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GREENING FACE: HOW FACIAL EXPRESSION IS MADE SENSIBLE, FROM PRE-CHRISTIAN ARCHITECTURAL SPACES TO POST-DIGITAL SMART ENVIRONMENTS[1]

Abstract: After the many algorithmic, computational, and digital turns over the last five decades, the ways in which we experience and understand the face as something in and of the environment appear to be fundamentally shifting. Indeed, today more and more corporations, institutions, and governments are using automated facial recognition systems within smart environments for abstracting data capital from facial behavior. Through a post-digital perspective, the author explores a history of ideas about the face in relation to its environment across the artistic, scientific and technologic imaginaries, both constants from the past and changes of the present. This intellectual historiography compares three sources: English folklorist Julia Somerset's 1939 article "The 'Green Man' in Church Architecture," German neurologist Joachim Bodamer's 1947 case history "The Face Blind," and Japanese computer scientist Takeo Kanade's 1973 doctoral project "Computer Recognition of Human Faces," as well as their rhizomatic interrelations. By tracing the role of the environment in the study of the face, the author maps a genealogical landscape of ideas that roams across the absence and presence of color, human perception and mediated vision, inner and outer ways of seeing, as well as nonvisible and visible imaging. And, to possibly reconcile the very real ambiguity of the human face with the digital binarism of our increasingly computational planet, the author proposes a "greening of the face" whereby the face and its environment are conceptually modelled as being concretized within a complementary, reciprocal process of becoming.

Keywords: biometrics, color theory, facial expression, facial recognition, Green Man, intellectual history, philosophy of science, physiognomy, psychology of art, smart environments

[1] This paper is dedicated in loving memory to William H. Chambers (1922-2018), physicist, former Deputy Associate Director at the Los Alamos Scientific Laboratory, a "green man" who skied on the mountains and flew in the skies, my teacher and grandfather. An earlier version of this paper was presented at the 12th Conference of the European Society for Literature, Science and the Arts (SLSAeu) on the theme "Green" at the University of Copenhagen 12-16 June 2018. My special thanks to Jens Hauser, bioart curator and theorist, for his invitation to present at SLSAeu Green. This gave impetus and inspiration to my research. I also thank Anna Nacher, in the Institute of Audiovisual Arts at Jagiellonian University, for her invitation to submit to the *Arts and Cultural Studies Review* (*Przegląd Kulturoznawczy*). This paper was made possible by your encouragement.

Introduction

In this space of cultural*isms* and at this time for hi*stories*, our conceptual models about the face as something in and of the environment have accrued enough explanatory anomalies as to drift into crisis. With the many algorithmic, computational, and digital turns over the last five decades, both the episteme by which we understand our facial behavior, as well as the techne by which we experience the living face, appear to be fundamentally shifting. Here and now, what is becoming of the relationship between the face and its environment? To what extent is this relationship constant from the past or changing for the present? And what role does green—both as a color and as a concept—play in how the face is made sensible and given meaning?

Today, more often than not, the concepts face and environment if co-located together conjure within the imagination some foreboding phantasm of automated facial expression recognition systems. This myth of ambient intelligence usually goes something like this: Facial recognition systems gaze down from a black-box ecosystem that unites cloud and ubiquitous computing. They look out through a distributed camera network across everyday devices such as closed-circuit television (CCTV), smartphone and webcam. And they extramissively radiate a Promethean-Apollonian-Diogenesian light that detects, extracts, and classifies the face. Facial recognition is everywhere, all the time. It is omnipresent and omniscient. Or, at least, that is how the myth often goes. Some people fear this as latent dystopian panopticonism. Others fetishize it as potential utopian transparency. Some desire withdrawal from the digital. Others desire immersion. But regardless how you make a stand, the use of techno-labor for abstracting data capital from facial behavior is indeed accelerating. More and more corporate, institutional, and government sensing technocracies employ facial recognition in order to meet consumer demands and user needs on the basis of the face, datafication the quantifiable self by informating a smart environment.

Such a conceptual model about the face in relation to its environment is not that of yesterday and will not be that for tomorrow. This is because models are created by the people who use them. A post-digital historicization for facial recognition in smart environments, therefore, must first and foremost be a history of ideas. And it must also consider the economic, political, social, and technological factors behind those ideas. To explore the relationship between the face and its environment across the artistic, scientific, and technologic imaginaries, I take a hermeneutic wandering in the wilds of a comparative intellectual historiography.

This is a tale of three sources: English folklorist Julia Somerset's 1939 article "The 'Green Man' in Church Architecture," German neurologist Joachim Bodamer's 1947 case history "The Face Blind," and Japanese computer scientist Takeo Kanade's 1973 doctoral project "Computer Recognition of Human Faces." This is a tale of the critical meta-analysis for their rhizomatic interrelations. And this is a tale of an assemblage between multiple, non-hierarchical entry and exit points into the imaginaries these sources represent, their contextualities and relativities. By tracing the role of the environment in the *cross*cultural, *inter*disciplinary, and *trans*historical study of the face, I map a genealogical landscape of ideas that roams across themes such as: absence and presence of color, human and mediated vision, inner and outer ways of seeing, as well as nonvisible and visible imaging.

By this perspectivizing through the post-digital paradigm, it may be possible to reconcile a very real ambiguity of the human face with the digital binarism of our increasingly computational planet. This requires not only accepting the current state-of-the-art for facial recognition, but also rejecting the implied shift of the digital revolution, and doing so with neither determinism nor reductionism.[2] Pragmatically speaking, the post-digital characterizes a paradigm after which images, media, and other thingynesses have been digitized (or, at least, digitized in crucial aspects of the codes and channels through which they are translated or transmitted), as well as after which the digital and analogue are being hybridized. In this space culturally, novel conceptual models are informed by truth-values implicitly linked to the ubiquitous computing that increasingly pervades our everyday life. But at this time historically, our enchantment or fascination with such a givenness of the digital is also already becoming a historical present.[3]

Towards being less nonconsciously reactant and more responsibly cognizant about the computable face as an important signifier in smart environments (i.e., to be face conscious),[4] I propose “a greening of the face.” The term “green” itself is messy. But it is also helpful. In the biological sense of the term, the color green (495-570 nanometers on the visible spectrum) is normally sensed within the eye by cells known as cones, located mostly in the center of the retina, which contain photopigments or molecules that convert light information into neural signals. In the cultural sense of the term, the concept green (after the Proto-Indo-European root *ghre*) is frequently sensed as having beneficial attributes, as representing fertility, growth, resurrection, and transition, the natural world and vegetal relations, or as a prophylaxis against evil as well as protection in afterlife.[5] At least since the ecological or environmental movement began, especially since the 1960s and 1970s, “greening” is also a process of transformation whereby something becomes less harmful and more beneficial to the environment, an awareness or activism rooted in health improvement and social justice. This paper, however, is not about whether or not facial recognition could be considered a “green technology,” their its impact on the environment, cleanness or

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2 R. Pepperell, M. Punt, *The Postdigital Membrane: Imagination, Technology and Desire*, London: Intellect Books, 2000, p. 2.

3 F. Cramer, “What Is ‘Post-Digital’?”, in: *Postdigital Aesthetics: Art, Computation and Design*, ed. by D.M. Berry, M. Dieter, Meadwille: Palgrave Macmillan, 2015, pp. 13, 19.

4 A.S. Wilkins, *Making Faces: The Evolutionary Origins of the Human Face*, Cambridge, MA: The Belknap Press of Harvard University Press, 2017, pp. 307-316.

5 M. Pastoureau, *Green: The History of a Color*, transl. by J. Gladding, Princeton & Oxford: Princeton University Press, 2014, p. 24.

sustainability, or how it might be used to mitigate the effects of human activity on the natural world; that argument must be for somewhere and somewhen else.

Rather, by "greening face" I mean: to become environmental of its computation.[6] This requires accepting that facial recognition deterretorializes the face away from and out of the environment during its process of facialization, whereby a symbolic calculus layers upon sensorial corporeality, and turns living expressivity into encoded language.[7] But it also involves rejecting the post-digital environment as simply a mere bracket, frame, or window through which to sense the face as something in the ocular field or a figure-to-ground. "A green model of the face," I propose, addresses how the face and its environment are being concretized together within a complementary, reciprocal process of becoming, as well as the ways in which the distinct mediations of an environment in turn give rise to different sensations of the face. These are some histories of such ideas.

1. The Green Man: A recurring motif across the artistic imaginary

The face and its environment have long and variously been represented together as a hybrid-icon. These hybridized likenesses, crossed between heterogenous sources in animal as well as plant kingdoms, share visual attributes from both the human face and a plant surface. By virtue of denoting at one and the same time dual objects, such phytomorphic physiognomies represent the attribution of characteristics from a plant (e.g. ecology, fertility, growth, and renewal) onto the human (i.e. some deity, divinity, sacred, or supernatural). Only in the mid-twentieth century, however, was the so-called "Green Man" first identified as a recurrent image and iconographic structure in architectural spaces across Western cultures and European civilizations.

In 1939 with her article "The 'Green Man' in Church Architecture" published in the journal *Folklore*, Julia (née Hamilton) Somerset (1901-1971)—known as Lady Raglan—described a "man's face, with oak leaves growing from the mouth and ears, completely encircling the head."[8] As Lady Raglan told the story, eight years earlier she had visited the Church of St. Jerome in the small rural village of Llangwm Uchaf, Monmouthshire in southeast Wales. The Reverend J. Griffith drew her attentional gaze to the Church's architectural space, with its mascaron sculptures from the medieval renaissance of the twelfth century. And there, carved from the south corbel of the chancellery arch, was what Lady Raglan would call the Green Man.

[6] J. Gabrys, *Program Earth: Environmental Sensing Technologies and the Making of a Computational Planet*, Minneapolis, MN: University of Minnesota Press, 2016, pp. 9, 324.

[7] G. Deleuze, F. Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, transl. by B. Massumi, Minneapolis, MN: University of Minnesota Press, 1988, pp. 170-172.

[8] Lady Raglan, "The 'Green Man' in Church Architecture", *Folklore* 1939, vol. 50, no. 1, p. 45. DOI: 10.1080/0015587X.1939.9718148.

"It occupies a very prominent position" in the architecture of "this fine old church," and "there are two more very like it on the opposite corbel," Lady Reglan detailed.[9] Shortly afterwards, she found others. Then there were many. So, Lady Raglan "named it" the Green Man, and collected evidence "to support this title," as well as to classify the "motif [across its] very wide distribution." Based on her observations in the field, she even illustrated this class according to its orders, and initialized these ink drawings "J.R." for Julia Raglan (Fig. 1).

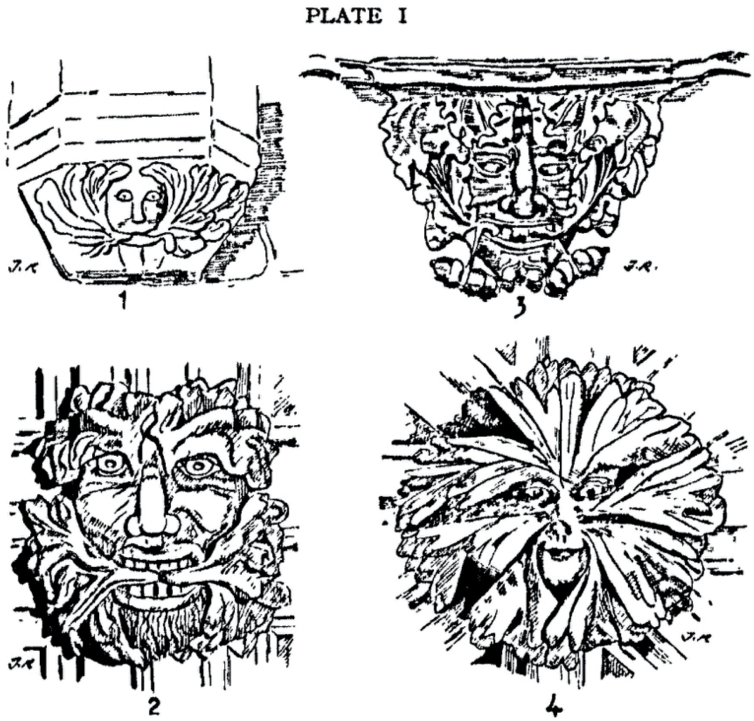

Fig. 1: Top left to bottom right, the Green Man at 1) St. Jerome Church, 2) Rochester Tower, 3) Lincoln, and 4) Norwich Cathedrals. Black and white graphic Illustrations by Lady Raglan, in: Lady Raglan, "The 'Green Man' in Church Architecture", Folklore 1939, vol. 50, no. 1, p. 46, Plate I

The Green Man, as English folklorist Mike Harding later grouped Lady Raglan's classes, may be represented by a "foliated face" with a mask that immerses the visage

9 Ibid.

in branches and leaves, "disgorged face" with vegetation spewing from the mouth, or "bloodsucker face" with vegetation sprouting from the facial orifices of the eyes, mouth, and nose.[10] But there are countless forms. And these extend across many codes and channels which translate and transmit information. Some even have the facial contour of a leaf margin, whether done in church façade column or faience panel corner (Figs. 2 and 3).

