

**Biomedical Research as Art: Celebrating Historical Breakthroughs in
HIV-1/AIDS Research**

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Project Statement

The queer community does not shy away from making HIV/AIDS the subject matter of our biomedical research and our art. As a queer scientist and artist, my goal is to have created artwork that sits at the intersection of these two, bridges a gap between art and science, and generates conversation around HIV-1/AIDS research, representing biomedical research as approachable, narrative, and humanitarian.

Each large-scale abstract painting depicts a significant breakthrough in HIV-1/AIDS research: the identification of human immunodeficiency virus (HIV) in 1983 and the 1987 clinical trial that demonstrated azidothymidine's effectiveness against HIV-1/AIDS. These monumental moments in HIV-1 research are abstracted— departing from classical history paintings— so as to not reduce the events to single pictures.

I cannot and will not speak on behalf of those who experienced the AIDS epidemic, are HIV+, or have lost people to HIV/AIDS. The works are created from the perspective of a queer student studying the biomedical sciences and intend to celebrate the advancements in HIV research history which have been, for some, beacons of hope, light in darkness.

I. Introduction

As of July 2022, there are 38.4 million people across the globe infected with Human Immunodeficiency Virus (HIV).¹ Recent data reports the 2021 HIV-related death toll as approximately 650,000, reduced drastically from 2.9 million at the height of the pandemic in 2003.² HIV fatality has been reversed due large in part to advancements in treatment, or, as the former director of the National Institute of Allergy and Infectious Diseases Anthony Fauci puts it, “‘incredible progress’ in HIV/AIDS research.”³ The subject of my research and work is this “incredible progress” mentioned by Dr. Fauci; great strides in HIV-1/AIDS⁴ research, such as the discovery of HIV or administration of azidothymidine, were both culturally impactful and, for those with HIV, life-altering events. We continue our efforts with several goals in mind: optimized treatment for patients living with HIV, a cure in the form of a vaccine, and, according to the World Health Organization (WHO), a reduction in deaths from 680,000 in 2020 to under 240,000 in 2030.⁵ It is the collective effort of virologists, molecular microbiologists, epidemiologists, and clinical researchers to approach these goals and adequately treat or eradicate HIV/AIDS.

In 1984, United States Department of Health and Human Services Secretary Margaret Heckler declared an Acquired Immunodeficiency Syndrome (AIDS) vaccine would be “ready for testing” by 1986.⁶ Nearly four decades later, we are still without an HIV/AIDS vaccine. The virus has challenged biomedical researchers in unprecedented ways; thus, research efforts targeting HIV/AIDS are ongoing. Behind current explorations of more advanced treatments and a vaccine is a rich history of HIV/AIDS research to reflect upon.

¹ Data from World Health Organization, “Summary of the global HIV epidemic, 2021,” *Global HIV Programme HIV Data and Statistics*, last modified July 2022, <http://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/hiv/strategic-information/hiv-data-and-statistics>.

² Robert Steinbrook, “The AIDS Epidemic in 2004,” *The New England Journal of Medicine* 351, (2004): 115-117, doi: 10.1056/NEJMp048156.

³ Maureen M. Goodenow, “World AIDS Day 2022 at NIH: Reflecting on the Progress and Promise of HIV/AIDS Research,” *HIV.gov*, December 15, 2022, <http://www.hiv.gov/blog/world-aids-day-2022-at-nih-reflecting-on-the-progress-and-promise-of-hiv-aids-research/>.

⁴ Throughout the duration of this paper, I will alter between HIV and HIV-1. They are used interchangeably conventionally and in literature. HIV/AIDS or HIV is more recognizable, but HIV-1 or HIV-1/AIDS specifies the viral strain of HIV we most commonly know as HIV. There is a distinction between HIV-1 and HIV-2 that does not matter in the context of this paper.

⁵ “HIV/AIDS,” *World Health Organization*, accessed March 26, 2023, http://www.who.int/health-topics/hiv-aids#tab=tab_1.

⁶ “History of HIV Vaccine Research,” *National Institute of Allergy and Infectious Diseases*, last modified October 22, 2018, <http://www.niaid.nih.gov/diseases-conditions/hiv-vaccine-research-history>.

My artwork (and thus this paper) touch on both, as full comprehension of modern approaches to HIV treatment requires knowledge of the notable scientific breakthroughs which continue to inform them. As someone who desires to join ongoing efforts in HIV-1 research, I have started to consider the philosophical motivations behind biomedical research, research triumphs and pitfalls, and which considerations should carry more weight than others as I translate those ruminations into large-scale acrylic paintings. Upon seeing Xavier Cortada's *In Search of the Higgs Boson* (2013), depicting the five experiments conducted by physicists which lead to the discovery of God's particle,⁷ I desired to produce similar work but specific to HIV/AIDS research on a broader scale. Instead of only five experiments, my work gestures towards two significant moments in the history of HIV research, in 1983 and 1987, respectively. These moments become monumental, depicted as large-scale abstractions— departing from classical history paintings so as to not reduce the events to single pictures.⁸

