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look to this. As for me I am made to pay for disinterestedness through my work, which you know any member of Congress may use his parliamentary privilege to make a fuss about.

Do come to me during part of your vacation. You will be at no expense except for the journey & I will give at least two hours a day to experiments on the Sun,⁶ clouds or what you will, & furnish the appliances. This tho' I should have to give up that much sleep—nature's sweet restorer⁷—which the ploughman & the *observer* know how to enjoy. Do gratify me.⁸

Yours ever truly
A.D. Bache

After describing the work performed in an observatory and the apparatus which would be needed, Hackley read from a paper on American and European observatories written by William H. C. Bartlett of West Point (misidentified as a "Mr. Barber"). Noting that Hackley's reading "seemed very long," the reporter admitted that "at this point of the discourse—it was an hour and a half long—without anything being advanced relevant to the chief question, a New York Observatory,

we departed."

⁶ Possibly a reference to Henry's recent experiments on the heat of sunspots (see above, "Record of Experiments," January 4, 1845).

⁷ Bache derived this metaphor from a line in *Night Thoughts* (1742), a collection of aphorisms and proverbs by the English poet Edward Young (1683–1765, *DNB*): "Tir'd Nature's sweet restorer, balmy sleep."

⁸ Henry did not visit Bache during the summer of 1845.

TO LEWIS R. GIBBES

Gibbes Papers, Library of Congress

Princeton May 31st 1845

My Dear Sir

As I have no excuse for suffering your letter of March¹ to remain so long unanswered which you will consider sufficient I shall therefore not attempt to render one but merely beg to assure you that the delay has arisen from no want of interest in you or your letters. On the contrary I am much obliged to you for the valuable and candid criticism on the syllabus and I shall not fail to avail myself of a number of your suggestions. In answering your letter I shall follow the order of the several items.

1 The third edition of *Biots Astronomy* I presume, for I have not seen the work, treats the subject as the other editions have done in a synthetical manner first describing the phenomena and the methods of observing them and then gradually inferring the general laws.

2 Of *Alliots Philos. des sciences*, I know nothing.

¹ March 1, 1845, above.

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3 I have just received a copy of the 4th edition of Pouillet and think it is quite an improvement on the preceding editions. It contains several new plates and appears to post up all the most important discoveries which have been made for the last five or six years. I procured my copy through John Pennington of Philadelphia.² Should you wish a copy or any French book, I would advise you to order it through him unless you have some more direct means from Charleston of communication with Paris.

4. Lloyd's book on Light and vision I am not well acquainted with, but his lectures on the wave theory I think are excellent. The part on diffraction is borrowed pretty largely from the original papers of Fresnell in the *Annales de chimie* but he could not have selected from better materials.

5 Powell's work principally refers to the mathematical explanation of the phenomena of the dispersion of light on the wave theory. It is mathematical. Lloyds lectures are elementary but give precise physical conceptions of the cause of the phenomena.

Syllabus

1 The definition I have given of the object of science is of great importance to me in my manner of teaching the subject of Physique. I wish to draw a wide distinction between the mere classification and description of phenomena and the laws which give us a full command of all the facts and enable us to predict. On this point I think there is a great want of knowledge among metaphysicians. In an article just published in the *North American Review* the author asserts that the business of science is the classification of facts and not the discovery of law³ and in all the reviews which have appeared of the new work entitled *The Vestiges of Creation* the true aim and object of Physical science appear to be misunderstood.⁴ I feel

² John Pennington (1799-1867), a Philadelphia bookseller and importer. *Henry Papers*, 5:346.

³ "The sole office of science is the theory, not of causation, but of classification. It is all reducible to natural history, the essence of which consists in arrangement." "[Review of] *Vestiges of the Natural History of Creation . . .*," *North American Review*, 1845, 60:426-478, quote from p. 467. The review is anonymous, but *Poole's Index* credits it to Francis Bowen, the *Review's* editor.

⁴ Henry's comment referred primarily to the review cited in the previous note; other reviews of Robert Chambers's anonymously published work that appeared by the time Henry wrote these words do not bear out his contention. Henry's issue was whether scientific laws were "merely" inductive generalizations, and thus of no greater status than a classification of

facts, or whether the laws—carefully induced by means of detailed observation based on analogous reasoning from known truths—possessed the status of causes. Henry favored the latter position and while not acknowledging at all Chambers's scientific competence, probably agreed with his intent to view all of nature as the expression of a few general laws.