Fig. 2: Column of the portal of the Church of Nossa Senhora da Conceição, brownish-colored stone, early 16th century, Lisbon, Portugal. Photograph by the author

Fig. 3: Faience panel corner, blue-pigment figure on white-color ground, late 17th century, Lisbon, Portugal. Photograph by the author, with kind permission from d'Orey Tiles[11]

Indeed, green men both new and old are constantly being formed or found, and having their photographic images shared on personal blogs as well as Facebook groups like the UK-based "Green Men & Suchlike Curiosities."[12] To Lady Raglan, "the figure variously known as the Green Man, Jack-in-the-Green, Robin Hood, the King of May, and the Garland, who is the central figure in the May Day celebrations throughout Northern and Central Europe," descended from a pre-Christian time before Abrahamic religions, and developed into a portrait of the face that varies greatly but holds "extreme realism [and] significance."[13]

10 M. Harding, *A Little Book of The Green Man*, London: Aurum Press, 1998, p. 38.

11 d'Orey Tiles, "Portuguese Azulejos", business website, created in 2008, https://doreytiles.pt/wp/?lang=en, accessed 11 December 2018.

12 S. Breadin (Creator & Administrator), "Green Men & Suchlike Curiosities: Seeking the Devil in the Detail", Facebook Public Group, created 6 October 2016, https://www.facebook.com/groups/196857724077416/, accessed 1 June 2018. As of this writing, the Facebook group lists "2,390 members."

13 Lady Raglan, op. cit., pp. 50, 54, 47.

The reason for having the Green Man in architectural spaces, Lady Raglan claimed, was simple: to make visible "to an illiterate people, the sum of human knowledge in stone."[14] The Green Man, a hero with a thousand faces across Europe, whether sculpted out of ceramic, glass, stone, or wood, can be "read" and understood by literate and illiterate alike. To Lady Raglan, this alone sufficiently accounted for his depiction everywhere from church buttress, and estate knocker, to palace floor, as well as among various other subjects both religious and secular. The Green Man may or may not be literally a green color or have ivy and oak branches and leaves encircling his head. But such a human face in architectural space is also conceptually greened, an imaging with "mystic meanings," illustrating "contemporary fables and tales" about the ecological relationship between humans and their environment. The Green Man is a lesson writ large on the ceilings, doors, floors, and walls for all to see, a lesson about what it means to be human in nature.

Lady Raglan also got the very concept of the "Green Man" from the environment around her, both in terms of the intellectual atmosphere or ethos that shaped her life, as well as in terms of the physical surroundings in which she lived. This singular concept of *the* Green Man, however, Lady Raglan invented rather than discovered. Where he "had been anonymous" she "gave him a name," contends cultural critic Josephine Livingstone.[15] As scholar of medieval literature Carolyn Larrington asserts, "The Green Man as an ancient folkloric figure, a vegetation god that's come down in the world, has been shown not to exist."[16] But while Lady Raglan's conclusion may remain heavily debated, that the figure "is neither a figment of the imagination nor a symbol, but is taken from real life,"[17] eighty years after she published her article it still has a wide and lasting influence.

The entire premise for the Green Man is built upon an exegetical fallacy of methodological empathy, in which Lady Raglan transferred a contemporary "symbol of the untouched natural world, the protector and guardian of the forests" onto its historical antecedents.[18] Which is to say, Lady Raglan substituted a concept for green "from [her] today" onto the faces "of yore." In Nietzschean or Foucauldian terms, she archaeologically traced green-faced men from an origin point, down through a singular history along an ever-more progressive continuity. And she traced this motif from some formalist essence, down through one then another privileged exemplar as a relatively-fixed mediation.

[14] Ibid., p. 48. Here Lady Reglan cites É. Mâle, *Religious Art in France, XIII Century: A Study in Mediaeval Iconography and its Sources of Inspiration*, transl. by D. Nussey, London: J.M. Dent & Sons, 1913.

[15] J. Livingstone, "The Remarkable Persistence of the Green Man", *The New Yorker*, 7 March 2016, https://www.newyorker.com/books/page-turner/the-remarkable-persistence-of-the-green-man.

[16] C. Larrington, *The Land of the Green Man: A Journey Through the Supernatural Landscapes of the British Isles*, London & New York: I.B. Tauris & Co. Ltd, 2015, p. 227.

[17] Lady Raglan, op. cit., p. 50.

[18] C. Larrington, op. cit., p. 227.

Of course, green men tokens have been designed since at least the first or second century CE and drawn since at least the early thirteenth century. For example, the so-called "Roman Green Man," stone-carved into the architectural space of an upper class *domus*, is now housed in the Vesunna Gallo-Roman Museum in Périgueux, France. And the French artist Villard de Honnecourt included green men in his portfolio along with many other architectural subjects, sketched from life while travelling across the land.[19]

But the Green Man type itself was invented by Lady Raglan in 1939. As Larrington argues, Lady Raglan invented the Green Man "for a world which was beginning to need him, a world in which people were gradually realizing how industrialization was stealthily degrading our planet."[20] And only since the 1940s has the Green Man, with an "appearance, as a hybrid of man and plant, [which] insists that humans are inextricably part of that natural world which we in the West are so keen to subjugate," become "representative of all that the modern world undervalues, excludes or lacks."[21]

Although, the proper noun "Green Man" itself has been in common parlance since at least the early seventeenth century, and used when speaking of architectural spaces.[22] As Lady Raglan attended, there have long been "an extraordinary number of 'Green Man' inns all over [England]."[23] *The Illustrated London News* in 1842, for instance, reported how "the King and Queen of the Belgians" arrived "*to the* Green Man" Hotel & Tavern (founded sometime before 1629), its signage advertising this brand name.[24] But only because of Lady Raglan's article did the term Green Man become more widely applied. Just a few years after this publication, German-born British art historian Nikolaus Pevsner even adopted it for his 46-volume *Buildings of England*. And today, architectural glossaries for travel literatures continue to enter the "Green Man: strange naturalistic figure with green fronds emanating from mouth, ears and even eyes, found in medieval churches and assumed to be related to pre-Christian (possibly druid fertility rite)."[25]

Despite giving a green men phenomena the top-down revisionist treatment, however, Lady Raglan made no point to build an ethnonationalist project through some hierarchizing vision of European culture, folklore, or myth. That is, she used green for ideographic rather than ideological purposes, and was not trying to put a value on

[19] V. de Honnecourt, *Album de dessins et croquis*, Paris: Bibliothéque nationale de France, 1225-1235, pp. 14, 47, http://gallica.bnf.fr/ark:/12148/btv1b10509412z.r=villard%20de%20honnecourt.

[20] Ibid.

[21] Ibid., p. 232.

[22] B.S. Centerwall, "The Name of the Green Man", *Folklore* 1997, no. 108, pp. 25-33, DOI: 10.1080/0015587X.1997.9715933.

[23] Lady Raglan, op. cit., p. 53.

[24] Illustrated London News, "No. 7, for the week ending Saturday, June 25, 1842", in: *The Illustrated London News, Vol. 1st from May 14 to December 31, 1842*, London: William Little, 1843, p. 98. See also pp. 440, 471 and 519. Italics in original.

[25] S. Jenkins, *Wales: Churches, Houses, Castles*, London: Allen Lane/Penguin Group, 2008, p. 282.

any one face over any other. Her ideas, therefore, stood in stark contrast to those of the Folkish Movement (*völkische Bewegung*) in Germany, its pseudo-Heideggerian progeny that influenced Nazism, or other populist romanticisms in Europe.[26] "The fact is," Lady Raglan contended, "that unofficial paganism subsisted side-by-side with the official religion [Christianity], and this explains the presence of our Green Man in a church window with the Virgin [Mary] beside him and below him the sun."[27]

Instead, Lady Raglan conceptualized historical accounts of her Green Man, including his sculpted motif in architectural spaces, to serve relatively the same purpose for a society as applied science: a way to develop knowledge about the natural and physical world that could be put into practical use in order to better survive within it. Yet, she believed there was more than meets the naked eye to the imaging of the Green Man. And Lady Raglan sought to pull back the leaves from the face—metaphorically speaking, that is—so as to reveal the allegoric-mythical origins behind this popular-cultural motif.

Lady Raglan's research into the Green Man was informed most of all by that of her husband, perhaps also done to some degree jointly. Almost ten years before she found her first Green Man, Lady Raglan (then going by her maiden name, Hamilton) married Major Fitz Roy Richard Somerset, the fourth Baron Raglan (1885-1964). Lord Raglan, retired from a career in the military, had been posted everywhere from Hong Kong, Egypt, the Sudan, Palestine, to Transjordan. He also pursued anthropology and archaeology, later even serving as president of the National Museum of Wales. Lord Raglan had been around; he had seen things. And in 1936 with his *The Hero: A Study in Tradition, Myth and Drama*, Lord Raglan developed a classification system by which to describe common patterns of mythic hero archetypes throughout Indo-European cultures.[28] To sum up, the 22-point system encompassed traits like the hero's "mother is a royal virgin," the hero "is victor over […] wild beast," and that they meet their death "often at the top of a hill."[29] Using Lord Raglan's hero-o-meter, assigning one point per trait, and depending on the total number of points, archetypes were categorized to be either more or less based on mythological ritual or historical fact.

Among many privileged exemplars, Lord Raglan categorized the very hero that Lady Raglan would later consider to be the origin story for the Green Man: Robin Hood scored a 13 out of 22 (more historical and less mythological).[30] In our contemporary artistic imaginary, this heroic outlaw is most popularly known from the major motion pictures directed by Kevin Reynolds and starring Kevin Costner in 1991, by Ridley Scott with Russell Crowe in 2010, and by Otto Bathurst with Taron Egerton in 2018. Already in late medieval England, however, with "A Gest of Robyn Hode,"

26 J. Livingstone, op. cit.

27 Lady Raglan, op. cit., p. 56.

28 Lord Raglan, *The Hero: A Study in Tradition, Myth and Drama* (1936), New York: Dover, 2003.

29 Ibid., pp. 174-175.

30 Ibid., pp. 179, 184.

a traditional Child Ballad printed between 1492 and 1534, the titular protagonist was iconographically structured as having a phytomorphic physiognomy: "His coloure is of grene," "Under the green wode hore," with he and his men casting "on their gowne of green" as "they came to the mery greenwood."[31] Lady Raglan inferred the greenness in Robin Hood from this recurrent image hybridizing the human face with a plant surface, church financial records for the "gardering of Robin Hood," and community festival references to May Day as "Robin Hood's day." By this evidence, at least to Lady Raglan, the historical figure Robin Hood could well have inspired the Green Man figurative motif.[32]

Much like her husband,[33] Lady Raglan did not categorically deny the historicity of individuals such as Robin Hood, whom she called the Green Man. Rather, she viewed their common legends to be non-historical. Lady Raglan thought such heroes existed. She he just did not think that the things said about them were necessarily based on actual events. That is, Lady Raglan considered allegorical stories for their literal meaning. To Lady Raglan, the true subject of the Green Man was neither imaginative nor symbolic. This mere community in some quality between the human face and a plant surface also resembled in its likeness our essential relationship to the physical environment. And the hybrid icon of the Green Man served as a Floralian reminder to celebrate spring, the fertility of the season for the soil, people and livestock, and that there is a time to plant.

As such, Lady Raglan herself conceded that the Green Man "does not seem to be quite in the same class" as other mascaron sculptures of the human face used in architectural spaces for decorative ornamentation, such as those depicting a chimera, demon, faun, gorgon, or satyr.[34] Some "pattern will possibly be found to be the origin of these figures," she contemplated, whether from the Greco-Roman world or the East. Although, they could have all "sprung from the same myth." In the humanities today, narratology and comparative mythology have principally turned away from such generalized, universalized categorization, emphasizing not only global correlations but also local contrasts. Even so, in the eighty years since Lady Raglan first introduced the phytomorphic physiognomy of the Green Man, numerous scholars have described him as a mythic archetype (or mythotype), inextricably entangling the outer visible imaging for architectural forms with the inner nonvisible imagery of psychological functions.