My ultimate goal is to bridge the gap between scientific research and art by contributing to public understanding of HIV/AIDS research, and there are artists who have set out to do the same. Katharine Dowson serves as a strong example; her work titled “A Window To A Future Of An HIV Vaccine” depicts one of HIV's envelope glycoprotein trimers, called Env, the subject of HIV vaccine research.⁹ Dowson's work was one of many involved in the “Art of Saving A Life” project on the importance of vaccine research.¹⁰ She states that the project was about increasing public education and creating discussion around HIV (and other subjects of vaccine research)-- exactly what I aim to do.¹¹ Similar to *Art of Saving A Life*, there are continuous efforts to exhibit bioart about HIV/AIDS. For example, the International AIDS Society (IAS) has embarked on a current project called “HIV science as art.” Artists living with HIV will be partnered with HIV researchers and create collaborative artwork to be displayed at the 2023 IAS conference. The goal is to create a greater sense of unity among Australians and amplify efforts in the HIV

⁷ See Appendix 1.

⁸ By “history painting,” I am referring to the genre of art which traditionally utilizes subject matters such as ancient Greek and Roman classical history, mythology, the Bible, and even eighteenth century battles.

⁹ See Appendix 2.

¹⁰ Katharine Dowson, “A Window To A Future Of An HIV Vaccine,” accessed April 6, 2023, <http://katharinedowson.com/dowson-gallery/2019/11/9/a-window-to-a-future-of-an-hiv-vaccine>.

¹¹ GatesFoundation, “Behind the Scenes with Katharine Dowson | The Art of Saving a Life,” Youtube, January 21, 2015, video, <http://www.youtube.com/watch?v=Xv4mf0KL1pk&t=100s>.

response.¹² Although I am unsure my work is capable of unifying a continent's population, it shares similar goals to Dowson's or the IAS: ideally, it should spark conversation about HIV-1/AIDS research— where we have been and where we are going.

As a disclaimer, my research and the resulting works are not about the experience of being queer but of being a *queer scientist* (and, simultaneously, artist). I cannot and will not speak on behalf of those who experienced the AIDS epidemic, are HIV+, or have lost people to HIV/AIDS.¹³ I do intend to celebrate the advancements in HIV research history which have been beacons of hope, light in darkness, by representing them in two abstract paintings.

II. Themes in *The discovery of human immunodeficiency virus (HIV)*, 1983¹⁴

The first painting of the two is titled after the first chronological breakthrough in HIV research (i.e. the identification of the virus). It stands 8'x8' and is non-objective. It touches on themes of external and internal struggle, control, humanization of biomedical research, and light versus darkness/life versus death.

As I delve into the research behind my first painting and its execution, I will mention several visual references, most of which are figurative. On the contrary, my work is abstract. For me, abstract painting requires me to be meditative and present; because I am working with a difficult subject, one which is full of emotion and requires my best judgment, I have chosen abstraction. And as I have mentioned, I want them to depart from classical history paintings and pull inspiration from *many* historical moments which can ultimately feed into one. The discovery of HIV was not one event but a conglomeration of them.

A. An Elegant Virus

¹² Rick Guasco, "A call to artists ahead of international HIV conference," The HIV Treatment Journal of TPAN - Positively Aware, December 22, 2022, <http://www.positivelyaware.com/articles/call-artists-ahead-international-hiv-conference>.

¹³ As a result, I have almost completely avoided referencing artists who lived with HIV/AIDS, produced work in response to the AIDS epidemic, or are currently living with HIV/AIDS. My work is intended to be made from the perspective of a scientist studying/researching HIV/AIDS. Of course, one would consider their motivation to conduct such research, and that, for me, has included the desire to alleviate the devastating emotional and physical impacts of HIV/AIDS. Still, I would like to acknowledge the lineage of artists who have produced work with the intention of countering silence around, bringing visibility to, and mourning those lost to HIV/AIDS. Works by artists like Felix Gonzales Torres, David Wojnarowicz, Mark Morrisroe, Zoe Leonard, and Ross Bleckner are essential, and accomplish similar goals to my own, but differ in their perspective.

¹⁴ See Appendix 3.

On June 5, 1981, a Centers for Disease Control (CDC) Morbidity and Mortality Weekly Report included five cases of pneumocystis pneumonia in gay Los Angeles men; the diagnosis was rarely seen outside of cancer patients undergoing chemotherapy (i.e. otherwise healthy individuals were *not* typically at risk).⁶ These five men, and, one month later, the additional twenty-six who presented with pneumocystis pneumonia had been exposed to— what *we* know as— HIV.¹⁵ Today, they would have been diagnosed with Acquired Immunodeficiency Syndrome (AIDS).

