

much to teach. Medicine is going forward so fast.

Let us broaden our conception of medical education by broadening our conception of education itself. Education is primarily the bringing out of something from within, not the forcing of something in from without. It is the discovery of the individual to himself. It is a process of training, not a process of fattening.

If these conceptions of education gain possession of us, we shall approach our teaching and our curriculum making in a corresponding spirit, and some at least of the difficulties and disappointments of our labor will disappear.

E. P. LYON

MEDICAL SCHOOL OF THE  
UNIVERSITY OF MINNESOTA

#### INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE<sup>1</sup>

SINCE January, 1912, I have made no report to this journal on the progress in the system of industrial fellowships initiated by me at the University of Kansas and since transferred to the University of Pittsburgh.

The working of these fellowships began September 1, 1911, on the university campus at Pittsburgh and in the temporary building erected at a cost of about \$10,000. In March, 1913, Mr. Andrew William Mellon and Mr. Richard Beatty Mellon, brothers and citizens of Pittsburgh, impressed by the evident practical value of this system both to learning and to industry, established it on a permanent basis through the gift of over half a million dollars and consented to allow their family name to be placed upon it as the "Mellon Institute of Industrial Research and School of Specific Industries of the University of Pittsburgh." While working in affiliation with the university and in close sympathetic accord with it, the institute is possessed of its own funds and is under its own management.

<sup>1</sup> This article was written by Dr. Duncan shortly before his death.

The gift of the Messrs. Mellon has been divided for expenditure as follows:

#### FOR IMMEDIATE EXPENDITURE:

Permanent building . . . . .	\$250,000
Apparatus . . . . .	60,000
Library . . . . .	20,000

#### FOR YEARLY MAINTENANCE FOR FIVE YEARS:

\$40,000 per year.

Since September, 1911, the following Fellowships have been established and in operation:

#### 1. BAKING:<sup>2</sup>

\$750 a year for 2 years.

Bonus, maximum cash: \$2,000.

Fellow:

Wilber A. Hobbs, B.S. (University of Kansas).  
(Accepted November 30, 1910.)

#### 2. ABATEMENT OF SMOKE NUISANCE:

\$12,000 1st year; \$15,000 2d year; \$12,000 3d year.  
Fellows:

#### *Staff in Charge*

- R. C. Benner, Ph.D. (University of Wisconsin), chief fellow first and second years.
- J. J. O'Connor, Jr., A.B. (University of Pittsburgh), economist and chief fellow third year.
- W. W. Strong, Ph.D. (Johns Hopkins), physicist.
- A. F. Nesbit, B.S. (Massachusetts Institute of Technology), electrical engineer.
- J. A. Beck, LL.B. (University of Pittsburgh), attorney.
- E. H. McClelland, Ph.B. (Lafayette), bibliographer.
- O. R. McBride, B.S. (Purdue University), engineer.
- J. E. W. Wallin, Ph.D. (Yale University), psychologist.
- H. H. Kimball, Ph.D. (George Washington University), meteorologist.
- A. B. Bellows, B.S. (Massachusetts Institute of Technology), engineer.
- J. F. Clevenger, M.S. (Ohio State University), botanist.
- C. H. Marey, bacteriologist.

#### *Advisory Staff*

Oskar Klotz, M.D., C.M. (McGill University), senior fellow.

<sup>2</sup> \* means that the fellowship has expired.

E. W. Day, A.M., M.D. (Georgetown).  
 W. C. White, M.D. (Toronto).  
 R. T. Miller, Jr., M.D. (Johns Hopkins).  
 W. W. Blair, M.D. (Hahnemann).  
 B. A. Cohoe, A.B., M.D. (Toronto).  
 S. R. Haythorn, M.D. (Michigan).  
 W. L. Holman, M.D. (McGill).  
 E. B. Lee, architect, senior fellow.  
 Richard Hooker, B.S., architect.  
 C. T. Ingham, architect.  
 Richard Kiehnel, architect.  
 Carlton Strong, architect.  
 K. K. Stevens, B.S., architect.

(November 30, 1910; revised June 24, 1911.)

3. ON THE RELATION OF THE POTS TO GLASS IN  
 GLASS-MAKING AND THE ELIMINATION  
 OF "STREA":\*

\$1,500 a year for 2 years.