That is, the Green Man comes just as much from our relationship to ourselves as our relationship to the world. Depending on who you read, this "proto-Dionysus figure" traces back to "the son, the lover, and the guardian of the Great Goddess in

31 F.J. Child, ed., "A Gest of Robyn Hode", in: *The English and Scottish Popular Ballads*, Part V, Boston: Houghton Mifflin, 1888, p. 65, Internet Archive: http://www.archive.org/details/englishscottishp05chil.

32 Lady Raglan, op. cit., pp. 50-51.

33 R. Segal, ed., *In Quest of the Hero*, Princeton, NJ: Princeton University Press, 1990, pp. xii, xxvi-xxix.

34 Lady Raglan, op. cit., p. 48.

the culture of the Danube basin from the seventh millennium B.C. onwards."[35] The Green Knight, King Arthur, Robin Hood, and other such heroes are "a recrudescence in poetry of the Green Man," himself "descendant of the Vegetation or Nature god of almost universal and immemorial tradition," who with "a composite of leaves and a man's head, symbolizes the union of humanity and the vegetable world."[36] Such an "angelic archetype responsible for all vegetation" has "different manifestations of the same primal urge" for "death and renewal."[37] Indeed, he is "the very personification of springtime and 'summer is i-comen in' [as well as] a nightmarish spectre," an "association between the human and plant elements," a symbiosis at once in harmony and struggle.[38] But there "is no single, archetypal meaning to which the Green Men have to conform."[39]

To some in the arts and humanities, the Earth Mother actually complements and contradicts the Green Man within an archetypal dualism between the feminine and the masculine. Thus, tokenized mediation for the Green Man of Lady Raglan has accelerated since the beginnings of the contemporary ecological and environmental movement in the 1960s, and with chemist James Lovelock and microbiologist Lynn Margulis setting forth their "Gaia hypothesis" in the 1970s. The Gaia theory, so-named after the mythological personification of cosmogenic principles in ancient Greece, proposes that all living organisms coevolve with their environment. This Earth Mother and the Green Man—much like the Yin and Yang in Chinese philosophy or Shakti and Shiva in Hindu religion—represent a dynamic system of opposing forces wherein the assembled whole is more than the sum of its parts. And where Gaia appears, the Green Man accompanies. Or so pens William Anderson, who poeticized how Green Man "can be seen as the child of Gaia by the sun [and] the living face of the earth."[40]

Archetypically-speaking, the Green Man and the Earth Mother form a kourotrophic iconology, their relationship that between a child and its mother, fellow consorts, or passionate lovers.[41] This bilateral complementarity re-connects us with our "living roots," "more or less wild instincts," and "sexuate urges." This is crucial, advocate philosophers Luce Irigaray and Michael Marder, for "becoming able to be-

35 C.J.P. Cave, *Roof Bosses in Medieval Churches: An Aspect of Gothic Sculpture*, Cambridge: Cambridge University Press, 1948, p. 66.

36 J. Speirs, *Medieval English Poetry: The Non-Chaucerian Tradition*, London: Faber and Faber, 1957, pp. 274-300.

37 W. Anderson, *The Green Man: The Archetype of Our Oneness with the Earth*, San Francisco: HarperCollins, 1990, pp. 25, 31 and 55.

38 K. Basford, *The Green Man*, Revised Edition, Suffolk: D.S. Brewer, 1998, p. 19.

39 J. Harte, *The Green Man*, Andover, MA: Pitkin Unichrome, 2001, p. 10.

40 W. Anderson, op. cit., p. 156.

41 A. Rothery, "The Science of the Green Man", last modified 2004, p. 3, http://www.ecopsychology.org/ezine/green_man.html.

have as a living being among other living beings without domination or subjection."[42] Thus, the Green Man now is an eco-activist, the poster child for the environmental movement, brought down from sculpted motifs in architectural spaces and out into painted costuming within performative space. Already in 1810 with his *Sports and Pastimes of the People of England*, for example, English engraver Joseph Strutt represented such plant-thinking by showing how people got all dressed up as a green man with a head of leaves (*tete de feuilles*) and went to the spring "Pageantry."[43] And in ceremonial and ritual happenings at the Burning Man Festival (Black Rock City, Nevada since 1986), Green Man Festival (Brecon Beacons, Wales since 2003), Jack-in-the-Green May Day Festival (Hastings, East Sussex since 1983), and beyond, the Green Man continues to serves as a vivid reminder of the complex synergy that exists between humanity and its environment.

These days, the Green Man is applied and appropriated ever more widely. With the clear and present danger from climate change, extreme weather, and human-made disasters, what "being green" means today is being substituted left and right onto the faces of yesterday. For example, the Green Man is retrospectively said to be represented as the Celtic Viridios, Egyptian Osiris, Germanic Freyr, Greek Dionysus, Islamic al-Khidr, and Sumerian Tammuz. He is said to be represented in William Shakespeare's Puck and J.M. Berrie's Peter Pan. He is said to be represented in works by Neil Gaiman and J.K. Rowling. He is said to be represented as DC's Green Arrow, Green Lantern, and Swamp Thing, Marvel's Gamora, Groot, and The Incredible Hulk, Star Trek's Orions as well as Star Wars' Yoda, and the X-Files' Little Green Men. He is even said to be represented as the Jolly Green Giant from Minnesota Valley Canning Company.[44]

The Green Man, then, if we carry forward the archetype theory of analytic psychologist Carl Gustav Jung, can be psychically understood to be a universal pattern that recurs across spatial cultural*isms* and temporal hi*stories* independent from traceable lines of linear transmission. Despite their many differences, all of these green men arche-tokens of the Green Man arche-type point at one and same time to dual objects: the human face and a plant surface. Thereby, they attribute characteristics onto the anthropological from the ecological. As contended by ecopsychologist Andrew

[42] L. Irigaray, M. Marder, *Through Vegetal Being: Two Philosophical Perspectives*, New York: Columbia University Press, 2016, pp. 86-87. See also G.R. Verner, *The Mythic Forest, the Green Man and the Spirit of Nature*, Sanford, NC: Algora Publishing, 2006.

[43] J. Strutt, *Glig-Gamena Angel-Deod: or the Sports and Pastimes of the People of England; Including the Rural and domestic recreations, May-games, mummeries, pageants, processions, and pompous spectacles, from the earliest period to the present time: illustrated by engravings selected from ancient paintings; in which are represented most of the popular diversions*, 2nd edition, London: T. Bensley, 1810, p. 334, plate XXXII, Folger Shakespeare Library: https://luna.folger.edu/luna/servlet/detail/FOLGERCM1~6~6~241409~116054:Glig-gamena-angel-deod---or-the-spo.

[44] P.M. Araneo, "Green Man Resurrected: An Examination of the Underlying Meanings and Messages of the Re-Emergence of the Ancient Image of the Green Man in Contemporary, Western, Visual Culture", MA Thesis, University of the Sunshine Coast, 2006.

Rothery, such phytomorphic physiognomies represent an archetypal Conservator, Generator and/or Warrior with "ecological consciousness" or "green intelligence."[45]

In Jungian terms, the Green Man is a general "archetype-as-such" that in turn gives birth to specific "archetypal images."[46] Jung's "archetypes," theorized in part as a response to Freud's "pre-subjective schemas," also hold common ground with Plato's "ideas," Kant's "categories," and Schopenhauer's "prototypes."[47] For Jung, archetypes are "empty and purely formal, nothing but a *facultas praeformandi*, a possibility of representation which is given *a priori*."[48] The entirety of humanity's phylogenetic history gives birth a "collective unconscious" filled with such inherited, inner representations. And these primordial images, carried within each and every one of us, are just waiting to be manifested.

Yet, while landing a "psychic orderedness," archetypes—such as the Green Man—in and of themselves lack a "solid content."[49] From this psychological view for the philosophy of art and aesthetics, it would be absurd, then, to assume that such variable representations could be inherited. Instead, archetypes are thought to receive influence and come to consciousness in an encounter with empirical facts, and through contact with an environment outside of the actualizing individual. This might occur, for example, in 1939 when Lady Raglan visited St. Jerome Church in Wales, or since the 1970s when an environmental activist opposes climate change. With such an encounter, the inner nonvisible imagery of the archetype-as-such type (Green Man) in the human psyche becomes consciously represented in the outer visible imaging of an archetypal image tokens (green-faced men) in architectural spaces.

2. Greened and degreened faces: facial perception across the scientific imaginary

Of course, the face and its environment have not only been co-located together by their hybridizing representation as a phytomorphic physiognomy across the artistic imaginary. In fact, the human face may actually become a green color for a number of reasons. For example, the facial bones may become green after death. Or the facial skin may become green with disease. The purpose for the environment in the very perception of the face itself, however, only becomes visible from the study of face blindness across the scientific imaginary.

Among skeletal remains within ancient burial sites, archaeologists not infrequently unearth facial bones having a green patina. This was the case with the skull for

45 A. Rothery, op. cit.

46 C.G. Jung, *Four Archetypes*, ed. by S. Shamdasani, transl. by R.F.C. Hall (1959), Princeton, NJ: Princeton University Press, 2010, pp. 4-13.

47 A. Samuels, *Jung and the Post-Jungians*, Hove, East Sussex & New York: Routledge, 1986, pp. 23-24.

48 C.G. Jung, op. cit., p. 13.

49 Ibid.

a young woman of the *Unterwölbinger* culture from the Early Bronze Age c. 2020-1770 BCE (Fig. 4). Discovered among the Franzhausen Swietelsky grave fields in the Traisen Valley (near present-day Vienna), the Austrian Federal Monuments Authority excavated her between 1981 and 1983. The funerary rite for this 25-to-30 years old woman involved her being interred wearing ceremonial headgear made from sheet bronze, which over the course of time oxidized, altering her physiognomic remains from whiteish to greened.[50]

Other exhumations have also uncovered such a green-colored staining, only more localized among the mandible and maxilla bones from the oral region of the face. At the Cathedral of Santa María de Vitoria in Spain, for example, burial practices even involved placing a bronze coin into the mouth of the deceased.[51] This Medieval Christian ritual was grounded on the Greco-Roman polytheistic myth: that a ferryman (i.e. Charon) must be paid for passage across the "river of woe" (Acheron) and for carrying the soul to the underworld (Hades). From out of these coins, copper reacted with an environment turned acidic by decomposition of the corpse, to form basic copper carbonate, seep into the porous bone, and renew the face of the dead with a greenness.

Fig. 4: Facial bones with green patina from copper oxidization of ceremonial headgear, burial No. 110, Early Bronze Age, c. 2020-1770 BCE. Photograph © Department of Anthropology, Natural History Museum Vienna. Used with permission

50 Andrea Stadlmayr, Department of Anthropology, Natural History Museum Vienna, email communication to the author, 12 November 2018.

51 K.A. Hopkinson, S.M. Yeats, G.R. Scott, "For Whom the Coin Tolls: Green Stained Teeth and Jaws in Medieval and Post-Medieval Spanish Burials", *Dental Anthropology* 2008, vol. 21, no. 1, pp. 12-17. DOI: 10.26575/daj.v21i1.97.

And among pubescent girls and young women suffering from diverse symptoms, early modern European medical practitioners would diagnose a "green sickness" on the basis of their physiognomic complexion.[52] This diagnostic terminology and its associated symptomologies became such common knowledge that the English bard William Shakespeare scripted curses: "Out, you green-sickness carrion," "troubled / With the green-sickness," and "Now, the pox upon her green-sickness for me!"[53] Fainting, fatigue, digestive disorders, liver *jaundice*, menstrual dysfunction, post-partum period, even humoral imbalance or so-called female hysteria[54]—all of these heterogeneous conditions and more—physicians historically grouped under some variant of the label green sickness.