The progression from an HIV-positive (HIV+) to AIDS diagnosis involves the complete degradation of one's immune system. HIV attacks CD4 T lymphocytes, white blood cells which fight infection.¹⁶ A healthy individual has 500 to 1500 CD4 T cells/mm³ of blood while an HIV+ individual with “severely compromised” immunity will have 200 cells/mm³ of blood. Technically, AIDS is a Stage 3 HIV infection, often accompanied by opportunistic infection;¹⁷ in Stages 1 and 2, the virus replicates within the bloodstream and HIV+ individuals are highly contagious, though not yet at risk of opportunistic infection due to thoroughly damaged immunity (pneumocystis pneumonia, tuberculosis, severe bacterial infections, cervical cancer, Kaposi's sarcoma, etc.).^{18,19} Throughout the 1980s and 1990s, there was a high likelihood a patient's HIV infection would progress into AIDS.

As mentioned, HIV provided biomedical researchers with a new challenge: unlike the influenza virus or coronaviruses, HIV is a *retrovirus*. Most viruses, whether they are categorized as DNA or RNA, operate within the central dogma of molecular biology, as all living organisms do. The central dogma states that genetic information flows in one direction (from DNA to RNA, RNA to protein);²⁰ HIV does not follow this rule. Instead of translating RNA into proteins, the

¹⁵ “Reflections on 35 Years of AIDS,” NIAID, June 2, 2016, video, <http://www.youtube.com/watch?v=7Kp1PKENhpA&t=115s>.

¹⁶ Centers for Disease Control, “About HIV,” *HIV*, last modified June 30, 2022, <http://www.cdc.gov/hiv/basics/whatishiv.html#:~:text=What%20is%20HIV%3F,they%20have%20it%20for%20life>.

¹⁷ “HIV/AIDS,” *World Health Organization*, accessed March 27, 2023, http://www.who.int/health-topics/hiv-aids#tab=tab_1.

¹⁸ “HIV/AIDS,” *World Health Organization*, accessed March 27, 2023, http://www.who.int/health-topics/hiv-aids#tab=tab_1.

¹⁹ Centers for Disease Control, “AIDS and Opportunistic Infections.”

²⁰ Elaine A. Ostrander, “Central Dogma,” *National Human Genome Research Institute*, last modified March 24, 2023, <http://www.genome.gov/genetics-glossary/Central-Dogma#:~:text=Central%20dogma.,or%20RNA%20directly%20to%20protein>

virus is equipped to reverse transcription, building DNA using RNA as a template.²¹ This, and several other complicating factors (proviral DNA, high incidence of mutation and drug resistance, etc.)^{22,23} have made the journey to effective treatment and a vaccine a difficult one—and, to me, are quite disturbing qualities, which have highly influenced my work.

Proviruses essentially hijack cells. Also called proviral DNA, one of those “disturbing qualities” mentioned is a viral form that incorporates viral genetic information into the host cell’s, permanently and irreversibly editing the genetic material. HIV experts describe this phenomenon as the virus’s ability to “hide out” in CD4 lymphocytes, camouflage, or wear an “invisibility cloak.”²⁴ To me, proviruses seem violating; there is something very *unsettling* about the possibility of an uncontrollable mass mutation of my DNA. Hearing Dr. Jessica Steier, host of the podcast “Unbiased Science,” describe HIV this way, referring to it as “an elegant virus,” struck a strange chord;²⁵ I had the sudden desire to turn my body inside out and pluck cell invaders out one-by-one. In *The discovery of HIV, 1983*, there is a recurring theme of (what I would refer to as) bleeding cells; the cells have experienced violence at the hands of HIV.²⁶ Perhaps they have turned themselves inside out, attempting to expel HIV infection. I want the painting to signify *carnage* attributed to HIV on both a micro-level, depicted as “bleeding cells,” and on a macro-level, which I will discuss in coming paragraphs.²⁷

I felt that it was also important to include patterns, geometrics, texture, busy moments with drips and spots— techniques inspired by some of my visual references: Lee Krasner’s *Burning Candles* (1955)²⁸ and Jay DeFeo’s *Untitled (Everest)* (1955) and *The Annunciation*

²¹ David Goodsell, “Molecule of the Month: HIV Reverse Transcriptase,” *PDB-101*, September 2002, <http://pdb101.rcsb.org/motm/33>.

²² David Goodsell, “Molecule of the Month: HIV Reverse Transcriptase.”

²³ Shokouh Makvandi-Nejad, “Human Immunodeficiency Virus (HIV),” *British Society for Immunology*, accessed March 29, 2023, <http://www.immunology.org/public-information/bitesized-immunology/pathogens-disease/human-immunodeficiency-virus-hiv>.

²⁴ Jessica Steier, “H-I-V...Not As Easy As 1-2-3: Eluding Vaccine Development for Decades,” January 25, 2021, in *Unbiased Science*, podcast, <http://open.spotify.com/episode/67JkVjvIMwHxOshYNynIa?si=f66202c063ac48c6>.

²⁵ Jessica Steier, “H-I-V...Not As Easy As 1-2-3: Eluding Vaccine Development for Decades.”

²⁶ See Appendix 3.

²⁷ See Appendix 4.

²⁸ See Appendix 5.