Views at least not opposed to Henry's position had appeared by this time in three reviews: David Brewster's in the *North British Review* and anonymous reviews in the *American Review* and *Littell's Living Age*. While the first two were hostile and the last favorable, all three reviewers agreed that science was more than the compilation and arrangement of observed facts. Indeed in 1837 Henry had personally confirmed with Brewster his own position against such a simple-minded Baconianism. (*Henry Papers*, 3:475-477.)

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however the force of your remark and shall endeavour to guard against the difficulty suggested.

2 So far as the earth is a heavenly body the subject of the tides belongs to celestial phenomena.

3 The sufficient reason is no reason at all. Although it is the foundation of almost all the axioms of rational mechanics of the French and new English school.

4 Any *physical* quantity which passes &c would be correct. Your remark is important. The principle is indeed a law of nature resting on experience and should not have a place in the introduction to the science any more than the laws of motion.

5 The term somatology I find in use and do not wish to venture on a new term.

6 Your remark on 'body' is good.

7 The term consistencies instead of states I am pleased with.

8 The term essential I do not now hold to. In natural philosophy we deal with contingent truths, with laws and facts which depend on the will of an Infinitely good and wise Being.⁵

9 I shall examine the vernier,—thank you for the hint.

10 I like your remarks on body figure &c.

11 Your definition of an atom is ingenious but rather too metaphysical to suit my taste.

12 I allude to the definition of matter as given by Newton in his Optics—matter formed of hard indivisible indestructable atoms &c.⁶

Brewster's article is in the *North British Review*, 1845, 3:470–515. Anonymous reviews are in *Littell's Living Age*, 1845, 4:60–64, and the *American Review: A Whig Journal of Politics, Literature, Art and Science*, 1845, 1:525–543. For Chambers's *Vestiges* and critical response to it, see M. J. S. Hodge, "The Universal Gestation of Nature: Chambers' *Vestiges* and *Explanations*," *Journal of the History of Biology*, 1972, 5:127–152, and Ronald L. Numbers, *Creation by Natural Law: Laplace's Nebular Hypothesis in American Thought* (Seattle, 1977), pp. 28–35. For Henry's other thoughts on the *Vestiges*, see the Buhler Diary entry printed below, March 3, 1846.

⁵ Henry expressed the "voluntaristic" view that "tended to subordinate in God the intellect to the will; above the Creator's wisdom and knowledge is to be stressed his power and dominion." Accordingly, created nature was an expression of God's will and the world *could* have been otherwise. "Laws and facts" were

contingent and ascertainable through empirical investigation, not "essential" and determinable by reason acting alone. This position has been traced through the Anglo-American school of natural philosophy at least as far back as the early seventeenth century and was a mainstay of Boyle's and Newton's philosophy of nature. It formed a major part of the latter's famous debate with Leibniz. See *The Leibniz-Clarke Correspondence*, ed. H. G. Alexander (Manchester, 1956), pp. xvi–xviii, and E. A. Burt, *The Metaphysical Foundations of Modern Science*, 2d ed. (1932; reprint edition, New York, 1954), pp. 194–202, 291–297 (quotation from p. 294).

⁶ "It seems probable to me, that God in the Beginning, form'd matter in solid, massy, hard, impenetrable, moveable Particles, . . ." Isaac Newton, *Opticks*, 4th ed. (London, 1730), p. 375. The quotation comes from the 31st Query. The work is in the Henry Library—purchased in 1822 according to the inscription

13 Soap bubble thickness of a misprint.

14 I define the real volume of a body to be that which it would possess were all the gross pores annihilated. To get the real volume of a piece of sp[o]nge⁷ dip it into a cylindrical glass vessel or into a vessel of any form in which the elevation of the liquid may be noted and the quantity displaced be ascertained this will give you the real volume. Next plunge the same sponge perfectly saturated with water into the same vessel of water used before and the quantity of the fluid now displaced will give the apparent volume. The small amount of matter contained in a sponge or its real volume as exhibited by the first experiment never fails to surprise a class. A sponge which in its uncompressed state will fill a large empty tumbler will scarcely elevate the water contained in the vessel more than one or two tenths of an inch.

<15> India rubber cloath does not suffer the insensible perspiration to pass off and therefore is deleterious to health.

15 The method of coloring agate is to soak it in oil and then heat the stone so as to *char* the liquid.

Immerse the stone in a solution of alum which in crystalizing in the poures will expand as ice does and produce the same effect.

