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Some Details as to Tolles' 1-75th Objective.

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EXPLANATORY.—So far as these items, which are furnished by request for this JOURNAL, touch others, it is pleasant to give them. Egoisms have small place in science, to be given only when they cannot be avoided. This paper is to be taken as a compliance with requests from such a source that not to heed them would show ill grace. The one-seventy-fifth microscope objective was made for a certain work. It did that work. Indeed it did more. It put American artizanship as worthy of a place among foreign artizans, the latter being voluntarily witnesses.

DETAILS.

1. The one-seventy-fifth was ordered for this purpose: In 1869, Geo. B. Harriman, D. D. S., of Boston, discovered a simple novel mode of dissecting teeth, which was to turn them on a lathe as iron is turned. Thus he succeeded in demonstrating the nerve axis cylinder of dentine. Though toothache means nerves in dentine, Dr. Harriman's statement was denied. To confirm his discovery Dr. H. ordered Robert B. Tolles, in 1870, to make this objective—giving him carte blanche

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as to price and time. Mr. Tolles, loath to undertake the order, was overpersuaded, and in three years, June 2d, 1873, handed it over to Dr. Harriman. Mr. Tolles told the writer that he would never make another because of the difficulties, and that only persistent pushing and urging brought forth the one-seventy-fifth. Dr. Harriman avers that the one-seventy-fifth did demonstrate and confirm the presence of axis nerve cylinders in dentine and thus realized its aim. So far as the writer knows, it sustains the claim of Dr. Harriman as the discoverer of nerve fibers in dentine in 1869.

2. Boston, October 2, 1894. *To whom it may concern:* This certifies that I, George B. Harriman of my own accord ordered the late Robert B. Tolles to make me a one-seventy-fifth inch objective in the year 1870; that I paid \$400 therefor, and I have his receipt; that I ordered it because I wished to verify my discovery of the axis nerve cylinder of the nerves of dentine by using a new mode of sections of dentine as iron is turned in a lathe; that the one-seventy-fifth inch objective did verify the presence of dentinal nerve tissue fiber; and that this objective did all I expected it to do and more.

*Signed,* GEORGE B. HARRIMAN.

Dr. A. C. Stokes has characterized this objective in his late book thus: "Nothing more miserable can be conceived." This being so, then the realization of one's expectations has been generally misunderstood and the English language must be rewritten to suit this new definition of our friend, who wrote as he felt, honestly no doubt, but who will find it hard to change the dictionaries to meet his new definition.

3. Mr. John Green, of East Boston, Mr. Tolles' first assistant, has allowed the use of the following, Tolles' autographic memorandum of the one-seventy-fifth as follows:

		Tk.	Mid.	.0235	Tk.
Bk.	.0260	.008	(.028)	.0235	.0085
	.0215		Ap.	.0235	
.028	.0215			.280 ex	H. F.
Ap.	.43 ex	.002			
		H. H. D.			
Front		Tk.		Delivered July 2, 1873	
		.0065			
		H. F.		Angular Aperture, 178°	

4. R. B. Tolles' memorandum, July 2, 1873: "Examined *Navicula angulatum* with sun-light and 2-inch ocular, a perfect picture, clear of all obstructions. Nothing intercepted the view." Observers: "Self and John Green. Afterwards exhibited same to Dr. Harriman and Mr. Wells. Sun clouded over, but a very fine show."

5. What the one-seventy-fifth did for the writer. The acquaintance of Dr. Harriman having been made, he kindly allowed the free use of himself and his one-seventy-fifth inch objective, and it was resolved to try to photograph the appearances of human blood in tuberculosis for the first time in the world. A large practice was relinquished and a residence taken up in Cambridge, Mass., on the ground that a college city must contain the most appreciative and sympathizing medical talent of the highest order, that would rejoice in the solution of this knotty problem and thus aid the desired end. It is pleasant to say that these expectations were realized in such men as Prof. A. P. Clarke, dean of the College of Physicians and Surgeons of Boston, and the Vice-President of the American Medical Association, 1895, Dr. H. O. Marcy, LL. D., President American Medical Association, 1892, Surgeon-General of Massachusetts A. F. Holt, now dead, and others, whose services are hereby gratefully acknowledged.

Photographs of consumptive blood were taken in 1876, with the one-seventy-fifth that verified this morphology.

Copies of these photographs were exhibited at the

centennial exhibition, 1876, deposited in the Yale College Library, exhibited in London, Berlin, Paris, Brussels, Glasgow, Newcastle-on-Tyne, &c., and pronounced to be inferior to none ever taken.

A somewhat technical account of the one-seventy-fifth, especially as to photography, was published in the August, 1879, number of the American Journal of Arts and Sciences, Journal de Micrographie, Paris, 1879, and Scientific American, 1879.

