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## **Ibn Tufail as a SciArtist in the Treatise of *Hayy Ibn Yaqzan*\***

**Nadia Maftouni\*\***

Associate Professor, University of Tehran

### **Abstract**

*Ibn Tufail as a scientist as well as an artist exposes the issues of human anatomy, autopsy, and vivisection and, thereby, could be regarded as a SciArtist. SciArt might be defined as a reciprocal relation between art and science. Followings are the kinds of these interactions: artistically-inclined scientific activities, science-minded artistic activities, and intertwined scientific and artistic activities. In their fictional treatises, Avicenna, Ibn Tufail, and Suhrawardi are traditional avatars of SciArt. This paper frames an account of SciArt, suggesting in detail Ibn Tufail's work as a prototypical example, while Avicenna and Suhrawardi go beyond the scope of this paper. An instant of intertwined scientific and artistic activities strongly captivates the attentions to Ibn Tufail, describing human anatomy, autopsy, and vivisection in his Treatise of Hay Ibn Yaqzan. Recognized as the first philosophical story, Hay Ibn Yaqzan depicts the whole philosophy of Ibn Tufail by the story of an autodidactic feral child a gazelle raised whom in an island in the Indian Ocean.*

**Keywords:** Ibn Tufail, Hay Ibn Yaqzan, SciArtist, SciArt, story

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\*\* E-mail: nadia.maftouni@ut.ac.ir

### Introduction

A physician, philosopher, novelist, and politician, ibn Tufail (c. 1105 Spain–1185 Morocco) is an influential, yet less known, Spanish polymath who has informed a wide range of later thinkers (Conrad 1996; Goodman 2009; Maftouni, 2017a, p. 74). While only one of his works has survived intact, the impact of this one piece is visible on major works of science and fiction. “Hayy Ibn Yaqzan,” i.e. alive the son of awake,<sup>1</sup>—the complete name of which is *Resalah Hayy Ibn Yaqzan fi Asrar al-Hikmah al-Mashriqiah Istakhlasaha min Dorar-i Jawahir-i Alfaz-i al-Rais Abi Ali Sina*—is regarded as the first recorded writing in history that is intentionally cast as a philosophical story, expressing ibn Tufail’s views via imagery. Hayy Ibn Yaqzan is the name of two totally different tales from Avicenna and Ibn Tufail. Ibn Tufail drew the name of his tale from Avicenna’s tale, but the plot and characters were fully different.

In brief, Ibn Tufail’s tale is the story of an autodidactic feral child a gazelle raised whom in a desert in the Indian Ocean. Without contact with other human beings, Hayy discovers ultimate truth. Connecting Asal, comes Hayy into contact with civilization and religion. Ibn Tufail’s recital recounts the problem of consistency between philosophy and revelation on which wrote Averroes, Ibn Tufail’s pupil, *Kitab Fasl al-Maqal wa Taqrir ma baina aSh-shari'a wa-l-Hikma min al-Ittisal*.<sup>2</sup>

Observing the other side, Russell once put it, “In England Papists, Turks, and Muhammadans<sup>3</sup> were indiscriminately lumped together as atheists threatening both Church and State.” (Russell, 1994, P. 228) In an age which was characterized, contrary to its label,<sup>4</sup> by unreasonable currents of religious persecution and intolerance, Hayy Ibn Yaqzan surprisingly became a bestseller within a short period of time.

Although one should not discount the appeal of its charismatic title, *Philosophus autodidactus*, to the age of the new philosophy, it is not sufficient to explain why an Islamic work from the medieval past should sustain such interest to become literally a bestseller.... Therefore in the face of virulent hostility to Islam as a false religion, the enthusiastic reception of an Arabic text which was not scriptural, nor specifically mathematical, astronomical, or medical, defies expectation (Russell, 1994, P. 228).

In broad fashion, Hayy, the hero of the story has happiness as his primary objective, striving to attain this elusive concept throughout the story. Breaking with the Aristotelian tradition dominating his time, Tufail sets about theorizing on happiness without offering a definition thereof. His approach has a striking similarity to the contemporary view that regards any attempt at capturing necessary and sufficient characteristics of an entity as a fool’s errand. Yet he takes pains to demarcate his target and distinguish it, in particular, from similar concepts such as pleasure and perfection, which are commonly associated with it. While deprived of contact with other human beings and their writings, Hayy goes on to discover the ultimate truth and genuine happiness solely in interaction with nature. Above all, ibn Tufail could be considered a sciArtist. The idea is that ibn Tufail in his story depicts the topics of science, i.e., anatomy, autopsy, and vivisection by the language

of art. I will center my discussion on this side of ibn Tufail, requiring us to be clear about the concept of sciart, as well his stances on the scientific topics.