(1958).²⁹ Although the works predate the AIDS epidemic, I believe their compositions lend themselves to what I identify as visual indicators of viral complexity, the variety of invasive mechanisms HIV is equipped with, and the “boiling tumult” of cellular activity— either alone or in response to a viral infection.^{30,31} It was challenging to reach a balance between virus-induced chaos and complete viral control (over cells). I wanted to exhibit our absence of control over HIV in contrast to HIV’s autonomy; as of 1983, we had limited authority over the virus, if any at all. I imagine this created a power imbalance scientists sought to resolve.

Considering all of the above, I was left with two questions that informed my work:

- 1) Are humans frightened by the control they cannot claim over viral infection and attempt to gain control by conducting biomedical research?
- 2) Do humans, bearing witness to other humans’ suffering, use empathy and altruism as motivators when approaching biomedical research?

I am unsure of the answers— if there are any. However, I have provided a loose argument above that my answer to the first is yes, and I have discussed how I have incorporated this idea in my work visually (internal chaos and struggle as “bleeding cells” and spotty/drippy texture). I find myself answering yes to the second question as well; certain moments in HIV-1 research history convinced me and thus have become strong artistic influences. I will continue to elaborate as I discuss the discovery of HIV in 1983.

B. The Greatest Challenge to Retrovirology

HIV does not create perfect DNA based on RNA templates, which means it has a high mutation rate. Reverse transcriptase, the enzyme HIV utilizes to turn RNA into DNA, makes about one mistake in every 2,000 bases it copies.³² For reference, DNA polymerase’s rate is around one in every 100,000-10 million bases.³³ It may seem counterintuitive, but HIV’s inability

²⁹ See Appendix 6.

³⁰ Paul Nurse, *What Is Life?: Five Great Ideas in Biology* (Great Britain: David Fickling Books, 2020), 63.

³¹ See Appendix 7.

³² David Goodsell, “Molecule of the Month: HIV Reverse Transcriptase.”

³³ Bradley D. Preston, Tina M. Albertson, and Alan J. Herr, “DNA Replication Fidelity and Cancer,” *Seminars in Cancer Biology* 20, no. 5 (2010): 281-293, accessed March 29, 2023, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2993855/#:~:text=It%20is%20estimated%20that%20replicative,to%201%2C000%20polymerase%20errors%20occur.>

to copy RNA well works strongly in its favor. The higher incidence of mutation, the more likely the virus is drug-resistant (an evolutionary advantage).³⁴ Both of these qualities— proviruses and drug resistance, two things intrinsic to retroviruses— complicate our understanding of HIV. Thus, Margaret Heckler was wrong: an AIDS vaccine could not be developed in two years, let alone several decades, and there are cultural, emotional, and social impacts attributed to HIV's ability to elude vaccine development. The way the following quote from the *Retroviruses* textbook frames the issue reminds us of the virus's true, intense impact: "*The immense human suffering caused by the continued spread of HIV constitutes the greatest challenge to retrovirology.*"³⁵ HIV is not only a subject of molecular microbiological study but an inflictor of carnage on a macro-scale: since the onset of the AIDS epidemic, HIV has taken 40.1 million lives.³⁶ There is an inner-body struggle (an individual's immune system versus the virus) as well as an outer-body struggle, which takes the form of human suffering and anguish.

In order to include this "outer body struggle" in *The discovery of HIV, 1983*, I emphasized battle and bloodshed.³⁷ Classical history paintings served as strong references for my palette, specifically Peter Paul Rubens' *The Massacre of the Innocents*³⁸ and Théodore Géricault's *The Raft of the Medusa*.³⁹ Rubens' seventeenth-century painting illustrates a biblical event: the execution of all male children two years and under in Bethlehem.⁴⁰ The highly populated, chaotic painting explicitly depicts the bloodshed of innocents; my work intentionally includes beige, tan, and brown flesh tones paired with bright and deep reds, to abstract Rubens' piece and evoke feelings of human struggle— and parallel the innocence of the children of

³⁴ David Goodsell, "Molecule of the Month: HIV Reverse Transcriptase."

³⁵ J.M. Coffin, S.H. Hughes, and H.E. Varmus, editors, "A Brief Chronicle of Retrovirology," in *Retroviruses*, (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 1997, <http://www.ncbi.nlm.nih.gov/books/NBK19403/#:~:text=Retroviruses%20were%20discovered%20at%20the,was%20caused%20by%20a%20virus.>

³⁶ "HIV," *World Health Organization*, accessed March 29, 2023, <http://www.who.int/data/gho/data/themes/hiv-aids#:~:text=Global%20situation%20and%20trends%3A,people%20have%20died%20of%20HIV.>

³⁷ See Appendix 8.

³⁸ See Appendix 9.

³⁹ See Appendix 10.

⁴⁰ "Massacre of the Innocents," Wikipedia, last modified April 3, 2023, http://en.wikipedia.org/wiki/Massacre_of_the_Innocents.