Between the sixteenth and nineteenth centuries, myriad doctors identified this "virgin's disease" (morbus virgineus) or "lover's fever" (febris amatorial) by looking for "a pallid greenish Tincture" to the skin; its sign that "the face and all the body is pale and white, and sometimes of a lead colour, blew [sic] and green;" such that "you may know the diseased, if you do but view their Faces."[55] And in the early seventeenth century, green sickness was termed chlorosis, variably denoting faces "the color of growing plants," "pale" or "blanched," while also connoting a state or condition associated with "desire," "loss of innocence" and "sexual experience."[56] Of course, there can be no one-to-one equivalency between these green sicknesses of the past and the biomedical taxonomies of the present. Even the meaning of the word "green" shifts over time. Nevertheless, contemporary doctors find the profile not dissimilar from hypochromic anemia. The acquired form of this anemia occurs in patients with a vitamin B6 deficiency from low iron intake. And the heredity form occurs with an iron overload that prevents red blood cells from accessing the iron. Consequently, these red blood cells appear paler than normal, and the face turns anemic—greenish.

With both these ancient burial practices and early-modern diagnostic languages, understanding and experience of the face was rooted in its relationship to the environment. The purpose for the environment in the perception of face, however, just started becoming apparent in the mid-twentieth century. It was made visible from cases of traumatic brain injury. Here, because the visual system is functionally segregated, it could be observed how damage to a specific brain area produces a specific neurological effect.

[52] H. King, *The Disease of Virgins: Greensickness, Chlorosis and the Problems of Puberty*, London: Routledge, 2004, p. 24.

[53] See W. Shakespeare, *Romeo and Juliet*, 1597, *3.5.156; Anthony and Cleopatra*, *1606, 3.2.4-6; and Pericles Prince of Tyre*, 1609, *4.6.13-14.* A. Oki-Siekierczak, "'How green!' The Meanings of Green in Early Modern England and in *The Tempest*", *E-rea* Online, 2015, http://journals.openedition.org/erea/4465.

[54] W. Schleiner, "Early Modern Green Sickness and Pre-Freudian Hysteria", *Early Science and Medicine* 2009, vol. 14, no. 5, pp. 661-676. DOI: 10.1163/138374209X12465448337628.

[55] As quoted by H. King, op. cit., pp. 29-32.

[56] Ibid., p. 37.

In 1947 with his case studies on "The Prosop-Agnosia," presented in *Archives of Psychiatry and Neurological Sciences*, German neurologist and social pathologist Joachim Bodamer (1910-1985) described a 24-year old Patient S who on the 9th of November 1944 came into his care with a gunshot wound to the head.[57] Patient S, while still completely blind for several weeks after his injury, gradually began to regain his sight at the hospital in southern Germany. Yet, visual impairment in seeing both color and form continued. What is more, Patient S could not perceive faces; he was "face blind." As Bodamer reported the case:

> Patient S "recognized a face as such, i.e. as different from other things, but could not assign the face to its owner. He could identify all the features of a face, but all faces appeared equally 'sober' and 'tasteless' to him. Faces had no expression, no 'meaning' for him…. He could distinguish men and women only by their hair or head covering and even then not always with certainty. Even S's own face, viewed in the mirror, evoked no spark of recognition: 'It could be that of another person, even that of a woman.'"[58]

By the exhibition of these symptoms, Patient S drew Bodamer's attentional gaze to the existence of a certain neurological inability for processing sensory information from the environment, and to how this disorder can simultaneously involve (un)perceiving both face and color. Bodamer termed his diagnosis *prosopagnosia*, a new sub-classification in the visual agnosias.[59]

Such an "ignorance to the face" had already been studied at least to some extent in the nineteenth century by ophthalmologist Antonio Quaglino, neurologist John Hughlings Jackson, and pathologist Jean Martin Charcot. But it was Joachim Bodamer's term prosopagnosia that famously entered the scientific imaginary. In 1985 with *The Man Who Mistook His Wife for a Hat*, for example, neurologist Oliver Sacks—whose clinical tales and patient stories have to date inspired three major motion pictures—portrayed the titular Dr. P with this "special form of visual agnosia."[60] When "the examination was over," Dr. P "started to look round for his hat. He reached out his hand, and took hold of his wife's head, tried to lift it off, to put it on. He had apparently mistaken his wife for a hat!" Wonderfully, she was unfazed. And, being acclimated to her husband's neurodiversity, she did not take it personally.

In fact, congenital or developmental prosopagnosia is not rare. About ten percent of people are born with some hereditary degree of face blindness (like Dr. P). The specific effects of acquired prosopagnosia, however, depend on the specific areas of brain damage (like Patient S). Whether from ballistic trauma or other physical injury,

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57 J. Bodamer, "Die Prosop-Agnosie", *Archiv für Psychiatrie and Nervenkrankheiten* 1947, no. 179, pp. 6-53.

58 H.D. Ellis, M. Florence, "Bodamer's (1947) Paper on Prosopagnosia", *Cognitive Neuropsychology* 1990, vol. 7, iss. 2, p. 86. DOI: 10.1080/02643299008253437.

59 M.J. Farah, *Visual Agnosia*, Second Edition, Cambridge, MA: MIT Press, 2004, p. 92.

60 O. Sacks, *The Man Who Mistook His Wife for a Hat and Other Clinical Tales* (1985), New York: Picador Books, 2015, pp. 7, 10, 12.

if the damage is to the front of the inferior temporal cortex, the individual may be able to detect faces in the environment but may not be able to recognize who the face belongs to. And if the damage is to the back of the inferior temporal cortex, they may not be able to detect faces at all. These brain areas and effects are relatively consistent across individuals. Still, brain damage often covers multiple anatomical landmarks. So, it remains challenging across the scientific imaginary for researchers to disentangle where in the brain is its sensitivity to face and where to color.[61]

Clearly though, our functioning in the environment depends upon our perception of the face, as Joachim Bodamer described with the pathology for face blindness in the case history of Patient S. In the words of Oliver Sacks: not being able to recognize somebody, or at least not being able to recognize them by the face, can lead a person to lose "the emotional, the concrete, the personal, the 'real' [and be] reduced, as it were, to the abstract and the categorical."[62] Humans are, after all, social animals. We live in a world involving face-to-face (as well as technology-mediated) interactions with others. And by means of the face (as well as its representations), we communicate our thoughts, what actions we may do, how we feel, and more.

Indeed, even the morphology of the face itself evolved through interactions between one face and another in their environment, during the mating game with its intersexual choice and intrasexual competition, with natural selective and sexual pressures. Thus, all facial behavior "once existed in a much lower and animal-like condition," as naturalist Charles Darwin revolutionarily argued in 1872 with *The Expression of the Emotions of Man and Animals*.[63] A century later, psychologist Paul Ekman, who developed the Facial Action Coding System (FACS) used today in facial recognition, even defined the face as "a multimessage, multisignal semiotic system" that receives and sends information about intention, cognition, affect, and more.[64] Such patterns of expressive action help also to establish an "image of self," delineated in terms of social attributes, encounters, and values, in a process sociologist Erving Goffman called "face work."[65]

Only in the early twenty first century, though, and in just the last decade, have scientific researchers begun to explore the role of color for face perception. Psychologists, neurologists, and evolutionary biologists debate how selective pressures in the

61 B. Sorger, R. Goebel, Ch. Schiltz, B. Rossion, "Understanding the Functional Neuroanatomy of Acquired Prosopagnosia", *NeuroImage* 2007, vol. 35, no. 2, pp. 836-852. DOI: 10.1016/j.neuroimage.2006.09.051.

62 O. Sacks, op. cit., p. 7.

63 Ch. Darwin, *The Expression of the Emotions in Man and Animals* (1872), New York: Penguin Books, 2009, p. 130.

64 J.F. Cohn, P. Ekman, "Measuring Facial Action", in: *The New Handbook of Methods in Nonverbal Behavior Research*, ed. by J.A. Harrigan, R. Rosenthal, K.R. Sherer, Oxford & New York: Oxford University Press, 2008, p. 9.

65 E. Goffman, "On Face-Work: An Analysis of Ritual Elements in Social Interaction", in: *Interaction Ritual: Essays in Face-to-Face Behavior*, ed. by E. Goffman (1967), New York: Doubleday, 2005, pp. 5-45.

environment have shaped the evolution of our trichromatic vision, which requires only red, green, and blue values to represent all the colors on the visible spectrum, converting information from photosensitive cells in the eye retina to neural signals in the visual cortex. Perhaps better foraging for young leaves or fruits may have provided adaptive utility. Or perhaps better detecting of intraspecific signals like those about sexual fitness or threat display may have provided selective advantage. Certainly, however, as evolutionary biologist Adam S. Wilkins made clear, how we sense the face, and how we sense a color, evolved together.[66]

In particular, the red-green channel in the human visual system is increasingly being shown to be important for facial behavior categorization of socially relevant information such as aggressiveness, attractiveness, dominance, emotion, fitness, health, or sex.[67] For example, psychologists Ian D. Stephen and Angela M. McKeegan, at the time respectively in the Department of Experimental Psychology at the University of Bristol and School of Psychology at University of Ulster, performed an experiment about how the color of the face effects its attractiveness. In this context, of course, facial color is not used in the cultural sense of the term, as it relates to ethnicity or race, identity or valuation. It is used in the biological sense, as it results from genetics, including hemoglobin circulation, melanin pigmentation, and ultraviolet ray exposure, as well as the fertility cycle and hormone levels. During this experiment, Stephen and McKeegan asked their research subjects to manipulate the color of the lips in color-calibrated digital photographs of the face along CIELab color-space axes in order to enhance attractiveness and sex typicality (Fig. 5).[68]

The experiment participants chose to increase the redness and decrease the greenness in lip contrast to enhance the femininity of female faces. And they chose to decrease the redness and increase the greenness in lip contrast to enhance the masculinity of male faces. To these participants, the degreened faces of women appeared more youthful and the greened faces of men appeared less aggressive, which respectively enhanced the attractiveness of these sexes. These findings, among others, confirm that the skin color of the face, by reflecting pigmentation levels, may act as a valid behavioral signal. Determined by the blood perfusion and oxygenation, the red-green axis in facial chromaticity is associated with cardiac health, sex hormones, and the absence of certain kinds of illness (such as the *hypochromic anemia* in the past known as green sickness), effecting categorization and even memory for individuals.[69]

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66 A.S. Wilkins, op. cit., pp. 226-229.

67 I.D. Stephen, D.I. Perrett, “Color and Face Perception”, in: *Handbook of Color Psychology*, ed. by A. Elliot, M.D. Fairchild, A. Franklin, Cambridge: Cambridge University Press, 2015, pp. 585-602. See also: C.F. Benitez-Quiroz, R. Srinivasan, A.M. Martinez, “Facial Color is an Efficient Mechanism to Visually Transmit Emotion”, *Proceedings of the National Academy of Sciences of the United States of America* (PNAS) 2018, vol. 114, no. 14, pp. 3581-3586. DOI: 10.1073/pnas.1716084115.

68 I.D. Stephen, A.M. McKeegan, “Lip Color Affects Perceived Sex Typicality and Attractiveness of Human Faces”, *Perception* 2010, vol. 39, no. 8, pp. 1104-1110. DOI: 10.1068/p6730.

69 A.D. Johnson, M.J. Tarr, “Red-Green, but Not Blue-Yellow, Color Manipulations Affect Memory of Facial Identity”, *Journal of Vision* 2004, vol. 4, no. 8, p. 419. DOI:10.1167/4.8.419.

