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THOMAS HARIOT'S OBSERVATIONS ON AMERICAN GEOLOGY IN 1588

GEORGE W. WHITE
University of Illinois, Urbana

Thomas Hariot's "A Briefe and True Report on the New Found Land of Virginia" of 1588 is sometimes regarded as the earliest publication on the natural history of what is now the United States (Meisel, 1929, vol. 3, p. 329; Goode, 1901, p. 363). Biologists have heard of his accurate and lively observations on plants and animals, but historians of American geology do not record his considerable and respectable geologic observations.

Observations of topography and mineral resources were made in the first half of the sixteenth century by the French in Canada and by the Spanish in Central and South America (Hornberger, 1937). English observations on minerals, especially of Newfoundland (Rickard, 1932, p. 3), were made before Hariot and were known to him; but to Thomas Hariot must go the credit for first writing in a widely available book form about mineral resources and about geological observations in what is now the United States.

Thomas Hariot (1560-1621) was born in Oxford. He graduated B.A. in 1580 and later became a fellow of Trinity College. Soon after attaining his degree he became mathematical tutor and adviser to Sir Walter Raleigh. Raleigh was long his patron, as was also Henry Percy, Earl of Northumberland, who provided him with a very adequate pension and a house suitable for a gentleman and scholar. Hariot spent most of his life in mathematical and astronomical studies. He is credited with independently inventing the telescope (he appears to have had some such device in Virginia in 1585), with modernizing algebra, and with inventing the signs for inequality. Details on his life are given by Goode (1901), Stevens (1900), Lorant (1946) and Dictionary of National Biography.

Hariot accompanied the Raleigh expedition of 1585 to Virginia[1] as historian, scientist, and adviser. Upon the return of the colonists to England in 1586 he prepared a report which was published in 1588. "A Briefe and True Report of the New Found Land of Virginia" is one of the rarest and most desirable items of Americana, there being but 5 known copies in the world, of which two are in the United States (Adams 1931, p. viii). De Bry republished it in Latin, French, German, and English in 1590, with engravings of water colors made by John White (Sabin, 1870, v. 3, p. 20). Facsimile reprints have been published, and recently it has appeared in an edition with modernized spelling and grammar and with the De Bry illustrations (Lorant, 1946).

[1] The settlement was in the present state of North Carolina on Roanoke Island. The inland explorations were mainly in Albemarle Sound and the Roanoke River. In Hariot's time "Virginia" was the indefinite region north of Florida.

Hariot's well-organized, straightforward, and compact report presents a favorable summary of the new country, its people, its natural history and its resources. He is contemptous of those who issued "malicious, and slanderous reports" and dwelt on the hardships and discomforts they had suffered, dealing with them as follows (Hariot, 1588, p. A4 verso):

> The cause of their ignorance was, in that they were of that many that were neuer out of the Iland where wee were seated, or not farre, or at the leastwise in few places els, during the time of our aboade in the countrey; or of that many that after golde and siluer was not so soone found, as it was by them looked for, had little or no care of any other thing but to pamper their bellies; or of that many which had little vnderstanding, lesse discretion, and more tongue then was needfull or requisite.
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> Some also were of a nice bringing vp, only in cities or townes, or such as neuer (as I may say) had seene the world before. Because there were not to bee found any English cities, nor such faire houses, nor at their owne wish any of their olde accustomed daintie food, nor any soft beds of downe or fethers; the countrey was to them miserable, & their reports thereof according.
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> Because my purpose was but in briefe to open the cause of the varietie of such speeches; the particularities of them, and of many enuious, malicious, and slaunderous reports and deuises els, by our owne countrey men besides; as trifles that are not worthy of wise men to bee thought vpon, I meane not to trouble you withall: but will passe to the commodities, the substance of that which I haue to make relation of vnto you.

In his list of "Marchantable commodities" Hariot mentions several minerals, including alum, of which he says (p. B2):

> *Allum*: There is a veine of earth along the sea coast for the space of fourtie or fiftie miles, whereof by the iudgement of some that haue made triall heere in England, is made good *Allum*, of that kinde which is called *Roche Allum*. The richnesse of such a commoditie is so well knowne that I neede not to saye any thing thereof. The same earth doth also yeelde *White Copresse*, *Nitrum*, and *Alumen plumeum*, but nothing so plentifully as the common *Allum;* which be also of price and profitable.