### **Conceptualization of SciArt**

SciArt refers to bilateral relations between science and art. In this part, I try to conceptualize the concept of SciArt in three types of sciArtists: artistically-inclined scientists, science-minded artists, and those equally involved in both artistic and scientific activities.

For conceptualization of “SciArt”, there are two concepts we should be clear about from start: science and art. Science covers different disciplines such as medicine, physics, metaphysics, and economics. And art, in this analysis, includes literature and so many different types of art: painting, sculpture, architecture, music, poetry, theatre, film, photography, conceptual art, and printmaking. McCleese (2015) says: “Most people think of art as paintings hanging on museum walls. However, art includes literature, sculptures, paintings, murals, and probably whatever else artists want to present as art.”

As Copley holds, both art and science, in spite of their divergences, are brought about by creative process. (Copley, 1987, pp. 213–215) In this process, they have bilateral services to each other. Science may assist art with enriching artworks, as I explain later in philosophical fictions. Moreover, in some media, such as computer graphics, holography, and space art science have been applied for the creation of art. (Garfield, 1989, pp. 3-8)

Art, on the other hand, can assist science with presenting scientific issues to the public as well as motivating their creativity. Many scientific improvements inspired by sci-fi.

In following sections I try to distinguish three approaches among sciArtists: artistically-inclined scientists, science-minded artists, and equally involved in both artistic and scientific activities, albeit I do not claim distinct borders between them.<sup>5</sup> After developing the theory, I apply it to ibn Tufail’s masterpiece, *Hay ibn Yaqzan*. Ibn Tufail (c. 1105–1185) is reckoned as a polymath: physician, philosopher, theologian, astronomer, vizier, and court official. Beside being a Court Physician, ibn Tufail was abreast of anatomy of his time. Expressing autopsy in his story, he constitutes an early supporter of dissection. Considering him a novelist, ibn Tufail would be regarded as a sciArtist. Although his work, by and large does not include allegory, literature by itself is reckoned as art in its broader account. That being the case, artist is applied to, for example, the poets, the musicians, the writers as well as the novelists.

#### **1. 1. Artistically-inclined Scientists**

Artistically-inclined scientists are the scientists who inclined to artists. For example, they protect artists or perform art programs.

James Webb (2015), who directed the start-up of the NASA Art Program, says:

Important events can be interpreted by artists to provide unique insight into significant aspects of our history-making advances into space. An artistic record of this nation's program of space exploration will have great value for future generations and may make a significant contribution to the history of American art.

### **1. 2. Science-minded Artists**

Science-minded artist can be used to refer to artists inspired by scientific issues or those inspire scientists. For instance, there are scientific issues in theater, fiction, or poetry. (Grünzweig, 2012) As I mentioned earlier, science includes, in this concept, all academic disciplines form humanities and social sciences to natural sciences. And art includes literature, music, painting etc. Artists inspired by science. In some cases science is front and center and artists are following it. In other words, scientists are inspiring artists to produce quasi-scientific artworks.

Joyce Yamade describes inspiring by science:

Science is the lens through which I understand the world, particularly paleontology and evolutionary biology. The writer who most significantly shaped my view of life was Stephen Jay Gould, whose essays I greatly miss. Often without conscious intent, my paintings reflect natural history and frequently contain oblique references to whatever I am reading (Yamade, 2015).

The NASA Art Program produced a collection of more than 2,000 artworks in an effort to present NASA's cutting-edge research to the public in a way more accessible than complex scientific reports. Artists from many different disciplines and backgrounds chronicled NASA's missions.

Quasi-scientific arts could be seen in every movie on Netflix, in the 1950s, their rockets had fins. And in that era, the V2 rocket shaped was the rocket in every sci-fi story told. As Tyson put it, "Our presence in space is affecting not only the engineers and the mathematicians and the scientists, it's affecting the creative dimension of that we call culture."<sup>6</sup>

Steve Miller's mixed media can be regarded as a quasi-scientific artwork. He says:

This work is a product of research at the Large Hadron Collider at CERN, Switzerland. The text is from the chalkboards of the Theory Group at CERN with the background images taken inside the tunnels and detectors of the Large Hadron Collider (Miller, 2015).