Bethlehem, as those lost to HIV/AIDS are, too, blameless.⁴¹ The opinion that people are deserving of HIV because of their life choices or identity has, for some, justified the massacre which was the AIDS epidemic and resulted in stigma around HIV and discrimination against those with it.⁴² The stigmas surrounding HIV are still a subject of HIV public health research in 2023, as they remain a barrier to its eradication.

Géricault's *Raft of the Medusa* had similar influences, but there was a certain darkness and lifelessness to its palette which I desired to incorporate as well. Géricault's nineteenth-century painting depicts the French naval ship *Méduse* wreckage,⁴³ a ghastly scene of desperate survivors, dead bodies, and the hopeless.^{44, 45} I will discuss themes of darkness further in coming paragraphs, but much like those on the raft of the *Méduse*, those diagnosed with HIV/AIDS felt hopelessness— even following the discovery of the virus in 1983. According to a 1985 study, male patients with AIDS were 66% more likely to take their lives than the general population— a heartbreaking statistic.⁴⁶ While the identification of HIV served as a hopeful moment in HIV/AIDS research, it did not magically rid AIDS patients of depression or fear; as a reminder, there was still no semblance of treatment or a cure. Thus, I incorporate, in some capacity, lifelessness with shades of taupe, yellow ochre, and icy blues, as well as a sense of impending darkness or doom, as the light shades battle the dark.⁴⁷ Again, I will delve further into this back-and-forth between hope and despair/light and dark as I reveal more about the 1983 discovery of HIV.

C. Nobel Laureate Françoise Barré-Sinoussi

⁴¹ See Appendix 8.

⁴² Centers for Disease Control, "HIV Stigma and Discrimination," *HIV*, last modified June 1, 2021, <http://www.cdc.gov/hiv/basics/hiv-stigma/index.html>.

⁴³ "The Raft of the Medusa," Wikipedia, last modified March 18, 2023, http://en.wikipedia.org/wiki/The_Raft_of_the_Medusa.

⁴⁴ See appendix 10.

⁴⁵ Clare Black McCoy, "Théodore Géricault, *The Raft of the Medusa*," Smarthistory, May 27, 2021, <http://smarthistory.org/theodore-gericault-raft-of-the-medusa/>.

⁴⁶ Gina Kolata, "AIDS Patients Are Found to Have an Extremely High Suicide Rate," *The New York Times*, Section B, (1988): 5, <http://www.nytimes.com/1988/03/04/us/aids-patients-are-found-to-have-an-extremely-high-suicide-rate.html>.

⁴⁷ See appendix 8.

The scientific community was aware of retroviruses previous to the discovery of HIV, the first retrovirus having been discovered in the early twentieth century.⁴⁸ Granted, the first *human* oncogenic (cancer-causing) retrovirus was isolated in the early 80s (a formative time in viral and retroviral research).⁴⁹ But, on May 20, 1983, retrovirology and HIV/AIDS research forever changed: an article (Barré-Sinoussi et al.) published in the journal *Science* reads “a retrovirus belonging to the family of recently discovered human T-cell leukemia viruses (HTLV), but distinct from each previous isolate, has been isolated from a Caucasian patient with signs and symptoms that often precede the acquired immune deficiency syndrome (AIDS).”⁵⁰ The HTLV the paper refers to is HTLV-3/AIDS-related virus (ADV), or, as we know it, HIV.⁵¹ Two French virologists who spearheaded this identification of HIV as the cause of AIDS would go on to win the 2008 Nobel Prize for Physiology or Medicine— those researchers are Luc Montagnier and Françoise Barré-Sinoussi.⁵²

An episode of the podcast “HIV unmuted” featuring Barré-Sinoussi was particularly influential in my work.⁵³ Now seventy-five, she has done a breadth of incredible work in HIV/AIDS beyond her 1983 discovery. In the podcast episode, she tells the story of receiving the news she had been awarded the 2008 Nobel Prize. At the time, she was working in Southeast Asia; she recalls: “After the announcement, several people, including people living with HIV, came to me [with] congratulations, and they came to me with flowers... They were crying, so I asked them ‘Why are you crying?’ One of them [answered] ‘because we are thinking about the

⁴⁸ Coffin, Hughes, and Varmus, editors, “A Brief Chronicle of Retrovirology,” in *Retroviruses*, (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 1997, <http://www.ncbi.nlm.nih.gov/books/NBK19403/#:~:text=Retroviruses%20were%20discovered%20at%20the,was%20caused%20by%20a%20virus>).

⁴⁹ Coffin, Hughes, and Varmus, editors, “A Brief Chronicle of Retrovirology,” in *Retroviruses*, (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 1997, <http://www.ncbi.nlm.nih.gov/books/NBK19403/#:~:text=Retroviruses%20were%20discovered%20at%20the,was%20caused%20by%20a%20virus>).

⁵⁰ Françoise Barré-Sinoussi, “Isolation of a T-lymphotropic retrovirus from a patient at risk for acquired immunodeficiency syndrome (AIDS),” *Science* 220, no. 4599 (1983), accessed March 29, 2023, <http://pubmed.ncbi.nlm.nih.gov/6189183/>.

