (Petroleum and Mineral Development), Bureau of Mineral Resources.
3. Deputy Director General (Geology Survey) Bureau of Mineral Resources.
4. Deputy Director General (College of Mines), Bureau of Mineral Resources ; Principal of the College and Secretary of the Board.
5. Representative of the Ministry of Education.
6. Representative of the Ministry of Finance.
7. Representative of the Universty of the Punjab.
8. Representative of the Mining Companies.
9. Representative of the Oil Companies.

The duties of the Board of Governors would include setting overall policy at the College and approving the annual budget for onward transmission to the Minister of Industries.

The chief administrative officer of the college is to be the Principal, assisted by six additional administrative officers. The Registrar will be the officer incharge of accounts and records ; the Dean of the College, a head of department appointed to the post, will be incharge of student and and staff matters and College discipline ; the College Engineer in charge of buildings, grounds and the College workshops ; the Director of Libraries in charge of College Library ; the Director of Publications in charge of College publications ; and the Director of Physical Training in charge of sports and sports facilities.

Staff.

The College Staff will consist of thirty-six gazetted members including the administrators mentioned above and one hundred supporting staff including demonstrators, clerks, laboratory attendants and the like.

The sanctioned posts will not be limited as to rank. The rank held by a senior staff member will be determined by the individual's level of professional attainment in teaching, research, publications, and consulting work, not by seniority or in competition with his fellow staff members. Appointments to the staff and promotions will be decided by a selection board appointed by the Board of Governors. The salient features of the proposed service conditions of the staff are given in Appendix II.

Appointments and promotions in the supporting staff will be decided by the head of the department concerned.

As usual in academic institutions, each senior staff member will be appointed on a nine-months academic year, altough his salary will be paid in twelve monthly instalments Vacation duty will be remunerated at the rate of the tenth of the annual salary per month of vacation employment. Administrative posts held in addition to normal teaching, research, and other duties will be paid at the rate of Rs. 250 per month during tenure of the administrative post. In the event that the Selection Board determines that a senior staff member's college duties prevent him from pursuing private practice available to him during his normal non-duty hours, a non-practicing allowance will be granted ; Rs. 250 per month for professors and Rs. 150 per month for assistant professors.

Building and Equipment.

Although detailed architectural planning has not been attempted it is advisable to design the eight main college buildings so that the construction is identical, with two stories of 40 × 200 ft. clear inside area surrounded by verandahs. Inside partitions should be readily movable to allow for changes in office space, storage space, lecture rooms.

and laboratories. Such flexibility can be provided by arranging service facilities (water, electricity, sewrage, etc.) in alternate structural columns. The buildings should be arranged in a quadrangle surrounding the central administrative building housing the library, museum, and theatre. At one side of the quadrangle workshops will be coustructed, with the pilot mill building at the opposite side. The housing area should flank both sides of the main entrance road leading to the College proper, with the sports area and playing fields at the rear of the College.

Proposed Location.

The ideal location for a college of mines would be in an area that is in the close proximity of engineering and metallurgical works, mines of coal, metals, and industrial minerals, oil fields, oil refineries, natural gas fields, and areas of geologic and topographic variety and interest. The location should be as will be relatively near a marketing area to supply the community involved. Transportation communication facilities by road, rail, and air should be such that all parts of the area to be served (in this case Pakistan) can be reached readily. Clement weather, of course, is an advantage.

In West Pakistan the only area meeting all of these demands is the Rawalpindi District. Nearby producing oil fields, an oil refinery, gas fields, Wah Ordnance Factory, Wah Cement, Dalmia Cement, Maple Leaf Cement, Major Coal Mines at Khewra, Khushab, and Makerwal, as well as countless smaller coal mines, Salt Mines at Khewra, Iron Ore Mines at Kalabagh, lead deposits in Swat, and many other known mineral deposits particulary in the nearby Hazara District. All of these are less than 150 miles from Rawalpindi and could easily be visited by a student group over weekend and many could be visited in an afternoon laboratory period.

Experimertal Mine.