Another example can be seen in Art Meets Science exhibits.<sup>7</sup> In Washington University's Hope Center for Neurological Disorders, Michael Eastman, a contemporary photographic artist, transformed scientific images into abstract works of art.<sup>8</sup> Furthermore, the MDI Biological Laboratory's fifth annual Art Meets Science exhibit featured science-inspired work by artists. Some of artists inspired by science focus attention on nature and natural world,<sup>9</sup> the nature of gravity, environmental science, climate change, and geomorphology,<sup>10</sup> biology, evolution, neurobiology and applied mathematics, quantum physics, and energy.<sup>11</sup>

As an example for metaphysics, one on SciArt Center says about their collage:

My artwork is map collage that offers the viewer a combination of imaginary landscapes with mystical, biblical, scientific and ecological themes. The visual description of a three-dimensional world on a flat plane is conjoined with the depiction of the metaphysical (Foer, 2015).

Buntaine (2015), regarding herself as a science-based artist, limited SciArt to this sort of SciArt: "It has only been for the past few decades, however, that artists have turned their creative gaze towards the sciences as their sole source of artistic information, inspiration, and conceptualization."

Artists inspire scientists. Sometimes, artists captivate and inspire scientists. Jules Verne's *Twenty Thousand Leagues under the Sea* could be counted as a quasi-scientific artwork which fascinated American inventor Simon Lake, Known as the father of the modern submarine. Igor Sikorsky, inventor of the modern helicopter, was inspired by a Verne book, *Clipper of the Clouds*. "Anything that one man can imagine, another man can make real." Sikorsky often quoted from Verne. Robert H. Goddard, who built the first liquid-fueled rocket, became captivated with spaceflight after reading an 1898 newspaper serialization of H.G. Wells' classic novel about a Martian invasion, *War of the Worlds*, and the concept of interplanetary flight gripped his imagination.

In 1914, H.G. Wells published a novel, *The World Set Free*, imagining the emergence of artificial atomic energy by 1933, followed by a devastating world war and the eventual emergence of a peaceful global government. Physicist Leo Szilard was inspired to solve the problem of creating a nuclear chain reaction when read the novel. In the 1930s and '40s, Edward Elmer Smith with his "Lensmen" novels chronicled the adventures of a futuristic Galactic Patrol. Sci-fi editor James W. Campbell wrote to Smith that the *Directrix*, a command ship featured in his series, had inspired a US naval officer to introduce the concept of combat information centers aboard warships.<sup>12</sup>

There are many inventions like the internet, organ transplants, the tablet computer, smartwatches, voice-controlled robots, Credit cards, Chess-playing computers, and Mobile phones were inspired by stories by the likes Jules Verne, Mary Shelley, Mark Twain and Arthur C Clarke.

### **2. 3. SciArtists Involving both Artistic and Scientific Approaches**

Some artworks are equally involving both artistic and scientific aspects. As an example, *The Hellstrom Chronicle*, an American film released in 1971, commingling elements of documentary and science fiction to present a gripping satirical depiction of the Darwinian struggle for survival between humans and insects. In the field of metaphysics, some authors describe philosophical issues with stories like *Hay ibn Yaqzan* and dramas like *Rattlesnake*, (Maftouni, 2015, pp. 174-204) and *Intuition*. (Nuri, 2000, pp. 169-201) They are philosophers as well as artists. Ibn Tufail's *Hay ibn Yaqzan* might be regarded as a masterpiece in the field. Being a physician as well as a novelist, ibn Tufail constitutes a landmark in the history of

medicine. In his story, ibn Tufail elaborates scientific issues of human anatomy, autopsy, and vivisection. This matter I will take up in the immediately succeeding sections.

### **3. An Account of Hay ibn Yaqzan**

Hay Ibn Yaqzan is the name of two totally different tales from Avicenna and Ibn Tufail.<sup>13</sup> Ibn Tufail drew the name of his story from Avicenna's treatise, but the plot and characters were totally different. Ibn Tufail's tale is the story of an autodidactic feral child a gazelle raised whom in a desert in the Indian Ocean. Without contact with other human beings, Hay discovers ultimate truth. Connecting Asal, comes Hay into contact with civilization and religion. Ibn Tufail's story proves there is no conflict between philosophy and religion.