Hariot noted the occurrence of iron and copper. His observations are confirmed in the report of the governor, Ralph Lane (Hakluyt, v. 8, p. 332), which will be quoted later. This passage is of great importance because of the mention of a "minerall man," upon whom we shall remark again. Hariot wrote (p. B3) as follows:

> *Iron*: In two places of the countrey specially, one about fourescore and the other sixe score miles from the Fort or place where wee dwelt: wee founde neere the water side the ground to be rockie, which by the triall of a minerall man, was founde to holde yron richly. It is founde in manie places of the countrey else. I knowe nothing to the contrarie, but that it maie bee allowed for a good marchantable commoditie, considering there the small charge for the labour and feeding of men: the infinite store of wood: the want of wood and deerenesse thereof in England: & the necessity of ballasting of shippes.
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> *Copper*: A hundred and fiftie miles into the maine in two townes wee founde with the inhabitaunts diuerse small plates of copper, that had beene made as wee vnderstood, by the inhabitantes that dwell farther into the countrey: where as they say are mountaines and Riuers that yeelde also whyte graynes of Mettall, which is to bee deemed *Siluer*. For confirmation whereof at the time of our first arriuall in the Countrey, I sawe with some others with mee, two small peeces of siluer grosly beaten about the weight of a Testrone [testone, shilling], hangyng in the eares of a *Wiroans* or *chiefe Lorde* that dwelt about fourescore myles from vs; of whom thorowe enquiry, by the number of dayes and the way, I learned that it had come to his handes from the same place or neere, where I after vnderstood the copper was made and the white graynes of mettall founde. The aforesaide copper wee also founde by triall to holde siluer.

In addition to the first section on merchantable commodities Hariot included a second section on "commodities for victuall and sustenance," which includes no minerals, and a third section on "things as is behoofull for those which shall plant settle and inhabit to know of . . . for building and other necessary uses." After discussing timber for houses and ships he says (p. D4 verso, E1):

Now for Stone, Bricke and Lime, thus it is. Neere vnto the Sea coast where wee dwelt, there are no kinde of stones to bee found (except a fewe small pebbles about foure miles off) but such as haue bene brought from farther out of the maine. In some of our voiages wee haue seene diuers hard raggie stones, great pebbles, and a kinde of grey stone like vnto marble, of which the inhabitants make their hatchets to cleeue wood. Vpon inquirie wee heard that a little further vp into the Countrey were of all sortes verie many, although of Quarries they are ignorant, neither haue they vse of any store whereupon they should haue occasion to seeke any. For if euerie housholde baue [have] one or two to cracke Nuttes, grinde shelles, whet copper, and sometimes other stones for hatchets, they haue enough: neither vse they any digging, but onely for graues about three foote deepe: and therefore no maruaile that they know neither Quarries, nor lime stones, which both may bee in places neerer than they wot of.

In the meane time vntill there bee discouerie of sufficient store [stone?] in some place or other conuenient, the want of you which are and shalbe the planters therein may be as well supplied by Bricke: for the making whereof in diuers places of the countrey there is clay both excellent good, and plentie; and also by lime made of Oister shels, and of others burnt, after the maner as they vse in the Iles of Tenet and Shepy, and also in diuers other places of England: Which kinde of lime is well knowne to bee as good as any other. And of Oister shels there is plentie enough: for besides diuers other particular places where are abundance, there is one shallowe sounde along the coast, where for the space of many miles together in length, and two or three miles in breadth, the grounde is nothing els beeing but halfe a foote or a foote vnder water for the most part.

This much I can say further more of stones, that about 120. miles from our fort neere the water in the side of a hill was founde by a Gentleman of our company, a great veine of hard ragge stones, which I thought good to remember vnto you.