6. The one-seventy-fifth inch objective verified the morphology of Syphilitic Blood.

7. It verified the morphology of epidemic influenza.

8. It beautifully photographed alcoholic yeast. (*Cerevisia saccharomyces*).

9. It elicited the following from Dr. O. W. Holmes, when, by his invitation, Dr. Harriman and myself had made him a lantern demonstration. Just as we were leaving he said: "Gentlemen, never has any one come to my house who has taught me so much as you have."

10. At London, 1889, Sir M. Mackenzie asked me to let him see the one-seventy-fifth. It was shown and thereby its owner was introduced at a banquet given, as he said, "to persons of the very highest influence in London,"—in language that can only be uttered to the most intimate friends or college classmates. These guests were Col. North, the Nitrate King, Sir Spencer Wells, Sir Augustus Harris, Sir W. A. Mackinnon, Sir A. Isaacs (Lord Mayor, 1889-90), Mr. McKenna (the young millionaire), Edmund Yates, Surgeon-Major Johnston (Aldershot) and A. N. Broadley.

11. It introduced its owner to the War Office at the invitation of Sir W. A. MacKinnon, the highest medical official of the British army, to show its work to his staff. Afterward, it was said: "Never has anyone here shown us such good work with the microscope."

12. At the earnest invitation of Sir W. A. MacKinnon, it was exhibited in a lecture on clinical morphology at Aldershot, the headquarters of the British army, to a most respectful audience of from forty to fifty army surgeons. This was followed by a vote of thanks and a banquet which was tendered to the owner.

13. It secured permission for the owner to do clinical morphological work in any army hospital in Great Britain.

14. A special lantern exhibition was given in London, 1889, to Sir W. A. MacKinnon, Sir A. Isaacs, Dr. Johnston and others at the residence of one of the editors of the "World." The first photograph taken with it elicited from Sir MacKenzie the words: "Wonderful, wonderful!" The Lord Mayor-elect was told that it was a great honor to have him present. "Oh, no," said he, "it is an honor to come; this one-seventy-fifth is the talk of London."

15. It caused Dr. MacKenzie to utter these parting words: "Your visit to London has been a great success." Which utterance is now a precious legacy made sacred by his death.

16. As to the photographs taken by Dr. Harriman and myself, they were pronounced in Paris not inferior to any ever taken.

17. January 29, 1891, Dr. Kohler, of Vienna, wrote for some of them to exhibit to the Royal Imperial Medical Society, of Vienna, "in order," as he said, "to be up with the times."

18. In Brussels, they received high commendation.

19. At the Berlin International Medical Congress, better ones were sought among the medical exhibits, but none better were found.

20. A gentleman representing a firm composed of the best microscope makers in Germany, having seen these

photographs, expressed a desire to look through the objective. Having done so, with a most impressive gesture, he said: "I thank you very much for this; it is the event of my life. I never expected to live to see such an instrument and such workmanship. We do not make them because people will not pay for them." Tolles' B stand, American oil light, direct, and a two-inch ocular were used on this occasion.

21. A London maker, of the very highest reputation and character, having witnessed a similar exhibition, expressed less demonstratively his satisfaction, but said that Mr. Tolles was the peer of any maker. He added "I made a one-eightieth inch objective, but it was not good." He would not tell who owned it. It has been verbally reported that photographs have since been taken with it.

22. This objective shows the value of direct light, especially from a clay wick, which gives 25 per cent more illumination than cotton gives. Used two hundred years ago by microscopists, "direct" light had gone into disuse until about forty-five years ago; Oliver Wendell Holmes taught its use to his pupils. He said that W. A. Spencer had also used it in testing objectives in course of construction. I have seen Mr. Tolles often do the same thing in his workshops. Even he did not get the best results with the one-seventy-fifth save by sun-light until the writer used the flat edge of an oil flame condensed "direct" by a one-inch ocular fitted into the sub-stage. This illumination has been entirely satisfactory and reliable. As compared with mirror light, it may be said to be *thrice* as effective.

23. The opening for light in the one-seventy-fifth is one-sixty-fourth inch. The amount of illumination shown in the first photograph justifies the above quoted remarks of Sir M. MacKenzie and the approval of all

others whose attention has been called to it. Certainly, direct light is ample for all lower powers. Probably too large openings for light are allowed with most objectives. Certainly, if direct light is used, such is the case. Mr. Tolles made for me a clinical microscope with one-inch ocular and with one-fourth inch objective, second-class and with ten-inch tube. The working distance was five thirty-seconds of an inch, the stage to remain save when objectives are changed. I asked him to reduce the stage opening to its smallest size. It has worked well for more than twenty years. Not long ago, Mr. Albert Storer, a Boston expert, found it to be one-twenty-fifth inch in diameter. Mr. Tolles also made for me another and much more expensive clinical microscope, with "huge" inside lenses, but he had to diaphragm the inside of this objective because the light was dazzling. The light of a common stearine candle, costing one cent, used direct with a two-inch eyepiece for condenser has given a good field and brought out details with Tolles' one-fiftieth inch objective. The same with reflected light gives a field containing only one-fourth of the direct illumination.