Bonus: \$2,500.

Fellow:

Samuel R. Scholes, Ph.D. (Yale University).  
 (January 25, 1911.)

4. BAKING:\*

(Wholly independent of but with acquiescence  
 of No. 1.)

\$4,750 a year for 2 years.

Bonus, cash: \$10,000.

Fellows:

Henry A. Kohman, Ph.D. (University of Kansas), senior fellow.  
 Charles Hoffman, Ph.D. (Yale University).  
 Alfred E. Blake, A.B. (New Hampshire College).  
 (January 25, 1911.)

5. GLUE:

\$1,200 a year for 2 years.

Fellow:

Ralph C. Shuey, B.S. (University of Kansas).  
 (February 3, 1911.)

6. SOAP:

\$1,200 a year for 2 years.

Fellow:

Paul R. Parmelee, B.S. (University of Kansas).  
 (February 3, 1911.)

7. UTILIZATION OF FRUIT WASTE:\*

\$1,000 a year for 2 years.

Bonus: \$10,000.

Fellow:

F. Alexander McDermott (George Washington University).  
 (May 12, 1911.)

8. COMPOSITION FLOORING:\*

\$1,500 a year for 2 years.

Bonus: 1 per cent. of sales for 5 years.

Fellow:

R. Rex Shively, B.S. (Oklahoma A. and M. College).  
 (August 15, 1911.)

9. CRUDE PETROLEUM:

\$10,000 first year; \$10,000 second year; \$10,000 third year, including apparatus fund.

Bonus: Collective interest 10 per cent.

Fellows:

Benjamin T. Brooks, Ph.D. (University of Göttingen), senior fellow.  
 Clinton W. Clark, M.A. (Ohio State University).  
 Lester Pratt, M.S. (New Hampshire College).  
 Hugh Clark, M.A. (Ohio State University).  
 Arthur H. Myer, A.M. (Leland Stanford Jr. University).  
 Frederick Padgett, B.S. (University of Pittsburgh).  
 F. W. Bushong, Sc.D. (Emporia College).  
 I. W. Humphrey, B.S. (University of Kansas).  
 George W. Stratton, Ph.D. (Ohio State University).  
 (September 22, 1911.)

10. NATURAL GAS:

\$4,000 first year; \$4,000 second year; \$6,000 third year, including apparatus fund.

Bonus: 5 per cent. industrial results.

Fellows:

R. H. Brownlee, Ph.D. (University of Chicago), senior fellow.  
 Roy H. Uhlinger, M.A. (University of Pittsburgh).  
 (September 22, 1911.)

11. CEMENT:\*

\$1,800 a year for 2 years.

Bonus: \$10,000.

Fellow:

J. F. MacKey, Ph.D. (University of Toronto).  
 (September 22, 1911.)

12. FOODS, PROBLEMS RELATED TO THE MANUFACTURE OF:

\$5,000 a year for 2 years.

Bonus: \$10,000.

## Fellows:

Clarence C. Vogt, Ph.D. (Ohio State University),  
senior fellow.

Harry P. Corliss, Ph.D. (University of Pittsburgh).

Mrs. Lou H. M. Vogt, Ph.D. (Ohio State University).  
(May 20, 1912.)

## 13. FATS AND OILS, BLEACHING OF:

\$1,500 a year for 2 years + \$300 apparatus fund.

## Fellow:

Leonard M. Liddle, Ph.D. (Yale University).  
(May 22, 1912.)

14. EFFECT OF HIGH POTENTIAL ELECTRICITY ON  
CHEMICAL REACTION:

\$1,000 a year for 2 years + \$300 apparatus fund.  
Additional consideration.

## Fellow:

W. E. Vawter, B.S. (University of Kansas).  
(October 28, 1912.)

15. DISCOVERY OF METHODS OF COATING STEEL OR  
OTHER METALS WITH COPPER OR

## OTHER METALS:

\$1,500 a year for 1 year + \$500 apparatus fund;  
3 months' extension.  
Bonus: \$10,000.

## Fellow:

C. L. Perkins, B.S. (New Hampshire College).  
(December 4, 1912.)

16. EXTRACTION OF COPPER FROM ITS ORES AND  
FROM COPPER "TAILINGS":\*

\$1,500 a year for 1 year.