The description of Hariot and the independent narrative of Lane show that part of the colonists crossed the Coastal Plain to the Fall Line and entered the Piedmont. In his "Conclusion" Hariot gives the first description of the changing character of the Coastal Plain toward the Piedmont. Americans would now say that an affirmative answer has been given to his optimistic final question (p. F2 verso, F3):

Now I haue as I hope made relation not of so fewe and smal things but that the countrey of men that are indifferent & wel disposed maie be sufficiently liked: If there were no more knowen then I haue mentioned, which doubtlesse and in great reason is nothing to that which remaineth to bee discouered, neither the soile, nor commodities. As we haue reason so to gather by the difference we found in our trauails; for although all which I haue before spoken of, haue bin discouered & experimented not far from the sea coast where was our abode & most of our trauailing: yet somtimes as we made our iourneies farther into the maine and countrey; we found the soyle to bee fatter; the trees greater and to growe thinner; the grounde more firme and deeper mould; more and larger champions [fields]; finer grasse and as good as euer we saw any in England; in some places rockie and farre more high and hillie ground; more plentie of their fruites; more abundance of beastes; the more inhabited with people, and of greater pollicie & larger dominions, with greater townes and houses.

Why may wee not then looke for in good hope from the inner parts of more and greater plentie, as well of other things, as of those which wee haue alreadie discouered?

Ralph Lane, governor of the colony left in Virginia over the winter

of 1585-86, gives more details about the journey on which the iron and copper were found. The journey appears to have been made primarily to search for a reported copper mine, which was presumably the source of the copper plates possessed by the local Indians. He did not find the mine. In making his excuses to Raleigh it is evident that importance of the discovery of metals was well recognized. It is in this passage that we find a clue to the identity of Hariot's "minerall man" (Hakluyt, v. 8, p. 331-332; modernized in Lorant, p. 741, 742):

> I have set downe this Voyage somewhat particularly, to the ende it may appeare unto you (as true it is) that there wanted no great good will from the most to the least amongst us, to have perfited this discoverie of the Mine: for that the discovery of a good Mine, by the goodnesse of God, or a passage to the Southsea, or some way to it, and nothing els can bring this Countrey in request to be inhabited by our nation. And with the discovery of either of the two above shewed, it will bee the most sweete and healthfullest climate, and therewithall the most fertile soyle (being manured) in the world: . . .
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> For this river of Moratico promiseth great things, and by the opinion of M. Hariots the head of it by the description of the Countrey, either riseth from the bay of Mexico, or els from very neere unto the same, that openeth out into the South sea.
>
> And touching the Minerall, thus doeth M. Youghan affirme, that though it be but copper, seeing the Savages are able to melt it, it is one of the richest Minerals in the world.

This Master "Youghan" is undoubtedly the "minerall man" of Hariot (1588, p. B3). But no Youghan appears in the list "of those as well Gentlemen as others, that remained one whole yeere in Virginia, under the Government of Master Ralph Lane" as given in Hakluyt (v. 8, p. 317-318). "Captaine Vaughan" is listed eighth in the list of 107 men. It is logical to assume that "Youghan" is a printer's error for "Vaughan." If so, who was "Captaine Vaughan"? He is the only man listed as "Captaine." Fourteen are listed as "Master," including Hariot, but in the text several are referred to as "Captaine" (p. 316).

The late sixteenth century "mineral man" appears to have been a combination geologist, mining engineer, assayer, and refiner. The profession was recognized and the title not uncommon (Hoover and Hoover, 1912, footnote, p. 283). Master Vaughan appears to have been the earliest English one in what is now the United States, but he was not the earliest attached to an English expedition to North America. That honor goes to "the minerall man and refiner . . . Saxon borne, honest and religious, named Daniel," who is reported by Edward Hayes to have been attached to the expedition of 1583 of Sir Humphrey Gilbert to Newfoundland and neighboring regions (Hakluyt, v. 8, p. 60). Along with Sir Humphrey, both Daniel and his ore specimens were lost on the return to England (*ibid.*, p. 67, 71).

It is possible that Hariot knew more than one mineral man. His patron, Raleigh, was a Devonshire man, who is reputed to have been a favorite of the miners of Devon and Cornwall. Raleigh became Warden of the Stannaries in 1585 and was active in using his new powers over the mining districts he already knew so well (Encycl. Brit., article Raleigh).