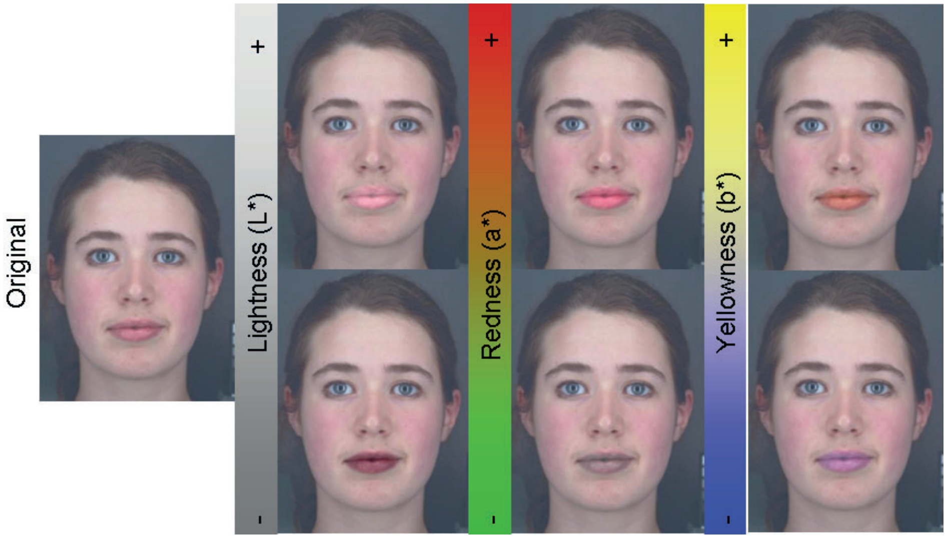

Fig. 5: An original face photograph (left), with high (top row) and low (bottom row) endpoints of the lip color manipulations, including the red-green axis calibrations (center column) and increased greenness (center column, bottom row). I.D. Stephen, A.M. McKeegan, "Lip Color Affects Perceived Sex Typicality and Attractiveness of Human Faces", *Perception* 2010, vol. 39, no. 8, p. 1106. Used with kind permission

Much like how Lady Raglan opened the concept of the Green Man to further artistic discourse by giving him a name, Dr. Bodamer opened the concept of face blindness to further scientific discourse by giving it a diagnosis. And in the years since Bodamer first published his description, scientists have developed our discernment of prosopagnosia forward, to discover ever more about how our neural machinery analyzes face. For example, neurobiologist Winrich Freiwald at Rockefeller University, neurobiologist Margaret Livingstone at Harvard Medical School, and system neuroscientist Doris Tsao at the California Institute of Technology, utilized neuroimaging techniques and electrophysical recording in order to observe how the brain structures of macaque monkeys became activated in specialized response to the face.[70]

During these experiments, the animal research subjects responded to various images of the face, from photographic representations to diagrammatic abstractions

[70] D.Y. Tsao, M.S. Livingstone, "Mechanisms of Face Perception", *Annual Review of Neuroscience* 2008, no. 31, pp. 411-437. DOI: 10.1146/annurev.neuro.30.051606.094238; D.Y. Tsao, N. Schweers, S. Moeller, W.A. Freiwald, "Patches of Face-Selective Cortex in the Macaque Frontal Lobe", *Nature Reviews Neuroscience* 2008, no. 11, pp. 877-879. DOI: 10.1038/nn.2158; W.A. Freiwald, D.Y. Tsao, M.S. Livingstone, "A Face Feature Space in the Macaque Temporal Lobe", *Nature Neuroscience* 2009, no. 12, pp. 1187-1196. DOI: 10.1038/nn2363; W.A. Freiwald, D.Y. Tsao, "Functional Compartmentalization and Viewpoint Generalization within the Macaque Face-Processing System", *Science* 2010, no. 330, pp. 845-851. DOI: 10.1126/science.1194908.

more along the lines of cartoons or emoji. Freiwald, Livingstone, Tsao, and their lab mates found that for primates both macaque as well as human particular brain cells "light up" when perceiving face. And they called these neural clusters "face patches." According to those findings, different face patches are dedicated to different facial information, such as the frontal or profile views of the face, its gaze direction or spatial position, and the shape of its various features. These face patches then interconnect across brain areas in a biological neural network that serves as a processing stream for information about the face.[71] When viewing test images, signals from individual cells of the face patches would not respond just to isolated features such as the eyes, mouth and/or nose. They would respond only to the total form of the face in all its complexity. That is, brains cells activated or fired only when stimulated by the face's gestalt, an organized whole more than the sum of its parts.

If we carry forward these experiments into a neuroarthistorical perspectivizing,[72] they may also be relevant for understanding the Green Man in architectural spaces, and how this figurative motif can make knowledge in stone legible to the literate and illiterate alike, as Lady Raglan first described with her 1939 article.[73] By using neuroimaging techniques and image stimuli, Freiwald, Livingstone, and Tsao additionally found that the face patches of the macaque monkeys responded to two eyes and one mouth only when inside of a circle.[74] A facial contour, some edge or line that bounded and defined the face as an object or shape, was necessary for the macaques to discriminate the face in relation to its environment.[75] Behavioral studies have similarly found that features external to the face, such as hair or hats, can boost performance in face detection tasks.[76] This may be one reason why, for the phytomorphic physiognomy of the Green Man, the "oak leaves growing from the mouth and ears, completely encircling the head" directs the gaze and draws the attention of the viewer to it as well as its "very prominent position" within architectural spaces.[77]

Across the scientific imaginary, however, it has proven difficult to reconcile the evidence: firstly, neuroimaging techniques and electrophysical recording showing functionally-specialized and largely-independent brain circuits process faces and

[71] W.A. Freiwald, D.Y. Tsao, M.S. Livingstone, op. cit. See also J.V. Haxby, M.I. Gobbini, "Distributed Neural Systems for Face Perception", in: *Oxford Handbook of Face Perception*, ed. by A.J. Calder, G. Rhodes, M.H. Johnson, J.V. Haxby, Oxford & New York: Oxford University Press, 2011, pp. 93-110.

[72] E.R. Kandel, *Reductionism in Art and Brain Science: Bridging the Two Cultures*, New York: Columbia University Press, 2016, pp. 26-39.

[73] Lady Raglan, op. cit., p. 48.

[74] W.A. Freiwald, D.Y. Tsao, M.S. Livingstone, op. cit.

[75] See, for example: P. Liu, L. Montaser-Kouhsari, H. Xu, "Effects of Face Feature and Contour Crowding in Facial Expression", *Vision Research* 2014, no. 105, pp. 189-198. DOI: 10.1016/j.visres.2014.10.014.

[76] See, for example: A. Torralba, S. Pawan, "Detecting Faces in Impoverished Images", *Artificial Intelligence Laboratory Memos* 2001, pp. 1-13. DOI: 10.1167/2.7.601.

[77] Lady Raglan, op. cit., p. 45.

colors; and secondly, clinical observations about prosopagnosia and achromatopsia showing how face blindness and color blindness so often go together. To address this discrepancy between data, neuroscientists Rosa Lafer-Sousa and Bevil Conway, in the Martinos Center for Biomedical Imaging at Massachusetts General Hospital, used functional magnetic resonance imaging in order to measure and compare "the responses to color with the responses to achromatic images of faces" in rhesus macaques.[78] For these fMRI experiments, Lafer-Sousa and Conway projected visual stimuli onto a screen in front of the animals that displayed the images of faces (e.g. frontal/non-frontal, familiar/unfamiliar, entirely/partially scrambled). As they sensorially perceived these face images, the "time course" for the macaques' responses, or what information about face they cognitively processed when and in what order, suggested how both face patches and color areas in the brain have an interactive, hierarchical arrangement. While these regions generally do not directly overlap, face- and color- specific information does link through a multistage processing stream—and does so in humans as in macaques.[79] This synergy may help to explain Bodamer's observations about how face and color blindness co-occur not infrequently.

Brain and cognitive scientists, further exploring the relationship between the perception of face and color less than fifty years after Bodamer and Patient S, began utilizing computers to model the human visual system.[80] This computational modelling has revealed, among other things, that perceiving the face depends upon our ability to detect and to recognize facial features. In the early twentieth century, however, scientific researchers are still determining which attributes (color, form, shape, light, etc.) of the face and its features the visual system uses during its perception tasks, and to what extent those stimuli are important for distinguishing the face both locally part-to-part and globally part-to-whole—as well as from other somethings out there in the environment at large.[81]

Putting these early computer models to the test, neural systems engineer Shay Ohayon at the Massachusetts Institute of Technology, along with Freiwald and Tsao, presented macaque monkeys with machine-made images in order to "assess selec-

[78] R. Lafer-Sousa, B.R. Conway, "Parallel, Multi-Stage Processing of Colors, Faces and Shapes in the Macaque Inferior Temporal Cortex", *Nature Reviews Neuroscience* 2013, vol. 16, no. 12, pp. 1870-1878. DOI: 10.1038/nn.3555.

[79] R. Lafer-Sousa, B.R. Conway, N.G. Kanwisher, "Color-Biased Regions of the Ventral Visual Pathway Lie between Face- and Place-Selective Regions in Humans, as in Macaques", *Journal of Neuroscience* 2016, vol. 36, no. 5, pp. 1682-1697. DOI: 10/1523/JNEUROSCI.3164-15.2016. See also: N. Dupuis-Roy, S.F. Soubeyrand, F. Gosselin, "Time Course of the Use of Chromatic and Achromatic Facial Information for Sex Categorization", *Vision Research* 2018. DOI: 10.1016/hj.visres_2018_08_004.

[80] V. Bruce, A. Young, *In the Eye of the Beholder: The Science of Face Perception*, Oxford: Oxford University Press, 1998, pp. 47-88.

[81] See, for example: P. Sinha, "Identifying Perceptually Significant Features for Recognizing Faces", *Proceedings of SPIE Electronic Imaging Symposium* 2002, vol. 4662, pp. 12-21. DOI: 10.1117/12.469529.

tivity for luminance contrasts in the face."[82] Ohayon and his team composed these "artificial parameterized face stimuli" by decomposing a "picture of an average face" into a "face-like collage of regions," each with a "unique intensity value, ranging between dark and bright," so as to generate permutations that covered all possible combinations between parts of the face and intensities of luminosity.[83] In agreement with computer models, fMRI neural recordings showed that the face patches in the macaque brain activated in response to the machine images and their relative contrast.

Significantly, in these experiments, the critical visual stimulus factor for determining response magnitude proved to be "contrast polarity."[84] That is, the difference in luminance between features of the face signals the brain about facial absence or presence. Testing these results with photographic images of "real" faces, Ohayan and colleagues also found that face-sensitive cells in the brain lit up both in response to luminosity contrasts as well as to feature shapes, a neural activation that only increased with the number of contrast-defined facial features. This stands to evolutionary reasoning. After all, under the natural lighting conditions where the visual system evolved, the eyes tend to appear darker than the forehead, the nose tends to appear brighter than the eyes, and so on.

Some psychologists have even investigated how facial chromaticity impacts the perception of the face through a technique known as "contrast negation." This has been shown to impair the perception of local part-to-part distances between facial features, the shape of the face in its three-dimensionality, and skin pigmentation.[85] For example, psychologists Benjamin Balas and Kate Stevenson, at North Dakota State University and Concordia College respectively, presented research participants with human as well as non-human primate facial images adjusted for positive or negative contrast (Fig. 6).[86] This stimulus set consisted of six full-color photographs for both human and macaque, adult males all; at 256 × 256 and 300 × 256 pixels, since the face of the human is vertically shorter than of the macaque; and cropped to the facial contour, with a circular or oval window in neutral black-or-white background color. Most significantly, they used GIMP (short for GNU Image Manipulation Program, a cross-platform, open source raster graphics editor) to invert pixel values and negate both the hue and luminance of the parent images, generating images where dark pixels became light and light became dark. Balas and Stevenson then presented

[82] S. Ohayon, W.A. Freiwald, D.Y. Tsao, "What Makes a Cell Face Selective? The Importance of Contrast", *Neuron* 2012, vol. 74, no. 3, pp. 567-568. DOI: 10.1016/j.neuron.2012.03.024.

[83] Ibid., p. 568.

[84] Ibid., p. 579.

[85] See, for example: R. Kemp, G. Pike, P. White, A. Musselman, "Perception and Recognition of Normal and Negative Faces: The Role of Shape from Shading and Pigmentation Cues", *Perception* 1996, vol. 25, no. 1, pp. 37-52. DOI: 10.1068/p250037.

[86] B. Balas, K. Stevenson, "Children's Neural Response to Contrast-Negated Faces is Species-Specific", *Journal of Experimental Child Psychology* 2014, vol. 119, pp. 73-86. DOI: 10.1016/j.jecp.2013.10.010.

these machine-made images to adults as well as children age four to six, continuously measuring their responses in terms of event-related potentials (ERP) using electroencephalography (EEG). This experiment showed that facial chromaticity impacts facial perception in the face-sensitive patches of the brain not only is specific to species, but that there is a difference between adults and children in how they respond, suggesting that the way in that we see the face develops and matures over a lifespan.