## Teaching Fellow:

Howard D. Clayton, B.A. (Ohio State University).  
(December 1, 1912.)

## 17. DESERT PLANT AND ADDITIONAL PROBLEM:

\$1,500 a year for 1 year + \$300 apparatus fund.  
Bonus: 7 per cent. interest industrial results.

## Fellows:

R. R. Shively, Ph.D. (University of Pittsburgh).  
Alfred E. Blake, M.S. (University of Pittsburgh).  
(January 31, 1913.)

## 18. BAKING:

\$6,000 a year for 2 years + \$500 apparatus fund.  
Bonus: \$10,000.

## Fellows:

Henry A. Kohman, Ph.D. (University of Kansas), senior fellow.

Charles Hoffman, Ph.D. (Yale University).

Trueman M. Godfrey, B.S. (University of Kansas).

(May 12, 1913.)

## 19. ALUMINUM:

\$5,000 a year for 2 years, including apparatus fund.  
Bonus: \$10,000.

## Fellows:

Hugh Clark, Ph.D. (University of Pittsburgh).

Lester A. Pratt, Ph.D. (University of Pittsburgh).

(May 12, 1913.)

## 20. GLUE:

\$1,500 a year for 2 years + \$300 apparatus fund.  
Fellow:

Ralph C. Shuey, B.S. (University of Kansas).  
(May 12, 1913.)

## 21. SOAP:

\$1,500 a year for 2 years + \$300 apparatus fund.  
Fellow:

Ben H. Nicolet, Ph.D. (Yale University).  
(May 12, 1913.)

## 22. GLASS:

\$1,500 a year for 2 years + \$300 apparatus fund.  
Bonus: \$3,500.

## Fellow:

R. R. Shively, Ph.D. (University of Pittsburgh).  
(July 14, 1913.)

23. RELATION OF ELECTRICAL POTENTIAL TO CATA-  
LYTIC ACTION:

\$1,500 a year for 2 years + \$300 apparatus fund.  
Bonus: 5 per cent. industrial results.

## Fellow:

Frank F. Rupert, Ph.D. (Massachusetts Institute of Technology).  
(July 14, 1913.)

24. EXTRACTION OF COPPER FROM ITS ORES AND  
FROM COPPER "TAILINGS":

\$1,500 a year for 1 year + \$300 apparatus fund.  
Fellow:

Charles O. Brown, M.A. (Cornell University).  
(July 14, 1913.)

## 25. YEAST:

\$5,200 a year for 2 years, including apparatus fund.  
Bonus: \$10,000.

## Fellows:

F. Alex. McDermott, B.S. (University of Pittsburgh), senior fellow.

William Smith, Scholar (University of Pittsburgh).

Ruth Glasgow, M.S. (University of Illinois),  
bacteriologist.

James C. Cuthbert, Scholar (University of Pitts-  
burgh).

(July 14, 1913.)

#### 26. HARDENING OF FATS:

\$1,000 a year for 1 year + \$300 apparatus fund.

Bonus: 49 per cent. interest.

Fellow:

E. O. Rhodes, B.S. (University of Kansas).

(September 19, 1913.)

#### 27. LEATHER SCRAP:

\$1,000 a year for 1 year + \$200 apparatus fund.

Bonus: 10 per cent. interest.

Fellow:

R. Phillips Rose, M.S. (University of Ohio).

(October 22, 1913.)

#### 28. FERTILIZER:

\$2,500 a year for 2 years, including apparatus fund.

Bonus: \$5,000.

Fellow:

Earl S. Bishop, D.Sc. (Queen's University, On-  
tario, Canada).

(November 1, 1913.)

#### 29. COPPER:

\$6,000 a year for 1 year, including apparatus fund.

Fellows:

F. R. Weidlein, A.M. (University of Kansas),  
senior.

H. D. Clayton, B.S. (Ohio State University).

G. A. Bragg, B.S. (University of Kansas).

(November 6, 1913.)

#### 30. RADIATORS:

\$2,000 a year for 2 years, including apparatus fund.

Bonus: \$5,000.

Fellow:

J. C. Ballantyne, B.Sc. (University College, Lon-  
don).

(November 18, 1913.)

#### 31. TURBINE ENGINES:

\$1,800 a year for 1 year, including apparatus fund.