⁵¹ Coffin, Hughes, and Varmus, editors, “A Brief Chronicle of Retrovirology,” in *Retroviruses*, (Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 1997, <http://www.ncbi.nlm.nih.gov/books/NBK19403/#:~:text=Retroviruses%20were%20discovered%20at%20the,was%20caused%20by%20a%20virus>).

⁵² The Editors of Encyclopaedia Britannica, “Françoise Barré-Sinoussi,” *Britannica*, last modified July 26, 2022, <http://www.britannica.com/biography/Francoise-Barre-Sinoussi>.

⁵³ Femi Oke, “The discovery that changed everything,” June 30, 2021, in *HIV unmuted*, podcast, <http://open.spotify.com/episode/7gmDcGwYViuhlQvIYpHbz4?si=e09bc7757afc4d00>.

others who did not have the chance to thank you.”⁵⁴ They discuss of Barré-Sinoussi’s activism; she is unsure she can call herself an activist but is sure she cannot accept injustice, inequity, or discrimination.⁵⁵ I feel as though Barré-Sinoussi serves as a clear example of empathy and altruism as the motivation behind scientific research, which is why I feature this moment she narrates in my work. In contrast to clumps of “bleeding cells,” there is a bouquet of flowers shrouded in light.⁵⁶

Incorporating this story of Barré-Sinoussi’s is also vital to achieving the goal outlined in my introduction— to bridge the gap between science and art and generate conversation around biomedical HIV research. In order for the topic to seem approachable to audiences with little to no understanding of microbiology or virology, the story of the virus’s discovery needed to feel *human*. Thus, instead of a literal depiction of HIV biology, there is an abstract representation of the moment a human being is celebrated for her contribution to HIV research.

Barré-Sinoussi also touches on the difficult period between identifying HIV as the causative agent of AIDS and the development of effective treatment; researchers knew what was harming those with HIV/AIDS yet could not intervene.⁵⁷ While HIV’s discovery was a celebratory moment, it was also an event that, in reality, did not relieve many of their grief or fear. It did not spare anyone from death; people would continue to die by the tens of thousands. To illustrate the struggle between these truths, light, bright moments in the paintings are impeded by darkness, and vice versa. In the process of painting, there was a constant back and forth between dark and light layers of paint, inviting viewers to question the genesis of each. Which is winning— the light, or the darkness? The identification of the virus, an enormous first step in the right direction, or the fact that we are still five years from the first antiretroviral drug? I would hope that, in any case, we are capable of acknowledging the wonderful moment which was Barré-Sinoussi’s discovery of HIV in 1983.

III. Themes in *The administration of azidothymidine, 1987*⁵⁸

⁵⁴ Femi Oke, “The discovery that changed everything.”

⁵⁵ Femi Oke, “The discovery that changed everything.”

⁵⁶ See Appendix 11.

⁵⁷ Femi Oke, “The discovery that changed everything.”

⁵⁸ See Appendix 12.

The second painting of the pair is titled after the next major breakthrough in HIV research (i.e. the first medication found to be effective against viral replication). It stands 8'x8' and is non-objective. Similar to the first, it touches on themes of light versus darkness/life versus death. Other influences include the antiretroviral mechanisms of action, human error in research, the “Lazarus phenomenon,” and digestion of science via metaphor and narrative, all of which I will expand upon.

Again, many of *Administration of azidothymidine*'s visual references are figurative while the work is abstract. As I will delve into further in the coming paragraphs, the administration of azidothymidine was certainly not one significant moment in history but a conglomeration of them.

A. A is for Azidothymidine (AZT)

On March 19, 1987, the United States Food and Drug Administration (FDA) approved the first antiretroviral therapy (ART) effective against HIV/AIDS. It had only been since 1985 that azidothymidine (AZT) first demonstrated signs of promise; the drug was fast-tracked briefly following the discovery of its efficacy against the virus and approved in a record 20 months— “a pace that has rarely been matched in modern drug development.”^{59,60} Prior to ART, the average life expectancy for an individual diagnosed with AIDS was approximately one year. In response to this “terrifying and lethal” nature of HIV and the AIDS epidemic, biomedical researchers at the National Cancer Institute (NCI) and drug company Burroughs Wellcome (now called GSK) worked quickly to arrive at effective and safe HIV/AIDS therapy.

Azidothymidine (zidovudine/3'-azido-2', 3'-dideoxythymidine/Retrovir[®]) was first synthesized in the 1960s by Jerome Horwitz as an anti-cancer drug; the initial goal was to interrupt cancer cell replication and thus suppress tumor growth— in this context, it was unsuccessful.⁶¹ Though, unshelved and re-synthesized in the 1980s, NCI and Burroughs Wellcome researchers found that AZT successfully interfered with human immunodeficiency

⁵⁹ This quotation is pulled from a 2010 literature review. Of course, in 2023, we are well-aware of the speed at which the SARS-CoV-2 vaccine was approved by the FDA and administered to the American population. Still, AZT stands amongst very few instances of record-pace FDA approval.