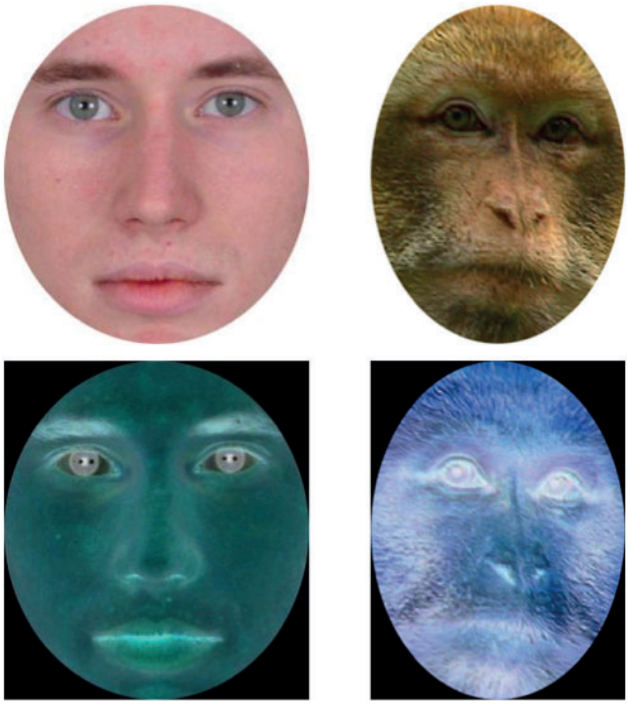

Fig. 6: Parent images of human and macaque faces with positive contrast (top row), adjusted for negative contrast (bottom row) where the human face appears green in color (bottom row, left column), as presented to research participants. B. Balas, K. Stevenson, "Children's Neural Response to Contrast-Negated Faces is Species-Specific", *Journal of Experimental Child Psychology* 2014, no. 119, p. 6. Used with kind permission

Again, from an eco-logical and neuroarthistorical perspective, the role of color luminosity and contrast for face perception may be one reason that the figurative motif of the Green Man so effectively highlights the face in relation to its environment, directing gaze and drawing attention to the features of its eyes, nose, and mouth in architectural spaces. Across the scientific imaginary, neurobehavioral research—from that done by Joachim Bodamer in the late 1940s to that done by Ohayon, Freiwald and Tsao in the early 2000s—even suggests a link between the areas of the brain that perceive faces and those controlling attention.[87] And, by further monkeying around, as it were, with images of the face, Freiwald, Livingstone, Tsao, and their lab mates found that macaques responded most dramatically to exaggerated facial features. As Lady Raglan described the Green Man, artists have often sculpted this plasticized grotesque with a high intensity of facial expressivity, an "extreme of realism" so in extremis that some have characterized the Green Man as a "fantastic monster" or captioned how "the carver's imagination has run riot."[88] But as established across the scientific imaginary, across the artistic imaginary the facial features of the Green Man were most likely intentionally exaggerated as a way to attract the attention of the viewer.

Of course, the human face may belong to a living person or a representational mask. The face may be made up of flesh, stone, or a numeric code of 1s and 0s. And the face may inhabit a pre-Christian architectural space or a post-digital smart environment. But regardless of its animation, materiality, or place, the multidimensional habitat for the face extends both "intrafacially" (inside the face itself, and between its features) as well as "extrafacially" (outside the face itself, and into the surroundings in which it expresses). Interpretation of the face has even been shown to depend on context, with the face patches in the brain demonstrating a context-sensitivity, their reaction to the face influenced by linguistic, emotive, and bodily cues, with valuation attributed out of expectation as well as perception.[89] But for the way face detection and recognition works, whether done by the human perceptual system or by a mediated vision system, the eyes, nose, and mouth must be located and identified away from and out of their ecological niche through a process of sensing dependent upon discriminating what is the face and what is its environment.

3. Unprismatizing greenlessness: facial recognition across the technological imaginary

This fundamental question, about the relationship between the face and its environment, the ways in which we make sense of the face and give it meaning, and how to extract and interpret the human face away from and out of its ecological niche, crosses not only the artistic and scientific imaginaries. Across the technological im-

87 E.R. Kandel, op. cit., p. 35.

88 Lady Raglan, op. cit., pp. 47-48.

89 M. Calbi, F. Siri, K. Heimann, D. Barratt, V. Gallese, A. Kolesnikov, M.A. Umiltá, "How Context Influences the Interpretation of Facial Expressions: A Source Localization High-Density EEG Study on the 'Kuleshov Effect'", *Scientific Reports* 2019, no. 9 (2107), pp. 1-16. DOI: 10.1038/s41598-018-37786-y. See also: P. Liu, L. Montaser-Kouhsari, H. Xu, op. cit., pp. 189-198; T. Minami, K. Nakajima, S. Nakauchi, "Effects of Face and Background Color on Facial Expression Perception", *Frontiers in Psychology* 2018, no. 9 (1012), pp. 1-6. DOI: 10.3389/psyg.2018.01012.

aginary as well, greening face is investigated, only not in the human visual system of face perception, but in computer vision systems for facial recognition.

In 1973 with his doctoral project "Picture Processing System by Computer Complex and Recognition of Human Faces" in the Department of Information Science at Kyoto University, Japanese computer scientist Takeo Kanade (金出 武雄 or Kanade Takeo, b. 1945) developed a new flexible picture analysis scheme with feedback, consisting of a collection of simple subroutines, each of which worked on a specific part of the picture.[90] Publishing this dissertation in 1977 under the title "Computer Recognition of Human Faces," Kanade's process for the computer measurement of facial features proceeded in two stages: first, by doing a coarse scan over the real-world image, transforming the image into gray-level, binary color; and second, by doing a fine scan over this adjusted digital image, extracting from the image both the specific parts and precise location of feature points in the face (Fig. 7).[91]

Computer Physiognomy was put on by The Nippon Electric Company (NEC) to showcase the economic growth and technological accomplishments of Japan post-World War II. These had been fueled in part by aid from the United States, which had built Japan up as an industrial base for the Korean and Vietnam Wars.[92] And as visitors approached the Japan Pavilion to interact with *Computer Physiognomy*, welcome banners and posters advertised the World Expo '70 motto "Progress and Harmony for Mankind." Historically, world fairs offered visitors a myth of the technological future as already being present. With no venue "to solicit the public's suggestions about emerging devices, systems, or role definitions," it staged "corporate-sponsored research and development of which ordinary people need only be in awe."[93] *Computer Physiognomy*, however, also had a more direct use value, yielding a database of facial images for budding research on the problems of computer face recognition.

By sorting living faces into social classifications, *Computer Physiognomy* demonstrated one of the many uses to which computers have since the 1960s been purposed. Such classifying of the face was hardly a new idea, however. Physiognomy has been around for some three millennia since classical antiquity. And this habit of thought is shown too by Lady Raglan with her Green Man type (and its foliated, disgorged, to bloodsucker tokens), Lord Raglan with his mythic hero archetypes (on a continuum between mythological and historical), and even Jung with his archetypes-as-such and archetypal images (Conservator, Generator, Warrior, etc.). However, at the World Expo '70, the computer appeared to fundamentally shift how the face can be experienced and understood.

90 T. Kanade, "Picture Processing System by Computer Complex and Recognition of Human Faces", Department of Information Science, Kyoto University, 1973.

91 T. Kanade, *Computer Recognition of Human Faces*, Basel: Birkhäuser, 1977, pp. 9, 26.

92 K.A. Gates, *Our Biometric Future: Facial Recognition Technology and the Culture of Surveillance*, New York: New York University Press, 2011, p. 25.

93 L. Winner, "Who Will We Be in Cyberspace?", *The Information Society* 1996, vol. 12, no. 1, p. 64. DOI: 10.1080/019722496129701.

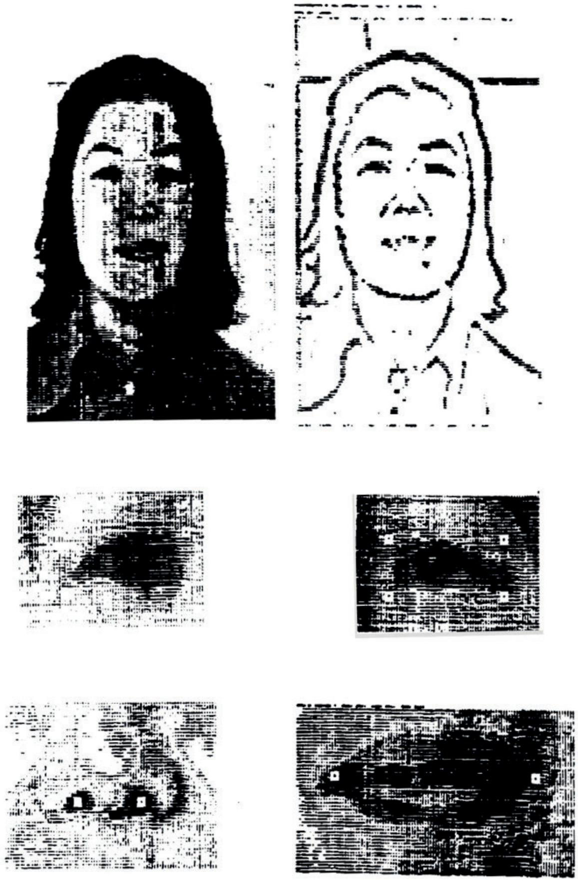

Fig. 7: Stage one coarse scan transforming real-world image into gray-level, binary color (top row), and stage two fine scan that locates eye corners, left eye corners, nostrils, and mouth extremities (bottom two rows). T. Kanade, *Computer Recognition of Human Faces*, Basel: Birkhäuser, 1977, p. 89. Used with kind permission

In the 1960s, computer scientists began developing face recognition for computer vision in response to clear and present social needs. Then as now, much but not all such research was being done with applications in mind for the logistics of military perception, as with the identification of enemy combatants or terror suspects. Funding for these early efforts, at least in the US during the post-*Sputnik* Cold War period as the Soviet Union and the United States struggled for technological superiority, even originated with the Department of Defense (DOD), the Defense Advanced Research Projects Agency (DARPA), and its Information Processing Techniques Office

(IPTO).[94] As Kanade himself speculated, these image processing techniques would one day contribute to "sophisticated applications such as interpretation of biomedical images and X-ray films, measurements of images in nuclear physics, processing of a large volume of pictorial data sent from satellites, etc."[95] The idea, however, was not to transfer the human onto a machine, but to hybridize machine and human, so that the sensory and cognitive faculties of the human could be extended by a machine.[96] And just some fifty years later, Kanade's techno-positive forecast has been fulfilled and is being furthered. Automated facial recognition systems, as well as the processes of image analysis developed in parallel to them, continue to find wider and wider application.

During this decade, in the years just before Kanade published his dissertation, several landmark researches prompted his doctoral project on computer recognition of human faces. In particular, Kanade referenced Woody Bledsoe at Panoramic Research, his own supervisor Toshiyuki Sakai at Kyoto University, and M.D. Kelly at Stanford. Each of these researches, in their way, encountered how most of the fundamental challenges with developing face perception for artificial intelligence and artificial vision originate from the relationship between the face and its environment.

Between 1964 and 1965 at the private company Panoramic Research Inc. in Palo Alto, California, computer scientist Woodrow Wilson (Woody) Bledsoe, along with Helen Chan and Charles Bisson, developed a "hybrid man-machine system" for facial recognition.[97] Little about the project is openly accessible today, principally because an unidentified intelligence agency provided the funding and favored no publicity.[98] Nevertheless, Kanade described this facial recognition based on geometrical parametrization and template matching.[99] With Bledsoe's technique, human operators used a graphical computer input device (RAND Tablet or Grafacon) to manually annotate digital photographs of the face and its environment for facial features and their coordinate positions (e.g. eye and mouth corners, pupils center, and hair contour at forehead midline). This "feature extraction" then enabled the computation of twenty different intrafacial distances inside the face itself and between its features (e.g. eye corners, mouth corners and pupil-to-pupil). Given a database of such template images (i.e. an "electronic mugbook") and a query image, the computer then matched query to template images by comparing their corresponding sets of distance measurements

94 K.A. Gates, op. cit., p. 29.

95 T. Kanade, *Computer Recognition of Human Faces*, p. 1.

96 M. DeLanda, *War in the Age of Intelligent Machines*, New York: Zone Books, 1991, p. 193.

97 W.W. Bledsoe, "Man-Machine Facial Recognition: Report on a Large-Scale Experiment", Technical Report PRI 22, Palo Alto, CA: Panoramic Research Inc., 1966; W.W Bledsoe, "Some Results on Multicategory Pattern Recognition", *Journal of the Association for Computing Machinery* 1966, vol. 13, no. 2, pp. 304-316; W.W. Blesdoe, H. Chan, "A Man-Machine Facial Recognition System—Some Preliminary Results", Technical Report PRI 19A, Palo Alto, CA: Panoramic Research Inc., 1965.