Bonus: \$3,000.

Fellow: (not yet appointed).

(January 5, 1914.)

#### 32. GLASS:

\$1,800 a year for 1 year, including apparatus fund.

Bonus: 25 per cent. interest.

Fellow: (not yet appointed).

(January 5, 1914.)

The total amount of money so far handed in by industrialists for expenditure in the little building mentioned above is \$183,800. The total fellowship list now runs at the rate of \$97,400 per year.

About the results of these fellowships, this much at this time may be stated:

1. Received a bonus of \$1,000.

2. On the basis of the experimental and investi-  
gative work accomplished has been extended  
through a third year.

3. On the termination of this fellowship the  
holder went over to the company at a salary of  
\$2,500 per year.

4. The bonus of \$10,000 has been acknowledged  
by the company and the first installment paid.  
The company then asked for a second fellowship  
at an increased rate and with a second bonus of  
\$10,000, which appears in this list as No. 18.

5. In recognition of the work of this fellowship  
the company on its expiration established a second  
fellowship at an increased rate, which appears in  
this list as No. 20.

6. On the termination of this fellowship, the  
fellow went over personally into his company with  
his process and in recognition of its success the  
company then established a second fellowship on  
the same subject at an increased rate, which ap-  
pears in this list as No. 21.

7. On the conclusion of this fellowship, in lieu  
of the bonus, under certain conditions the pro-  
prietary rights in his process were conferred upon  
the fellow.

8. While this fellowship was successful, from  
the standpoint of the results of the investigation,  
it was a failure owing to changing circumstances  
in the specific example of the industry concerned.

9. This large and important fellowship, which  
had a tenure of two years, has been extended  
through a third year on the basis of the results  
accomplished. These results are of prime impor-  
tance to the petroleum industry.

10. This fellowship, established for two years at  
\$4,000 a year, has been extended through a third  
year for the sum of \$6,000, the salary stipend of  
the senior fellow being raised from \$2,500 a year  
to \$4,000 a year.

11. This fellowship was a failure, owing in large  
measure to a lack of willingness on the part of  
the company concerned to cooperate with the ad-  
ministration and the fellow.

12. This fellowship is now in operation and it is  
believed that it will have a successful termination.

13. There is no question about the very success-

ful operation of this fellowship and of its ultimate results.

14. This fellowship has already yielded the essentials of an important industrial process. It has a very large importance to the institute, owing to the fact that the donor has made over all results to the institute to be used for the establishment of further researches by the institute.

15. The laboratory investigation of this subject has been completed and its large-scale working is now being arranged for. Pending the completion of the large-scale operation, the fellowship has been extended.

16. This investigation has proved so important that it has been extended through the addition of another fellowship, No. 24, at \$1,500 a year, and, subsequently, of still another, No. 29, at \$6,000 a year.

17. The original object of this fellowship proved impossible of an industrial solution, owing to the fact that investigation of the plant concerned showed that it contained nothing of potential industrial value. The object of the investigation was thereupon changed and the ultimate results are not yet determinable.

18. Was established by the same company on the basis of the success of No. 4. While it has been in operation only since September, it already unquestionably deserves its bonus.

19. A fellowship yielding results of prime importance.

20. Was established on the basis of the success of No. 5.

21. Was established on the basis of the success of No. 6.

22. Is already unquestionably successful.

23. A most interesting fellowship on a most interesting subject. This research is remarkable in that the donor desires that the institute should receive for its own purposes 70 per cent. of the results.

24. Established in correlation with No. 16. It is already yielding promising results.

25. A strong fellowship in operation only since September.

26. This fellowship was transferred from the University of Kansas. It has already yielded an important industrial process.

27. It is impossible to forecast the end of this fellowship.

28. Begins operation on January 5, 1914.

29. Was established in cooperation with fellowships No. 24 and No. 16. The results of this fel-

lowship would probably justify the total expenses of the whole fellowship system.

30. Went into operation a month ago.

31. Has been accepted but is not yet signed.

32. Has been accepted but is not yet signed.

In the spring of 1912 owing to ill health, the result of too much responsibility, arrangements were made to give me an associate director, Dr. Raymond F. Bacon, who came to me from the Bureau of Chemistry at Washington. Dr. Bacon's scientific prescience, his suggestive power in research, together with his sympathetic understanding of the traditions of the work and his personal loyalty have made him an ideal associate. Since the spring of 1913, he has been aided in his work of supervision through the appointment of Dr. E. Ward Tillotson as assistant director. Dr. Tillotson has already established the success of several fellowships through his personal supervision.