16 The diminished density of wire may be shown by attaching it at one end to the bottom of a long glass vessel the upper end of which consits of a tube with a thin bore the whole being filled with water the <decent> alteration of the liquid in the fine tube will give the change in the volume of the wire allowance being made for change produced by the quantity of wire drawn out of the liquid. I have never repeated the exp with wire but have attempted it with a large piece of india rubber in a bottle furnished with a graduated tube but the result was doubtful.⁸

on the flyleaf. Henry faintly annotated in pencil the section of the quotation with the words:

This is now the basis of the atomic theory in chemistry, but the consequences which flowed from it are not perceived until this (?late) century.

(Alternate readings in the last clause are "were not perceived" and "the last century.")

⁷ Deterioration of the manuscript.

⁸ One can gauge the effect of the syllabus on Henry's course by these three demonstrations—determining the volume of a sponge, coloring agate, and measuring the density of a stretched wire. These experiments became part of his curriculum after the syllabus was completed, but did not regularly appear before then. In 1842–1843, Henry did not present

these demonstrations at all, while all three appeared for the 1845–1846 class. The years between were transitional. Using a sponge to determine the difference between real and apparent volume was included in Henry's course, but the method of coloring agate to show its porosity was not. Henry also showed that the density of rubber—not wire—decreased by stretching, or rather, he tried to do so. A surviving notebook from that class has the experiment written in, but then lined through.

Notebooks of William J. Gibson, Henry Van Vleeck Rankin, and William Gledhill, all for the course year 1842–1843; of Robert Allen, Jr., for 1844–1845; and of Theodore W. Tallmadge, for 1845–1846, all in the Princeton University Archives.

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I send you with this letter a copy of an article which I prepared on the Coast Survey.⁹ It is intended for popular [. . .]¹⁰ requested a number of copies for distribution among the members of Congress. It was prepared while the printer was waiting for matter and sent to the press page by page and therefore contains a few mistakes which will be corrected in the reprint.

Professor Alexander made a very satisfactory set of observations on the transit of Mercury.¹¹ The day was beautifully clear and nothing happened to mar the pleasure of a good observation except a little annoyance on account of high wind.

[Mr. Alex]ander¹² has just published a large syllabus of his course on astronomy and will send you a copy as soon as he gets them from the printer. I should say he has printed a syllabus for the article is not presented to the public but is merely intended for his class.¹³

Mr. A requests me to thank you for the copy of your observation[s].¹⁴ He will probably write to you on the subject. He has just learned that a comet has been seen near the sun by one of the professors at Boston.¹⁵ No particulars are given. Mr. A himself saw what he thought to be a comet on the morning preceding the transit which disappeared. He thinks the one seen at Boston may be the same.

I hope you will excuse me for writing to you on paper of this kind. I chose this sheet that I might not be confined to the ordinary limits of a sheet of letter paper.¹⁶ Have you seen Dr Draper's book and Dr Grays criticism on it in the North American review?¹⁷ With much esteem yours &c
Joseph Henry

⁹ See above, Henry to Bache, March 15, 1845.

¹⁰ Here two to four words are missing due to a tear in the paper. A likely reading is "... distribution. Mr. Bache has. . . ."

¹¹ On May 8, 1845; see above, Henry to Bache, May 6, 1845.

¹² Deterioration of the manuscript.

¹³ *Syllabus of Lectures on Astronomy: Part I* (Princeton, 1845). With regard to the state of this work, however, Stephen Alexander himself wrote to Gibbs, February 7, 1846: "My syllabus of Astronomical Lectures is not on the advance; as the Juniors have come into my hands and I am getting out for them something in the Diff. Calculus. I hope to avail myself of your criticism of it, one of these days." By this time, Alexander had assumed the duties of Professor of Mathematics, after Albert B. Dod's death. (Gibbes Papers, Library

of Congress.)

¹⁴ A tear in the paper.

Henry's reference to Gibbs's observations is not obvious. However, it may allude to sightings of the Southern Comet of 1844. This comet appeared in the second half of 1844, was easily visible by December, and reappeared in late January 1845 after its perihelion. It was telescopically visible down to the middle of March. *Silliman's Journal*, 1845, 48:402-403 and 49:220.

¹⁵ See above, Henry to Bache, May 6, 1845, note 8.

¹⁶ The paper is both longer and narrower than standard writing paper.

¹⁷ See John Torrey to Henry, February 4, 1845, above. Henry commented on Draper's ideas in his letter to Alexander Dallas Bache, September 7, 1846, below.