It is easy to speculate that after Hariot's return to Eng-

land in 1586 he came into contact with the mine captains, mineral men, and refiners of Cornwall. Perhaps Captain Vaughan himself was a Cornish mining man. In the two and one-half years between his return and the publication of "Briefe and True Report," Hariot may have had many opportunities to increase his knowledge of mineral resources. But at any rate we can be impressed by his geological knowledge when we summarize what Hariot knew, from personal observation and actual experiment, about the geology of Virginia:

1. There was a wide flat coastal region (Coastal Plain) without prominent stones.

2. Along a distinct line (Fall Line) hard (crystalline) rocks appeared and continued an unknown distance into the country (the Piedmont).

3. The character of the crystalline rock varied and included a "hard ragge stone" (see "rag," Fay, p. 554; Rice, p. 336).

4. The rocky ground at places contained iron, which he had seen and knew on professional advice to be ore.

5. Copper occurred beyond the limit of exploration, but supposedly not far away. The material was positively copper on the basis of its melting character.

6. The copper was silver-bearing, as determined by trial by Hariot and the "minerall man."

7. Excellent and plentiful clay for brick existed in the Coastal Plain.

8. Probably the fossil shells in the Coastal Plain sediments were recognized as remains of actual organisms. Hariot knew enough about fossils[2] and was interested enough to discuss them in 1589 with Jacob Cole, nephew of the geographer Ortelius (Parks, p. 168, 251). Almost certainly he had made note of them in Virginia only three years before. He had noted the abundance of oyster shells there and it would have been strange if he had not noted similar, but fossil, shells in the Coastal Plain sediments. Certainly other observers who came after him did so and made the proper interpretation (Evans, 1749; also quoted in White, 1951, p. 154).

[2] Until the eighteenth century shells, bones, teeth, crystals, stalactites, and other objects were all called fossils. Much of the early insistence on the inorganic origin of fossils is thus more easily understood.

REFERENCES

ADAMS, R. A., 1931, Introductory Essay; to A brief and true report of the new found land of Virginia, by Thomas Hariot, A facsimile reproduction of the 1588 quarto: Ann Arbor, Edwards Brothers.

DICTIONARY OF NATIONAL BIOGRAPHY, article on Hariot.

ENCYCLOPAEDIA BRITANNICA, 1947, Article on Raleigh: Chicago.

EVANS, LEWIS, 1749, A map of Pensilvania, New-Jersey, New-York . . . ; Philadelphia.

FAY, A. H., 1920; 1947, A Glossary of the Mining and Mineral Industry: U. S. Bur. Mines, Bull. 95.

GOODE, G. B., 1901, The beginnings of natural history in America: Rept. U. S. Nat. Mus., 1897, pt. 2, 1901, pp. 357-406.

HAKLUYT, RICHARD, 1598-1600, The Principal Navigations Voyages, Traffiques & Discoveries of the English Nation . . . : References are to the readily available Glasgow edition of 1903-1905.

HARIOT, THOMAS, 1588 [1589 new style], A briefe and true report of the new found land of Virginia . . . : London; the facsimile reproduction, Ann Arbor, 1931, was used for this study.

HOOVER, H. C. and HOOVER, L. H., 1912, Georgius Agricola, De Re Metallica, translated from the first Latin edition of 1556 . . . : London, Mining Magazine; reprinted 1950, New York, Dover.

HORNBERGER, THEODORE, 1937, Science and the New World (1526-1800): Huntington Library, San Marino, California.

LORANT, STEFAN, 1946, The New World: New York, Duell, Sloan and Pearce.

MEISEL, MAX, 1929, A bibliography of American natural history: vol. 3, Brooklyn, Premier.

PARKS, G. B., 1930, Richard Hakluyt and the English voyages: Am. Geogr. Soc. Spec. Pub. No. 10, New York.

RICE, C. M., 1948, Dictionary of geologic terms: Ann Arbor, Edwards Brothers.

RICKARD, T. A., 1932, A history of American mining: A.I.M.E. series, New York, McGraw-Hill.

SABIN, JOSEPH, 1870, A dictionary of books relating to America: vol. 3, New York, J. Sabin and Sons.

STEVENS, HENRY, 1900, Thomas Hariot the mathematician the philosopher and the scholar . . . : London, privately printed.

WHITE, G. W., 1951, Lewis Evans' contributions to early American Geology —1743-1755: Ill. Acad. Sci. Trans., vol. 44, pp. 152-158.