The administration of the institute consists at present of the director, with the associate director and assistant director. Their work of direction and supervision is greatly lightened by the senior fellows. It should be pointed out that the fellowships of the institute consist of two kinds, individual and multiple fellowships. An individual fellowship utilizes the services of one man, directly responsible to the administration; a multiple fellowship, the intensive services of several men under the direction of a senior fellow who in turn is directly responsible and under the administration. There are seven senior fellows in the institute. The adequate supervision of the thirty-nine fellows at present in the institute is in this way entirely practicable and explains the results obtained.

The \$97,400 per year at present being expended by this institute in the various researches in operation have been handed in to the institute by various companies in accordance with a definite agreement between each company concerned and the institute.

As this whole system of research is locked up in or depends upon these agreements, their importance warrants my insertion at this point of an agreement which is deemed by us at this time as representative of a reasonable arrangement. The one I submit is that of a multiple fellowship in blank.

#### COMPANY'S MULTIPLE FELLOWSHIP AGREEMENT

(Fellowship No. XXIX.)

THIS AGREEMENT made and entered into this \_\_\_\_\_ day of \_\_\_\_\_ 1913, between the

Mellon Institute of the University of Pittsburgh, of the City of Pittsburgh, Pennsylvania, hereinafter called the "Institute" and the \_\_\_\_\_, of \_\_\_\_\_, \_\_\_\_\_ hereinafter called the "Company,"

WITNESSETH: that for the purpose of promoting the increase of useful knowledge, the parties hereto agree as follows:

1. The Company shall pay to the Institute annually in advance for a period of \_\_\_\_\_ years, beginning \_\_\_\_\_, 1913, the sum of \_\_\_\_\_ dollars ( \_\_\_\_\_ ) for the foundation of a Multiple Industrial Fellowship to be known as \_\_\_\_\_, the exclusive purpose of which is \_\_\_\_\_

2. The Institute shall accept the sums so to be furnished by the Company and shall devote them to the furtherance of the problems of this Fellowship; and to this end all money received from the Company under this Agreement shall be paid over by the Institute in monthly installments to the holders of this Fellowship in such amounts as may be agreed upon by the Institute and the Fellows concerned, or expended for such apparatus and supplies related to this research as the Director of the Institute may deem it advisable to purchase and for traveling expenses related to the elucidation of the problems concerned. The Fellows shall be provided, at the expense of the Institute, with a separate laboratory and with such apparatus, supplies and reagents as in the opinion of the Director constitute a reasonable provision. The Company, on its part, shall cooperate with the Institute in this research by providing the Director thereof and the Fellows of this Fellowship with its sympathy and with whatever knowledge of the subjects of research it may possess, and, on approval of the Company, with its factory facilities for large-scale experimentation.

3. The holders of the Fellowships provided hereunder shall be appointed by the Committee of Management of the Institute upon the nomination of the Director in accordance with the terms of their formal letters of application to and as approved by the Director, and they shall give their whole time and attention to the object of the Fellowship, with the exception, if the Director so elect, of three hours a week which each shall give to instructional work in the University of Pittsburgh. The Fellows shall work under the advice and direction of the Director and shall from time to time through the Director for-

ward to the Company reports of the progress of their work. During the existence of the Fellowships provided hereunder the Company shall have the right, through and with the acquiescence of the Director, to employ and take into its regular service any or all of the Fellows of this Fellowship, upon terms to be agreed upon between the Fellow or Fellows and the Company, and the Institute shall appoint a successor to the Fellowship vacated by reason of the regular employment of one or more of the Fellows by the Company, provided the condition of the research work shall in the opinion of the Director make necessary or advisable the appointment of such successor.

4. The Institute, at the expiration of the Fellowship, shall return to the Company any money paid to it by the Fellow, in case any thereof shall remain unexpended for the purpose of this Fellowship.