Not surprisingly, I focus on our topics, departing from philosophical aspects of Hay ibn Yaqzan.

Narrating two versions of the birth of Hay Ibn Yaqzan, Ibn Tufail goes on with the story. Based on the first version, Hay came into the world in an Indian island under the Equinoctial, where men came into the world without parents.

The second version has much in common in some respects with the birth of Prophet Moses.

There lay, not far from this our island, another great island ..., which was then governed by a prince of a proud and jealous disposition. He had a sister of exquisite beauty, which he confined and restrained from marriage, because he could not match her to one suitable to her quality. He had a near relation whose name was Yaqzan, that married her privately, according to a rite of matrimony then in use among them: it was not long before she proved with child, and was brought to bed of a son; and being afraid that it should be discovered, ... she put him into a little ark ..., and that very night the strong tide carried him ashore on that island we just now mentioned. ... It happened that a roe which had lost her fawn, heard the child cry, and following the voice (imagining it to have been her fawn) came up to the ark. (Maftouni, 2017b, p. 14).

#### **3. 1. Human Anatomy in Hay ibn Yaqzan**

Ibn Tufail discusses human anatomy in great detail, when he recites the account of those who contend Hay generated without parents. Starting by explaining three major internal organs, the heart, brain, and liver, he continues with the arteries and veins.

They ... give you a particular account of the formation of all the parts, as the physicians do of the formation of the fetus in the womb, omitting nothing till he was completely formed, and just like an embryo ready for the birth. In this account they are forced to be beholding to this vast mass of fermented earth, which you are to suppose contained in it all manner of materials proper for the making man's body, those skins which cover it &c.; till at last, when he was complete in all his parts, as if the mass had been in

labor, those coverings, which he was wrapped up in, burst asunder, and the rest of the dirt dried and cracked in pieces. (Maftouni, 2017b, p. 50)

In such a way, Hay came into the world, and started crying for help and food up till the roe which had lost her fawn found him. “Now, both those who are of the other opinion and those who are for this kind of generation, agree in all the other particulars of his education: and what they tell us is this.” (Maftouni, 2017b, p. 51)

### **3. 2. Ibn Tufail and Autopsy**

Autopsy does stand as a topic of interest in the treatise of Hay ibn Yaqzan. The idea is that between Hay and the roe, the emotion of parenting and childhood developed. The roe kept maintaining the Hay.

She stayed by him and never left him, but when hunger forced her; and he grew so well acquainted with her, that if at any time she stayed away from him a little longer than ordinary, he would cry pitifully, and she, as soon as she heard him, came running instantly. (Maftouni, 2017b, p. 52)

But the situation would not last forever. The roe grew lean and weak, continuing a while in languishing circumstances until she died and naturally ceased all her actions and motions. Hay called the roe, but there was no answer. Then he began to examine the roe, peeping into her eyes and ears. However, Hay perceived no viewable defect. Then he continued to examine all parts of her body but found nothing. Since the external examination didn't pay, Hay was led to perform an autopsy.

When he had examined every external part of her, and found no visible defect and yet at the same time perceived an universal cessation of motion in the whole body, not peculiar to one member but common to them all, he began to imagine that the hurt was in some organ which was remote from the sight and hidden in the inward part of the body; and that this organ was of such nature and use, that without its help, none of the other external organs could exercise their proper functions; and that if this organ suffer any hurt, the damage was general, and a cessation of the whole ensued. (Maftouni, 2017b, p. 66)

Hay was anxious to find that organ and remove the defect, thereby giving body back its functions. In the bodies of wild beasts and other animals, he had formerly observed that there were just three cavities, i.e., the skull, breast, and belly. Then Hay thought this major organ that all members stood in need of which, must be in the center in the breast. In addition, he felt such an organ in his breast. So examining it, he resolved to open her breast and remove the impediment. For this part of the story onwards, Ibn Tufail is considered an early supporter of autopsy and vivisection. Hay provided himself with splinters of dry cane and fragments of flint, making and incision between the ribs and cutting through the flesh. He came to the diaphragm and found it much tough, assuring himself that it must belong to the organ which he looked for. So if he got through that, he would find it. He ran into difficulty because of his primitive instruments. However, he sharpened them again and renewed his attempt and got ahead.