24. Projection work of this objective has been done on a large scale. In 1879, at Boston, in lectures at which were present two thousand educated people, a screen twenty-five feet square was successfully covered with lime-light projections of the one-seventy-fifth photographs. In evidence of this, a gentleman from London stated that he had seen the best work of the Polytechnic Institute, that he felt qualified to judge, and that this work of the one-seventy-fifth was unapproachable.

25. As, at that time, considerable antagonism was shown toward the one-seventy-fifth, a learned and famous individual connected with the above-named lectures visited all Europe and took pains to ascertain the

facts, but found nothing to contradict the statement last cited. At that time, also, physicians were asserting, over their own names in the daily press, that there was no one-seventy-fifth in existence, but, confronted with it, they then said it was good for nothing. The satisfaction expressed by thousands who have seen the public demonstrations, ought to suffice.

26. This is a letter dated editorial rooms "Our Day," 17 Beacon Street, Boston, January 30, 1895: "Dear Dr. Cutter: That powerful microscope of which you asked me to give an opinion needs no commendation except its own worth. It was greatly admired in the exhibitions you gave in Boston to my audiences of from 2000 to 3000 people, and containing hundreds of teachers, preachers and other educated men. The instrument has a history in Boston and New York that establishes its fame. Yours truly, JOSEPH COOK."

27. In relation "to the use of the one-seventy-fifth in microchemical examinations of blood-stains," Dr. Harri-man writes, January 25, 1895: "\* \* \* \* \* When compared with lower power objectives, the one-seventy-fifth made by Tolles presents a very striking exhibition of blood corpuscles, clear, round and well defined, and there is no mistaking the difference under such high magnifying power. The morphological changes are more ably demonstrated by its use. \* \* \* \* \*"

28. Recently, it has brought out the so-called "Plasmodium malarix" in red blood corpuscles with surprising beauty, clearness and color. I say "so-called," because the patient did not have malaria, and I say this because the appearances varied from the typical plasmodium to twin symmetrical spores, and because the color of these spores was distinctly copper-colored. For years I have taught that this was characteristic of the spores of *Crypta siphilitica*.



29. This objective can be used dry or wet, with a cover one two-hundred-and-fiftieth inch thick, or without a cover.

*Partial List of Papers involving the One-seventy-fifth.*

BY G. B. HARRIMAN, D. D. S.

"Discovery of Nerve Fibers in the Soft Solids of Dentine." Dental Cosmos, January, 1870.

"The Microscope." Dental Register, March, 1874.

"The Use of the One-Seventy-Fifth Objective in Microchemical Examinations of Blood-Stains." (Unpublished.)

BY E. CUTTER.

Lecture before the Chicago Medical Society, February 17, 1879, on "The Morphology of Diseased Blood." Chicago Medical Journal, 1879.

"Tolles' One-Seventy-Fifth Objective, its History, Uses and Construction." American Journal of Arts and Sciences, New Haven, August, 1879.

"Leavens and Man." Written by invitation of the Philosophical Society of Great Britain, 1882. (Bread bacteria are figured among the fifty or more illustrations).

"A New Physical Sign of the Pre-Tubercular State." 1877, sixty-eight illustrations.

Illustrated lecture on "Alcohol and Blood." Tribune (Cambridge, January 15, 1879.

*Dec. 30th, 1895, Note 1. Dr. Stokes' statement should be quoted as follows :*

"It has been said that anything more miserable than the one-seventy-fifth need not be desired, a statement that I can readily believe. No discoveries have ever been reported as having been made with it, so far as I know, and few observations have been described."

*Note 2. The one-seventy-fifth inch objective has been owned by me since 1884.*

EPHRAIM CUTTER.

# EPHRAIM CUTTER, A.M., LL.D., Hon. F.S.Sc. Lond.

M.D. HARVARD, 1856, and UNIVERSITY PENNSYLVANIA, 1857.

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(\*From Transactions Tenth International Medical Congress.)

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- B.** FOOD IN MOTHERHOOD. Duodecimo, pp. 144. London, David Stott, publisher, 370 Oxford Street, West. Price, 25 cents.
- C.** DIET IN TUMOR AND CANCER. (1) Details of twenty-seven cases of tumor and cancer of breast, calvarium, abdominal walls, vertebral column, scapula, neck, stomach, liver, womb, fibro-cystic, complicating pregnancy. (2) What is Cancer? With Index. Quarto, pp. vi. and 23. Price, 25 cents.
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