⁶⁰ Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic,” *Antiviral Research* 85, no.1 (2010): 1-18, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2815149/>.

⁶¹ Paul Volberding, interview by Audie Cornish, *AIDS Drug Creator Never Profited From His Discovery*, NPR, September 21, 2012, <http://www.npr.org/2012/09/21/161581396/aids-drug-creator-never-profited-from-his-discovery>.

viral replication.⁶² It was capable of doing so because the drug is an *antiretroviral*, and more specifically, a nucleoside reverse transcriptase inhibitor (NRTI).

To recall, when HIV replicates, it is synthesizing DNA from an RNA template—something only retroviruses are capable of. When HIV enters a human CD4 cell, it begins its replication process by employing its enzyme reverse transcriptase (RT).⁶³ RT base pairs with naturally occurring nucleosides (guanine, cytosine, adenine, and thymine) (normally, something human DNA polymerase does to replicate our genome).^{64,65} If done successfully, a single strand of DNA is synthesized; if AZT is present, though, reverse transcription (the synthesis of viral DNA from RNA) can no longer occur.⁶⁶ The NRTI blocks RT base pairing in an action called chain termination—without succinct single-stranded DNA, the virus’ replication is suppressed.^{67,68} AZT’s mechanism of action is represented in my work in two ways: by the nature of the interaction between the large, red mass and the bright, glowing arch and what I will refer to as “burst” cells.^{69,70}

In *The administration of azidothymidine, 1987*, AZT becomes a hero, a God-send bathed in light.⁷¹ It stops the growing red mass abruptly. The red, purposefully reminiscent of blood (more on this later), contains cell clumps at its core. Among the mass are “burst” cells, “cracked” cells, and cells that have been wiped away.⁷² They closely resemble a recurring element in work by The Bambanani Women’s Group,⁷³ co-authors of the graphic novel *Long Life... / Positive HIV*

⁶² Alice Park, “The Story Behind the First AIDS Drug,” *Time Magazine*, March 19, 2017, <http://time.com/4705809/first-aids-drug-azt/>.

⁶³ “HIV: Mechanisms of Action of NRTIs,” *Mechanisms in Medicine*, July 11, 2013, video, <http://www.youtube.com/watch?v=XK52oKGekeA>.

⁶⁴ See Appendix 13.

⁶⁵ “HIV: Mechanisms of Action of NRTIs,” *Mechanisms in Medicine*.

⁶⁶ “HIV: Mechanisms of Action of NRTIs,” *Mechanisms in Medicine*.

⁶⁷ See Appendix 13.

⁶⁸ “HIV: Mechanisms of Action of NRTIs,” *Mechanisms in Medicine*.

⁶⁹ See Appendix 14.

⁷⁰ See Appendix 15.

⁷¹ See Appendix 14.

⁷² See Appendix 15.

⁷³ See Appendix 16.

Stories, which I will touch on more in my final section. The “burst” cells are those which have been in contact with AZT; the drug has slain them, rendering them unable to replicate. Healthy, intact cells nearby have grown from antiretroviral (ARV) treatment– AZT has given them a new life uninterrupted by HIV infection.⁷⁴

B. Le mieux est l'ennemi du bien

I intend for the viewer to notice imperfections within AZT’s light. I have considered AZT’s troubled past within my composition: there is, again, a battle between a light, bright moment and darkness which creeps in from all sides. Carbon black paint applied to the edges with a palette knife oozes in.⁷⁵ AZT is a large glowing arch but spotty, cloudy, and flawed.⁷⁶ Blemishes in AZT’s halo represent imperfections often associated with pharmaceuticals, including flawed clinical trials, high costs, and disagreeable side effects. AZT’s story is a complicated one.⁷⁷ Similar to *The discovery of human immunodeficiency virus (HIV), 1983, Administration of azidothymidine, 1987* features a back-and-forth between light and darkness. AZT represented hope for some while others viewed it as “a very toxic drug”; it was a “rocky start” to the ultimate development of “truly effective” antiretrovirals.⁷⁸

One of my goals in making this artwork is to humanize biomedical research. Elements of my first painting were inspired by the story of Barré-Sinoussi receiving flowers as congratulations; the equivalent moments in *Administration of azidothymidine* were what I found to be uniquely human attributes of the GSK clinical trial. There is concern surrounding the drug trial’s honesty, and a Time Magazine article claims “there are stories of patients... pooling their

⁷⁴ See Appendix 15.

⁷⁵ See Appendix 17.

⁷⁶ See Appendix 14.

⁷⁷ Paul Volberding, interview by Audie Cornish, *AIDS Drug Creator Never Profited From His Discovery*, NPR.

⁷⁸ Paul Volberding, interview by Audie Cornish, *AIDS Drug Creator Never Profited From His Discovery*, NPR.

pills, to better the chances that they would get at least some of the drug rather than just placebos.”^{79,80} This sits with me.