98 M. Ballantyne, R.S. Boyer, L. Hines, "Woody Bledsoe: His Life and Legacy", *AI Magazine* 1996, vol. 17, no. 1, pp. 7-20. DOI: 10.1609/aimag.v17i1.1207.

99 T. Kanade, *Computer Recognition of Human Faces*, pp. 4, 10, 48.

between facial features, returning the closest matching test image or "nearest neighbor."[100]

During this project at Panoramic Research, issues certainly arose from what psychologist Paul Ekman in the 1970s would define as the static, slow, rapid, and artificial signs of the face; basically, facial structure, aging, expression, and adornments (such as glasses, hats, or hair that may interrupt the visibility of the face).[101] But, additionally, Bledsoe found that "the recognition problem is made difficult by the great variability in head rotation and tilt, lighting intensity and angle."[102] Because of this, the face extends extrafacially outside of itself and into the surroundings within a multidimensional habitat, confounding the matching process. And the computer had a difficult time being able to read in an image what is the face and what is not. That is, if an image of the Green Man was put to this computer, it would not be able to tell the eyes, mouth, and nose of this sculpted motif from the ceilings, floors, and walls of its architectural space. During facial recognition, therefore, images must to be corrected so that the face can be discriminated in relation to its environment; images must to be "normalized."[103]

In 1968, Toshiyuki Sakai—who later became Kanade's doctoral supervisor—in the Department of Electrical Engineering at Kyoto University, along with his colleagues Makoto Nagao and Shinya Fujibayashi, also found that "one of the most difficult problems in pattern recognition is to locate an object" such as a face "in a noisy background" environment.[104] Sakai, Nagao, and Fujibayashi's method not only formed the basis for *Computer Physiognomy* at World Expo '70, but was also the earliest work to successfully program a computer to confirm either the absence or presence of the human face within a digital image of the face in its environment. As evidenced for the human visual system across scientific imaginary, sensing relative brightness, contrast, and luminosity is important during face perception for discriminating the face in relation to its environment. Similarly, for a computer vision system as evinced by the technological imaginary, basic problems arise during programming a computer to simply locate the face in its environment, since the face "may be partially hidden in other figures, and even if there is no obstacle they do not always appear the same, e.g. because the lighting is different in different situations."[105]

100 W.W. Bledsoe, "Man-Machine Facial Recognition…", qtd. in: M. Ballantyne, R.S. Boyer, L. Hines, op. cit., p. 11.

101 P. Ekman, "Facial Signs: Facts, Fantasies, and Possibilities", in: *Sight, Sound and Sense*, ed. by T. Sebeok, Bloomington, IN: Indiana University Press, 1978, pp. 125-126. See also M. Pantic, M.S. Bartlett, "Machine Analysis of Facial Expressions", in: *Face Recognition*, ed. by K. Delac, M. Grgic, Vienna: I-Tech, 2007, pp. 377-416.

102 M. Ballantyne, R.S. Boyer, L. Hines, op. cit., pp. 10-11.

103 K.A. Gates, op. cit., p. 30.

104 T. Sakai, M. Nagoa, S. Fukibayashi, "Line Extraction and Pattern Recognition in a Photograph", *Pattern Recognition* 1969, vol. 1, no. 3, pp. 233-248.

105 Ibid., p. 233.

Then in 1970 at Stanford University with a landmark dissertation project, around the same time *Computer Physiognomy* was staged during the World Expo, computer scientist M.D. Kelly introduced his "multiresolution image analysis" for discriminating the face away from and out of its environment.[106] Predicting later findings made across the scientific imaginary about the facial contour in face perception,[107] this facial recognition technique used an edge or line that bounded and defined the face as an object. And although in some ways similar to Bledsoe's technique of geometrical parametrization for template matching, Kelly's technique did not require human intervention. Rather, this top-down, two-stage program enabled a computer with automatic "planning:" first, to extrafacially extract the body and head outlines from an image; second, to intrafacially locate the facial features of the eyes, nose and mouth; before then comparing edge maps between a query image and a template image.[108] Kelly tested his technique on an image dataset consisting of 72 images, comprised of 24 sets of three images of ten persons, including a close-up image of the head and face, an image of the body, and an image without the body, head, or face but with its background or environment.

This general flow of processing, as Kanade described in 1973 with his doctoral dissertation, corresponds to his own technique. Although, in Kanade's technique, a flexible image analysis scheme was applied with feedback. Whereas, in Kelly's technique, edge detection and template matching were "all applied heuristically in a goal-directed manner" by a "straight-line program" to an "input picture in a predetermined order."[109] To exemplify, through this program the computer "smoothed" original images by local averaging, searched for edges that may outline the head in its environment, projected these edge locations back onto the original image, and locally performed a fine search for edges forming the head outline. The computer then repeated this process for the face. After outlining the body, head, and face, the computer extracted ten measurements (from the body, its height as well as the width of the head, neck, shoulders, and hips, and from the face, the width of the head as well as the distances between the eyes, from top of head to eyes, between eyes and nose, and from eyes to mouth), which it then used during matching query and template images to identify the class label (what expression, whose face, etc.).[110]

These early researches in facial recognition done by Woody Bledsoe, Toshiyuki Sakai, M.D. Kelly, and their colleagues, among others, provided the basis for Kanade to build his own technique. And much like how Raglan opened the Green Man to the artistic imaginary by giving him a name, and Bodamer opened face blindness

106 M.D. Kelly, "Visual Identification of People by Computer", Technical Report AI-130, Stanford AI Project, Stanford, CA 1970.

107 W.A. Freiwald, D.Y. Tsao, M.S. Livingstone, op. cit.

108 R. Chellappa, Ch.L. Wilson, S. Sirohey, "Human and Machine Recognition of Faces: A Survey", *Proceedings of the IEEE* 1995, vol. 83, no. 5, pp. 712, 718. DOI: 10.1109/5.381842.

109 T. Kanade, *Computer Recognition of Human Faces*, pp. 4-6, 48.

110 R. Chellappa, Ch.L. Wilson, S. Sirohey, op. cit., pp. 712, 718.

to the scientific imaginary by giving it a diagnosis, Kanade opened the concept of face recognition to the technological imaginary by giving it a technique. Kanade's technique for feature extraction in pattern recognition would, it can be said retrospectively, mark a paradigm shift for the study of the face. This human science has traversed over two millennia, without formal disciplinization, moving from classical physiognomy, through modern anthropometry, to contemporary biometrics. At the time of this writing, Takeo Kanade is a professor at The Robotics Institute of Carnegie Mellon University in Pittsburgh, Pennsylvania, and known worldwide as one of the foremost researchers in computer vision, facial recognition, and image processing. Since this inception of automated facial recognition systems in the late 1960s and early 1970s, however, more limited goals have been the norm with this area of research. Now computer scientists make incremental advances, rather than model revolutions, with how to program a computer for recognizing within a digital image the face in relation to its environment.

Much like across the scientific imaginary, today across the technological imaginary there continues to be the need for better epistemology and deeper understanding about the very physics of vision—both in humans and in machines. Overall the most significant challenge in facial recognition for computer vision is the relationship between the face and its environment, down even to how light wavelengths on the visible spectrum travel from the sun to the earth to be reflected by the structures typical of natural objects, making them sensible. Even the Green Man, over his many genealogical histories and token mediations, occurs in architectural spaces not as a two-dimensional (2D) but rather a three-dimensional (3D) sculpted motif. And such three-dimensionality, by exaggerating the contour and contrast of the face relative to its environment, likely increased how it directed the gaze and drew the attention.

This is to say that the human visual system evolved for an environment of three spatial dimensions as well as the temporal dimension. The living face takes its space and time within this multidimensional habitat. Computer vision systems, however, were designed for an environment of two spatial dimensions (height and width) as well as the temporal dimension (eventually at least with face tracking, moving pictures, and video analysis). And mostly, facial recognition happens within such bi-dimensional representations. After all, face recognition is done not on the living face itself, but on digital, digital copy, or digitized face images. This compression of data from the environment, and flattening of the visual field, severely constrains the programming of a computer for recognizing objects such as the face.[111] As with other areas of computer vision and artificial intelligence, therefore, the idea with automated facial recognition systems was to optimize human-machine divisions of perceptual labor.[112]

In the decades following these first efforts in facial recognition, *Computer Physiognomy* at the World Expo '70 in Japan, and Kanade's doctoral project on "Computer

[111] K.A. Gates, op. cit., p. 31.

[112] M. DeLanda, op. cit., p. 193.

Recognition of Human Faces," the research and development of techno-labor for abstracting data capital from facial behavior has accelerated. Not until the late 1980s and early 1990s, however, did automated facial recognition systems begin moving up from computer server rooms and out into post-digital environments.

Face recognition started to become a more widely integrated and invisible part of the everyday living face with ubiquitous computing—or ubicomp for short. In 1988, computer scientist Mark Weiser, then at Xerox Palo Alto Research Center (PARC), defined the term "ubiquitous computing" as describing "a physical world richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives and connected through a continuous network."[113] But actually, this idea had been first proposed forty years earlier, some ten years after Lady Raglan's "The 'Green Man' in Church Architecture" and a year after Dr. Bodamer's "The Prosop-Agnosia." Back already in 1948, cryptanalyst and mathematician Alan Turing hypothesized about the future of "Intelligent Machinery," that would encompass "television cameras […] as well as some sort of 'electronic brain'," and emulate the human visual system within some Cartesian apparatus.[114] As Weiser later dreamed, one day such machines would "fit the human environment, instead of forcing humans to enter theirs," also making even facial recognition as nonconscious ready-to-hand as face-to-face communication.[115]

Here and now, computer scientists across the technological imaginary develop ubiquitous computing applications with automated facial recognition for assisted living, autonomous cars, educational institutions, facilities management, healthcare services, home residences, retail stores, transport hubs, and beyond.[116] To exemplify: For smart retailors, Echion marketing solutions in Germany is testing how facial recognition may be used at the grocery check-out line in order to personalize advertising for targeted demographics by scanning the age and sex of these consumers.[117] For smart cars, the Affectiva software company in Boston is prototyping how facial recognition may be used in an automobile in order to provide drivers with adaptive infortainment and fatigue monitoring through in-cabin emotion sensing.[118] And for smart campuses, Hangzhou No. 11 High School in eastern China is analyzing how

[113] M. Weiser, R. Gold, J.S. Brown, "The Origins of Ubiquitous Computing Research at PARC in the Late 1980s", *IBM Systems Journal* 1999, vol. 38, no. 4, p. 694.

[114] A. Turing, "Intelligent Machinery", in: *Mechanical Intelligence: Collected Works of A.M. Turing*, ed. by D.C. Ince (1948), Amsterdam: North Holland, 1992, pp. 107-127.

[115] M. Weiser, "The Computer for the 21st Century", *Scientific American*, September 1991, pp. 94-104.

[116] See, for example: E. Lonzano-Monasor, M.T. López, F. Vigo-Bustos, A. Fernández-Caballero, "Facial Expression Recognition in Ageing Adults: From Lab to Ambient Assisted Living", *Journal of Ambient Intelligence and Humanized Computing* 2017, vol. 8, no. 4, pp. 567-578.

[117] C. Bleiker, "Personalized Ads in the Real World", *DW News*, posted 6 June 2017, https://www.dw.com/en/personalized-ads-in-the-real-world/a-39133518.

[118] R. el Kaliouby, "Driving Your Emotions: How Emotion AI Powers a Safer and More Personalized Car", *Affectiva* Blog, posted 5 January 2017, http://blog.affectiva.com/driving-your-emotions-how-emotion-ai-powers-a-safer-and-more-personalized-car.

facial recognition may be used during class lessons in order to help teachers monitor student attention and performance through an Intelligent Classroom Behavior Management System (Fig. 8).[119] Within these so-called "smart environments," automated facial recognition systems are used in order to sense the presence and preferences of their human inhabitants, adjusting the environment to their needs, and continuously bettering quality of life.[120]

fig. 8: Smart Campus demonstration observed by visitors 21st China Beijing International High-Tech Expo (CHITEC), where the color green is used to visually represent the facial contour with a square picture plane when detecting the face in relation to its environment, 18 May 2018, Beijing, China. Photograph © Associated Press (AP)/Mark Schiefelbein. Used with permission

And for smart stations, the Centre for Machine Vision at the Bristol Robotics Laboratory in the UK is proposing how facial recognition may be used at the railway station security check in order to identify passengers and fast-track lanes.[121] Computer scientists and electrical engineers Lyndon Smith, Wenhao Zhang, Melvyn Smith, and their lab mates at the University of the West of England, determined the face to be more recognizable in three dimensions than in the two dimensions most automated facial recognition systems compress and flatten it down into. From the shape in space of the face, approximately eighty unique nodal points discriminate the face of

[119] N. Connor, "Chinese School UsesFacial Recognition to Monitor Student Attention in Class", *The Telegraph*, posted 17 May 2018, https://www.telegraph.co.uk/news/2018/05/17/chinese-school-uses-facial-recognition-monitor-student-attention/.