Because directed practical training is an essential part of the proposed college of mines, it will be necessary to have a well-equipped coal mine directly under the control of the college. The practical training programme of the degree and diploma students is so designed that the mine can operate throughout the year on student labour, with two six-weeks periods available for sardar and overmen refresher training programs. Other than management, a minimum of surface workers would be necessary for maintenance, repairs, and services. The cost of the training program would be debited against mine income. The mine is to operate on a commercial basis, with profits re-invested on equipment and capital improvements.

With the main college in the Rawalpindi District, it would seem feasible to establish the training mine within easy travel distance ; for

instance, in the Khushab area a number of mines are now operating and an extensive coal seam is known to exist.

Conclusion.

Nothing in this proposal for a Pakistan College of Mines is markedly original. Many things from many schools in many countries have been freely borrowed. The internal degrees, for instance, are similar to those of the Royal School of Mines,London. The professional degrees will be reeognized by those familiar with Colorado School of Mines. The practical training programmes are in many ways similiar to the work done at the Cambourne School of Mines. Nearly all colleges offering mineral sciences emphasize program in research and extension ; Montana School of Mines, for instance, includes as an integral part the Montana Bureau of Mines. The internal control system is standard in any accredited American University and the external examination is common throughout the world in one form or another ; in the United States an external examination is required for the professional engineer's license. The certificates and diplomas offered are closely allied with those offered by the Swedish Training Institute in Karachi and the proposed Polytechnics in Pakistan. The intermediate science and the bachelor degree are based, of course, on present syllabi of the Board of Secondary Education and the University of the Panjab. The certificates of proficiency in mining are required by the mining laws of Pakistan.

However it may appear, the proposal should not be considered of a hastily mixed hodge-podge of ideas. It is the result of a sincere attempt to answer the needs of mineral science technology in Pakistan based solely on the conditions, laws, and opportunities in Pakistan.

APPENDIX I
Letter from Dean Spielman

Memorandum

To Dr. M.T. Buchanan, Campus Co-ordinator, Pakistan Project.

Form J. F. Spielman Dean of the School of Mines and College of Engineering, Washington State University, Pullman, Washington, U. S. A.

Subject :—

Report on Mining Engineering.

Thanks very much for the copy of your letter of September 28 to Stan Swenson relative to Bob Burn's report of a conference on Aug. 17, 1959 on mining education and the minutes of the conference which were attatched thereto. I have read these reports several times and find them most interesting.

After thinking this matter over for several days I am of the opinion that an independent School of Mines might be a good thing for Pakistan at this time. Such an institution might, if properly conceived and adequately financed, be a tremendous stimulant to the development of mineral industries in the country. This certainly is true in the initial development of the mineral industries in our own country. There are, however, several dangers in the establishment of such an institution which should be borne in mind. These are :—

(1) If such venture is to make the contribution to the mineral industries which one should rightfully except it should be the local point of all major services to the mineral industries. This should include all Government assistance in teaching, research and extension.

(2) Adequate departments of minerology, structural and economic geology, together with appropriate financing for work in these areas should be an integral part of the institution. A study of independent schools of mines will show that no successful venture appears where these departments have not been integrated with the institution. Actually these subjects bear the same relationship to mining engineering that anatomy and medicine bear to training for the medical profession.

(3) While such an institution could and perhaps should offer training in the engineering science with a "mining bias", great care should be exercised to avoid over emphasis to this bias. Actually a mining engineer should have have a very sound and broad training in the engineering sicences but not biased so strongly towards mining engineeringas to endanger a realization of the broad application involved.

(4) While it is realized that the Government of Pakistan might obtain assistance through I. C. A. or the Colombo Plan for the establishment of such an institution it still will not be a cheap venture. The education of a mining engineer is expensive as compared to training for many other professions. This fact must be accepted initially and adequate financing to do a real job should be planned in advance. The job should either be done exceedingly well or it should not be attempted at all.

I am sure you realize this is a subject which I could discuss hours on end. There certainly is not any point in doing this at the present time. I hope these comments are of some use to you and that you will let me know if I can help further on this interesting suggestion,

APPENDIX II

STAFF

Service Conditions.