5. Any and all discoveries made by the Fellows, or any of them, during the term of this Fellowship as well as all information obtained by them germane to the subjects of their investigation shall become the property of the Company, subject to the terms and provisions of this Agreement, and any Fellow making such discovery or obtaining such information shall promptly and without demand make revelations of all such information and discoveries. Such revelations shall be made to the duly designated representatives of the Company directly, or through the Director, as the Director may determine.

6. Any Fellow or Fellows making a discovery or invention germane to the subject of their investigation shall, at any time, at the option and expense of the Company, apply for letters patent, and shall upon demand assign such letters patent and any and all right to such invention to the Company under the conditions of this Agreement. In case the Company desires to keep secret such discovery or invention, or for any reason desires that letters patent shall not be applied for, the Fellow or Fellows shall not at any time apply for patent or patents in their own name, and shall not disclose such discovery or invention to others except as herein provided.

7. The Company shall, in addition to the sums paid to the Institute as foundation for the Fellowships, pay to the Fellows collectively a maximum cash bonus of \_\_\_\_\_ dollars ( \_\_\_\_\_ ) or any part thereof which in the opinion of the Board of Arbitration (hereinafter provided for) is deserved by the Fellows of this Fellowship, and the amount of this payment and the

time or times of payment shall be decided by the Board of Arbitration upon application of either of the parties hereto. The relative distribution of the bonus to the individual Fellows concerned shall be wholly within the power of the Director to decide and determine.

8. In the event of any difference of opinion between the parties hereto as to the interpretation of this Agreement, or the rights of the respective parties to this Agreement, the matters in issue shall be referred to a Board of Arbitration, which Board shall consist of a representative of the Institute and a representative of the Company, and a third person whom these two shall select. The decision of this Board shall be obtained without recourse to the courts and when rendered shall be binding upon the parties hereto.

9. During the term of this Fellowship, the holders thereof may publish such results of their investigations as do not, in the opinion of the Company, injure its interests. On or before \_\_\_\_\_, 19—, the holders thereof shall complete a comprehensive monograph on the subject of their researches. The subject matter of such monograph shall not contain specific information of the process or methods of the Company but it shall be confined to a statement of new discoveries of scientific fact obtained by this Fellowship and such statement shall not contain data or information in regard to the cost of manufacture by any process revealed in such statement. A copy of this monograph shall be forwarded to the Company and a copy shall be signed and placed in the archives of the Institute until the expiration of three years from the time hereinafter provided for the termination of this Fellowship, when the Institute shall be at liberty to publish it for the use and benefit of the public.

In the event that in the opinion of the Company such publication at such time will unduly injure its interests, it shall have the privilege of appealing at any time for an extension of time of such publication to the Board of Arbitration provided for herein, which, after considering the appeal, shall, if in its opinion such publication will unduly injure the Company's interests, extend the time of publication to a time when in the Board's opinion publication will not unduly injure the interests of the Company.

10. The Fellowships provided under this Agreement shall terminate the \_\_\_\_\_ day of \_\_\_\_\_, 191—.

IN WITNESS WHEREOF, the parties hereto have

caused their names to be subscribed the day and year first above mentioned by their duly authorized officers.

Witness: MELLON INSTITUTE OF UNIVERSITY  
OF PITTSBURGH

\_\_\_\_\_ By \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_

The permanent building which will be in occupation by the institute by next September is splendidly fitted to correspond with its needs. In order that the institute may not grow too large for maximum efficiency in its different researches and for the maintenance of its fraternal spirit it has been determined to limit its members to seventy fellows. As the present number of fellows is thirty-seven, this will necessitate a considerable increase in the directional and supervisional permanent staff. Perhaps I may be permitted to say here that I am eagerly on the watch tower for men possessed of the rare qualities requisite for such positions.

The Graduate School of Specific Industries which will be connected with the Institute on the completion of its building, I shall make the subject of a future statement.

Finally it may be said, on the basis of the two years intervening since my last statement to this journal, that this system of cooperation between industry and learning, between the factory and the university, has positively passed the tentative and experimental stage and that it now stands as a valuable and permanent relation to both. Any anxieties I may have are not now connected with this example of the system, but with my desire that it should be extended into other educational institutions. We believe that this can be accomplished by handing over to the universities for this service some of our own men inducted into a full knowledge of the working of this system through years of connection with it.

ROBERT KENNEDY DUNCAN