[120] D.J. Cook, S.K. Das, *Smart Environments: Technology, Protocols, and Applications*, Hoboken, NJ: Wiley, 2005, p. 3. See also: Z. Mahmood, ed., *Guide to Ambient Intelligence in the IoT Environment: Principles, Technologies and Applications*, Berlin: Springer, 2019.

[121] L.N. Smith, W. Zhang, M.L. Smith, "2D and 3D Face Analysis for Ticketless Rail Travel", in: *International Conference on Image Processing, Computer Vision, and Pattern Recognition (IPCV'18)*, ed. by H.R. Arabnia, L. Deligiannidis, F.G. Tinettii, Athens, GA: CSREA Press, 2018, pp. 16-22.

one person from that of another person as well as from the environment. With this 3D machine vision system at the railway station security checks, a person walks by and light-emitting diodes (LEDs) emit flashes of near infrared (invisible) light to illuminate their face. The system then applies a lighting template and algorithm to detect orientations between parts of the face across the whole of its surface. In this way, a high-resolution 3D model of the face is recovered, which can be employed as a biometric. The machine vision system can then compare a given 3D digital face image to those in a database of rail users who have already signed up and been scanned, in order to check whether or not each traveler has purchased a ticket. The system is robust enough in its sensing that it can even discriminate between the 3D face of a person and a 2D photograph of their face (Fig. 9).

Green as a color, of course, can be found in these smart environments. It can be found in the smart campus of the Intelligent Behavior Management System in China (Fig. 8). And it can be found in the smart station from the Bristol Robotics Laboratory in the UK (Fig. 9). Or, at least, here green is made visible to users of automated facial recognition systems on the surface of the interface. For these ubiquitous computing applications, computer scientists encode a green among the colors used to visually represent: the facial contour with a rectangular or square picture plane when detecting the face in relation to its environment,[122] surface feature shapes recovered from the face,[123] and even temperature differences between facial expressions classified during thermal imaging.[124] Here, green functions as a bracket, frame, or window through which the face is made recognizable as something within the field of computer vision. It functions to discriminate extrafacially part-to-whole the face from other somethings in the environment or intrafacially part-to-part between facial features. Across the artistic imaginary, Lady Raglan described the Green Man as a "man's face, with oak leaves growing from the mouth and ears, completely encircling the head."[125] And across this technological imaginary, much like with the Green Man, green has a diagrammatic form and not a datafying function. It is useful only to "cut and paste" the face away from and out of its environment. It tells, and does not show, information about the relationship between humans and the world all around them.

[122] N. Connor, op. cit.

[123] L.N. Smith, W. Zhang, and M.L. Smith, op. cit.

[124] See, for example: S. Jarlier, D. Grandjean, S. Delplanque, K. N'Diaye, I. Cayeux, M.I. Velazco, D. Sanday, P. Vuilleumier, K.R. Scherer, "Thermal Analysis of Facial Muscles Contractions", *IEEE Transactions on Affective Computing* 2011, vol. 2, no. 1, pp. 2-9. DOI: 10.1109/T-AFFC.2011.3. Also: S. Matsuno, T. Mizuno, H. Asano, K. Moto, N. Itakura, "Estimating Autonomic Nerve Activity using Variance of Thermal Face Images", *Artifical Life and Robotics* 2018, vol. 23, no. 3, pp. 367-372. DOI: 10.1007/s10015-018-0436-z.

[125] Lady Raglan, op. cit., p. 45.

Fig. 9: Three-dimensional machine vision system for smart railway stations, discriminating between the 3D face of a person (right) and a 2D photograph of their face (left), where green is among the colors used to visually represent the face during surface gradient reconstruction. Photograph © Centre for Machine Vision, Bristol Robotics Laboratory, University of the West of England, Bristol, UK. Used with kind permission

A green color, however, is not only superficial in recognition processes, but may also be salient in recognition performance. The red-green channel hue distribution of the human face in a digital image, for example, affords for more robust detection of eye shape and size than does luminance information.[126] When image resolution is degraded, facial recognition performs with color images significantly better than with gray-level. And, indeed, facial signs may be encoded primarily on the basis of luminance-defined bounding-edge structure—the absence of greenness, or its presence.

But in post-digital smart environments, the human face is also conceptually unprismatized into a greenlessness. Ubiquitous computing applications with automated facial recognition work in principle by detecting, extracting, and classifying the face based on matching or comparing visible query images to nonvisible template images. These dataset images go through a process of normalization that may include: staged expressors in a controlled laboratory but not spontaneous expressions in an uncontrolled nature; image alignment, cropping, and resizing for face-only no-background data; compressing and flattening the face from its native three dimensional space to an artificial two dimensions; and, more often than not, gray-level monochromatic values rather than color polychromatic channels.[127] As with Kanade's technique,

[126] A.W. Yip, P. Sinha, "Contribution of Color to Face Recognition", *Perception* 2002, no. 31, pp. 995-1003. DOI:10.1068/p3376.

[127] A. Pentland, T. Choudhury, "Face Recognition for Smart Environments", *IEEE Computer* 2000, p. 51.

today's digital imaging of the face in relation to its environment that is used while doing facial recognition transforms the living face, in all its multidimensional and polychromatic glory, into a bidimensional and binary-colored representational face.

Conclusion

Across the tales of Raglan, Bodamer, and Kanade, I have with this paper explored what has become of the relationship between the face and its environment, the extent to which this relationship is constant from the past and is changing for the present, and the role green—as both a color and a concept—plays in how the face is made sensible:

Across the artistic imaginary, the face and its environment are represented together in hybrid-icons. Such phyotomorphic physiognomies share visual attributes from both the human face and a plant surface. And they signify the attribution of characteristics from a plant onto the human, serving as a reminder of seasonal fertility and spring celebration. The tale of the Green Man perhaps best exemplifies these ideas. The Green Man is a hero with a thousand faces. In pre-Christian (as well as Christian) architectural spaces throughout Western cultures and European civilizations, he has many genealogical histories and token mediations, independent from traceable lines of socio-cultural diffusion or transmission. This sculptural motif can have branches and leaves surrounding its head, spewing from its mouth, or sprouting from its orifices. He can be made out of ceramic, glass, stone, wood, or some other thingyness. And he can be located in the ceiling, door, floor, or wall of a church, estate, or palace. He can even be performed. But regardless of these variations, the Green Man need not necessarily be—but often is—green in color.

The Green Man is certainly, however, "green" in concept. A recurrent imaging, the Green Man makes visible through its mediations the sum of human knowledge about the environment at any given cultural space and historical time. And he can be understood by literate and illiterate alike, those who read texts as well as those who read images, open to all who have visual literacy. The Green Man, often, is interpreted in relation to an Earth Mother within a mythological personification of cosmogenic principles. Here, he is conventionally encoded within a dualistic system of opposing forces (e.g., death and life, masculine and feminine, technology and nature) which both contradict and complement each other. The Green Man could even be said to be archetypal, a primordial image from out the depths of humanity's collective unconscious. By the mid-twentieth century, and with the beginnings of the contemporary environmental movement, the Green Man has even come to epitomize the eco-activist. Today, this phytomorphic physiognomy also symbolizes being ecological conscious, the green intelligence within each and every one of us, from which we act as part of rather than above nature, her protagonist rather than antagonist.

Across the scientific imaginary, the face and its environment are represented together as having evolved through interaction with one another. Under natural selective and sexual pressures, the visual system evolved, providing adaptive utility and selective advantage. And trichromatic vision has made humans better at the foraging for nutritious food and detection of mating signals. The tale of face blindness perhaps best exemplifies these ideas. Color and face blindness frequently co-occur. Such prosopagnosia, a neurological inability to process sensory information from the environment, can lead an individual to not be able to interpret socially-relevant facial behaviors. Humans are, after all, social animals, who live in a world based on communication with other humans. Facial chromaticity in general, and the relative visibility of red-green in particular, can be a sign of good health or hormonal activity. It can signal the absence or presence of different emotion states. And it can be received by a prospective sexual partner as a messenger of attractiveness. But regardless of the signal, to human perception the face becomes “greened” as well as “degreened” in color.

All the more so, however, the face is “greened” in concept. Color, far from being an isolated attribute of the face, is inextricably bound up with its relative brightness, contrast, form, luminosity, shape, and more. Visually discriminating color, and green, is necessary for the perception of the face in relation to its environment. In the brain, specialized areas become activated in response to sensing different facial information, such as the frontal or profile views of the face, its gaze direction or spatial position, and the shape of its various features. These face patches and color areas have an interactive, hierarchical arrangement in the brain. And while these functionally-specialized and largely-independent brain circuits generally do not directly overlap, information sensed about face and color link through a multistage processing stream. Still to be determined, however, is exactly which attributes of the face and its features are used by the visual system during various perception tasks. What is clear, however, is that contrast polarity, is important for distinguishing the face both locally part-to-part and globally part-to-whole.

Across the technological imaginary, the face and its environment are represented together as a significant challenge for computer vision. The multidimensional habitat for the face extends both inside the face, between its features, as well as outside the face, amid its surroundings. And basic problems arise when programming a computer to locate the face in relation to its environment because of relative brightness, contrast, luminosity, and other visual attributes. The tale of facial recognition perhaps best exemplifies these ideas. In post-digital smart environments, automated facial recognition systems can be used to sense the preferences of human inhabitants, adjust the environment to their needs, and continuously better quality of life. This ubiquitous computing application cannot transfer human perception onto machine vision. Rather, it can rather hybridize human and machine, extending sensory and cognitive faculties. The red-green channel hue distribution in the face can be salient to how this recognition performs, affording for more robust facial detection. But regardless of its visual attributes, to machine recognition the face may or may not be green in color.

But significantly, however, the face must be "unprismatized" in both color and concept; it must be made "greenless." The way facial recognition works is by detecting the face in relation to its environment, extracting facial points or landmarks, and classifying these faces into categories between. Facial recognition, however, does not work on the living face itself, but on representational faces—digital, digital copies, or digitized face images. During facial recognition, these images must to be corrected so that the face can be discriminated in relation to its environment. The images must to be normalized. This process of normalization may include the compression of data from the environment, and flattening of the visual field, which severely constrains how a computer can recognize objects such as the face. But even more importantly, this normalization depends upon discriminating what is the face and what is its environment, as facial signs are located and identified away from and out of their ecological niche.

Across these artistic, scientific, and technological imaginaries, conceptual models about the face and its environment are co-located together, concretized within a complementary, reciprocal process of becoming. By wandering in the wilds of the comparisons and contrasts between histories of such ideas, it becomes clear that distinct techne (ways of making) by which we experience the living face can give rise to different episteme (habits of knowing) by which we understand our facial behavior. These conceptual models are created by the people who use them, such as Raglan, Bodamer, or Kanade; created during human perception or mediated vision of the face, inner ways of seeing the unconscious or outer ways of seeing the world, nonvisible imaging of the mind or visible imaging of the body, and, through it all, making the face into something green, greened and degreened, or an unprizmatized greenlessness.

Today, the techno-myth runs rampant that an all-seeing and all-knowing ambient intelligence through ubiquitous computing brings facial recognition into smart environments at our airports, businesses, cars, homes, hospitals, railway stations, and schools. But although the world appears to be fundamentally shifting, from a post-digital perspective where the givenness of the digital is already a historical present, it can be experienced and understood how the face and its environment are concepts that have long and variously been intrinsically porous and processually inseparable.

To bring together face consciousness and green intelligence by "greening face," to become environmental of its computation, I mean being responsibly conscious about how the face is made sensible by its environment. This is to view the environment not as in relation to the face, but the face as in relation to the environment. By its environment, the face is perceived. By its environment, the face is detected, extracted, and classified. By its environment, the face is given interpretation and meaning. From pre-Christian architectural spaces to post-digital smart environments, the face is part of rather than above its context.

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