The first part he met with was the lungs, which he at first sight mistook for that which he searched for, and turned them about this way and that way to see if he could find in them the seat of the disease. He first happened upon that lobe which lay next the side which he had opened and when he perceived that it did lean sideways, he was satisfied that it was not the organ he looked for, because he was fully persuaded that that must needs be in the midst of the body, as well in regard of latitude as longitude. (Maftouni, 2017b, pp. 71-72)

He carried on till he found the heart. He saw it closed with a very strong cover, and fastened with stout ligaments, covered by the lungs on that side which he had opened. Then he searched the other side to find the same membrane on the inside of the ribs, and the lungs in the same posture which he had observed on that side which he had opened first. He inferred this organ was the part which he sought.

Therefore he first attacks the pericardium, which after a long trial and a great deal of pains, he made shift to tear; and when he had laid the heart bare, and perceived that it was solid on every side, he began to examine it to see if he could find any apparent hurt in it; but finding none, he squeezed it with his hand, and perceived that it was hollow. He began then to think that what he looked for might possibly be contained in that cavity. When he came to open it, he found in it two cavities, one on the right side, the other on the left. That on the right side was full of clotted blood that on the left quite empty. (Maftouni, 2017b, pp. 73-74)

Then Hay thought that one of those two cavities should be the receptacle of what he sought because there was nothing in the right side but congealed blood. This blood does not differ from any other while which he sought was something peculiar to that place.

Which I find I could not subsist without, so much as the twinkling of an eye. And this is that which I looked for at first. As for this blood, how often have I lost a great deal of it in my skirmishes with the wild beasts, and yet it never did me any considerable harm, nor rendered me incapable of performing any action of life, and therefore what I look for is not in this cavity. Now as for the cavity on the left side, I find it is altogether empty, and I have no reason in the world to think that it was made in vain, because I find every organ appointed for such and such particular functions. (Maftouni, 2017b, pp. 75-76)

### **3. 3. Vivisection in Hay ibn Yaqzan**

Hay in order to view the trajectory of life practiced vivisection on live animals. At first he fixed his attention on the substance which was departed from the heart of the roe. As per his observations, all animals as long as they lived were constantly warm and got cold after death. In the bargain he found that there was a greater degree of heat in his breast, near the place where he had made the incision in the roe. Thus Hay thought of dissecting live animals.

This made him think that if he could dissect any animal alive, and look into that ventricle which he had found empty when he dissected his dam the

roe, he might possibly find it full of that substance which inhabited it, and so inform himself whether it were of the same substance with the fire, and whether it had any light and heat in it or not. (Maftouni, 2017b, p. 86)

For this purpose, Hay took a wild beast and tied him down, and dissected him in the same fashion he had dissected the roe until he came to the heart. Then he opened the left ventricle and learned it was full of an airy vapor hotter than he could well endure it, recalled a little mist or white cloud. In such a way died the animal instantly.

From whence he assuredly concluded that it was that hot vapor which communicated motion to that animal, and that there was accordingly in every animal of what kind soever, something like it upon the departure of which death followed. He was then moved by a great desire to enquire into the other parts of animals, to find out their order and situation, their quantity and the manner of their connexion one with another and by what means of communication they enjoy the benefit of that hot vapor, so as to live by it, how that vapor is continued the time it remains, from whence it has its supplies, and by what means its heat is preserved. (Maftouni, 2017b, pp. 88-89)

Dissecting all kinds of living and dead animals, Hay landed in first place of naturalists and arrived to the highest degree of knowledge in this kind.

### **Conclusion**

We face three different kinds of connection between science and art, called SciArt: artistically-inclined science, science-minded art and SciArt with intertwined artistic and scientific approaches. Artistically-inclined scientists are scientist inclined to artists, like James Webb who directed the NASA Art Program. The science-minded artworks could be inspired by science, such as the collection of more than 2,000 artworks in NASA Art Program, or could inspire scientists like Jules Verne's books and Edward Elmer Smith's novels.

An avatar of intertwined artistic and scientific activities could be observed in ibn Tufail's story, Hay ibn Yaqzan. The argument boils down to the following simple idea:

Retailing the story of those who believed that Hay came into the world without parents, ibn Tufail took up human anatomy in complete detail. For example, he explained heart, brain, liver, arteries, and veins. When the roe mother died, Hay examined all parts of her body but failed to find anything. After external examination, Hay performed an autopsy.