When considering pay scales of the teaching staff at the Pakistan College of Mines it may be appropriate to assess the staff problems of the existing engineering colleges in the country. These problems can be classified as :

(1) difficulty of recruitment.
(2) difficulty in retaining superior staff.

Difficulty of Recruitment.

During the last ten years the Public Service Commissions have tried repeatedly to recruit staff for the various engineering institutions in the country but have failed in their efforts to secure the necessary number of qualified teachers. Recruitment from foreign countries, too, has failed.

The teaching posts in most engineering colleges in Pakistan are unattractive for the following reasons :

(1) Engineers with superior or advanced degrees are few in Pakistan. The small number available are rapidly absorbed in private companies and in semi-government organizations like P.I.D.C. These firms and organizations pay higher salaries, and offer rapid advancement based on ability and incentive.

(2) The second choice of employment for engineers is government service where administrative posts are available and advancement is assured. In P. W. D., an assistant executive, engineer is certain to become executive engineer after five years service and is almost certain to become a superintending engineer before retirement, and without acquiring further academic qualifications. Existing sanctioned staff in engineering colleges is limited both by number and by rank. Only one in three lectures can hold any hope of becoming an assistant professor, and only one in twelve has any opportunity

of reaching professor's rank. Also the qualifications are far more exacting for appointment to the engineering colleges than to government engineering services.

In short, the attractiveness of an engineering post is based on (1) pay, (2) advancement, (3) opportunity for original and independent work and work of a varied and interesting nature. An engineer attracted by this third factor is, of course, preferred by an engineering college. Most engineering colleges at present offer no opportunity for independent research nor is an opportunity for consultation or employment in industry provided. The duties of the staff member are confined solely to repetitive teaching and administrative duties.

Difficulty in Retaining Superier Staff.

Many of the factors listed above, of course, also prevent existing colleges from retaining superior staff once they have been recruited. Staff members leave the college service for two basic reasons. First of importance is the lack of opportunity for advancement. When the limited number of higher posts have been filled, the lecturers who are qualified for advancement leave the service. Second, the stultifying duties of constant repetitive lecturing and laboratory instruction are not satisfying to the superior intellect. The turnover in teaching staff that these factors cause is, itself a further cause for turnover. When staff members leave the service, their work must be taken by the remaining staff as an additional work load, causing further dissatisfaction and more departures.

Suggested Service Conditions.

To insure the attractiveness of the staff posts at the College of Mines, the following service conditions are suggested :—

(1) The staff member's time will be divided equally among (*a*) teaching duties, (*b*) research problems of a practical and applied nature, and (*c*) consulting work in industry and government.

(2) Posts will be sanctioned by rank but by professional competence only. Every advancement will be based only in the individual staff member's professional attainment. For instance, the rank of the staff member holding the post of mineralogist will be based on the qualifications, experience, and professional competence of the staff member concerned, regardless of the rank of the other members of the Geology Department.

(3) Pay scales will be competitive to other posts available to an equally qualified man. The following consolidated pay scales, based on present practice in P. I. D. C. are suggested :

Lecturer	...	500-40-1000 plus free housing or 10% of pay in lieu thereof.
Assistant Professor	...	1000-50-1200/75 1500 plus free housing or 10% of pay in lieu thereof.
Professor	...	1500-75-2000 plus free house or 10% of pay in lieu thereof.
Principal	...	2500 fixed, plus free housing or 10% of pay in lieu thereof.

In lieu of provision for pension, a provident fund should be provided wherein the staff member contributes 10% of basic pay, matched by the College.

In addition, a staff member should receive one-ninth of his basic annual salary for each month of vacation work demanded by the college. In the event college duties prevent a senior staff member from accepting consulting work otherwise available to him, a non-practicing allowance of Rs. 250/- per month for a professor and Rs. 150/- per month for an Assistant Professor should be allowed.

Staff members holding administrative posts in addition to their other duties should be allowed an additional payment equivalent to the non-practising allowance.