Finding the trace of life, Hay practiced vivisection on a variety of live animals as well. Describing issues of human anatomy, autopsy, and vivisection in an artwork, then ipso facto ibn Tufail should be deemed a major sciArtist.

### **Notes**

1. Hayy Ibn Yaqzan for the first time was translated into English by Simon Ockley in 1708. The history of Hayy Ibn Yaqzan translated from the Arabic by

Simon Ockley, revised, with an introduction by Fulton (1929). Ockley in the preface of the treatise of Hayy Ibn Yaqzan mentioned that the first publication was in 1671. In 1671, Edward Pococke translated Hayy Ibn Yaqzan into Latin under the title *Philosophus Autodidactus*. Another English translation is Ibn Tufail's *Hayy ibn Yaqzan: a Philosophical Tale*, translated with an introduction and notes by Lenn Evan Goodman. Another one is *The Journey of the Soul: the Story of Hai bin Yaqzan*, translated by Riad Kocache.<sup>1</sup> The other one is *Two Andalusian Philosophers* translated by Jim Colville with an introduction and notes.<sup>1</sup> A much condensed translation is *Medieval Islamic Philosophical Writings*, edited by Muhammad Ali Khalididi. Among others, a reviewed work which could be seen in *Journal of Near Eastern Studies* is "Ibn Tufayl's Hayy Ibn Yaqzan: A Philosophical Tale by Lenn Evan Goodman, Ibn Tufayl" review by Michael E. Marmura (1974). Another reviewed Work is "Ibn Tufayl's Hayy Ibn Yaqzan, a Philosophical Tale Translated with Introduction and Notes by Lenn Evan Goodman" review by Parviz Morewedge in *Philosophy East and West* (1977). More recently, it has been edited in an English-Arabic version, including an analytical introduction (Maftouni, 2017b) to which we refer in this paper.

2. Hayy Ibn Yaqzan in Avicenna's recital is a poetical name for the Active Intellect. It may be observed that Avicenna in the treatise of "Al-Qaza wa al-Qadar" or "The Divine Decree and the Predestination" mentions the name of Hayy Ibn Yaqzan without allegory or a tale. (Avicenna, 1979, p. 348.)

3. Muhammadan (also spelled Mohammedan, Mahommedan, Mahomedan, or Mahometan) is archaic term for Muslims. The word was formerly common in usage, but the terms Muslim and Islamic are more common nowadays.

4. He refers to the Enlightenment or the Age of Enlightenment. While French historians traditionally place the Enlightenment between 1715, the year that Louis XIV died, and 1789, the beginning of the French Revolution, some recent historians begin the era in the 1620s, when starts the scientific revolution.

5. This remark could be seen in SciArt Center Community: "Whether you're a science-minded artist or an artistically-inclined scientist (or both!), for our SciArt membership you will be added to our exclusive mailing list..." (<http://www.sciartcenter.org/5/12/2015>).

6. Tyson N. says, "The headlines that were writ large over that era had built into them the fact that innovation created those headlines. Innovation brought to you by an ambitious community of scientists, technologists, engineers and mathematicians." (Tyson, 2012)

7. See: <https://www.newscientist.com/blogs/culturelab/2010/05/art-meets-science-aesthetics-politics-and-metaphysics.html>.

8. See: <https://magazine.wustl.edu/2012/june/Pages/WhereArtMeetsScience.aspx>

9. See: <http://www.sciartcenter.org/un-natural-nature-virtual-exhibit.html> 5/12/2015.

10. See: Buntaine J. <http://www.sciartinamerica.com>.

11. See: <http://www.sciartcenter.org/un-natural-nature-virtual-exhibit.html> 5/12/2015.

12. See: <http://www.smithsonianmag.com/science-nature/ten-inventions-inspired-by-science-fiction-128080674/?no-ist> 24/12/2015.

13. Hay Ibn Yaqzan for the first time was translated into English by Simon Ockley in 1708. (London: Printed and sold by E. Powell)

The history of Hayy Ibn Yaqzan translated from the Arabic by Simon Ockley, revised, with an introduction by A.S. Fulton. London: Chapman and Hall, 1929.

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