Experimental design was imperfect, too, as some decrease in mortality could have been attributed to external factors (i.e. a participant receiving a blood transfusion amidst their involvement in the trial, boosting their immune response).⁸¹ Of course, clinical research conducted by humans will *always* include human error and bias— and when the research has human subjects, allegedly, things like pill pooling can occur. I value these missteps in HIV-1 research history by making them the true subject of work.

Azidothymidine’s reputation was further tarnished by its cost (in USD *and* a patient’s time), toxicity, and adverse side effects. HIV/AIDS activists had several run-ins with the drug company that holds AZT’s patent, GSK, protesting its annual wholesale cost of \$6,300.⁸² It is described as having been a “very inconvenient drug,” as patients were required to stick to a strict regimen, taking it every four hours.⁸³ High doses of zidovudine (AZT) are associated with mitochondrial toxicity, which can manifest as myopathy or lactic acidosis with or without hepatic steatosis (fatty liver disease), as well as intestinal issues, nausea, vomiting, and headaches.^{84,85} But AZT (and NRTIs) are “overall safe drugs,”⁸⁶ and side effects, “while real and not to be discounted,” do not “preclude [NRTI] approval as effective therapies for HIV-1/AIDS.”⁸⁷ In fact, AZT is still prescribed to HIV+ patients today.

⁷⁹ The credibility of this claim was less important to me than the claim itself. Even if it is untrue that trial participants were “pooling pills,” it strikes my interest that we make this claim at all. There is something very human to me about cheating biomedical research and very significant that motivations to do so were simultaneously in one’s own interest and altruistic. I also feel it is important I am capable of acknowledging missteps in research, as they contribute just as significantly to research outcomes that successes do.

⁸⁰ Alice Park, “The Story Behind the First AIDS Drug.”

⁸¹ Alice Park, “The Story Behind the First AIDS Drug.”

⁸² Willis M. Emmons III, “Burroughs Wellcome and AZT (A),” *Harvard Business School Case*, September 1991, <http://www.hbs.edu/faculty/Pages/item.aspx?num=23070#:~:text=Abstract,segments%20of%20the%20U.S.%20government>.

⁸³ Paul Volberding, interview by Audie Cornish, *AIDS Drug Creator Never Profited From His Discovery*, NPR.

⁸⁴ Parth H. Patel and Hassam Zulfiqar, *Reverse Transcriptase Inhibitors* (Treasure Island, Florida: StatPearls Publishing, 2023), <http://www.ncbi.nlm.nih.gov/books/NBK551504/>.

⁸⁵ Alice Park, “The Story Behind the First AIDS Drug.”

⁸⁶ Parth H. Patel and Hassam Zulfiqar, *Reverse Transcriptase Inhibitors*.

⁸⁷ Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic.”

Consider azidothymidine the “prototype” or a first step in the right direction. Voltaire’s aphorism “le mieux est l’ennemi du bien,” or “perfect is the enemy of good,” applies: AZT administration was not flawless (by any means), but it was, for many, reasonably effective and a representative of hope. It is, in my work, celebrated as the goodness Voltaire speaks of— a beacon of light.⁸⁸

In reality, the full story of successful ART is “about more than AZT, or any one drug for that matter.”⁸⁹ Enter optimized AZT/NRTI dosage, combination antiretroviral therapy (cART), protease inhibitors and highly-active antiretroviral therapy (HAART), and integrase inhibitors.

C. Jesus Raises Lazarus From the Dead

It is a natural next step in scientific experimentation to optimize results; I found myself asking the same questions about motivations behind research I had while executing my first painting about the efforts to better ARVs.⁹⁰ Perhaps there are some researchers whose drive is perfection (or something close to it), but research as an effort to further improve the lives of HIV+ patients and reduce the number of AIDS-related deaths— born out of empathy and altruism— was far more vital to my artwork, as is to me personally.

Because initial administration of AZT was less than ideal, inconvenient, accompanied by toxic side effects, and (eventually found to be) not entirely effective on its own, researchers began the search for a “reduced pill burden,” decreased side effects, and new ways to combat drug-resistant viral strains.^{91,92} Although we jump forward several years, as ART research does not make its next significant breakthroughs until the mid-1990s, I find it is still important to associate my painting with the year 1987, as it signifies the genesis of ART.

⁸⁸ Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic.”

⁸⁹ Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic.”

⁹⁰ 1. Are humans frightened by the control they cannot claim over viral infection and attempt to gain control by conducting biomedical research? 2. Do humans, bearing witness to other humans’ suffering, use empathy and altruism as motivators when approaching biomedical research?

⁹¹ “Starting and Staying on Antiretroviral Therapy,” National Institute of Allergy and Infectious Diseases, last modified November 27, 2018, <http://www.niaid.nih.gov/diseases-conditions/starting-antiretroviral-treatment>.

⁹² National Cancer Institute Center for Cancer Research, “The First AIDS Drug,” *Center for Cancer Research Landmarks*, 2017, <http://ccr.cancer.gov/news/landmarks/article/first-aids-drugs>.

HIV-1/AIDS research took leaps and bounds in the year 1995. In February, results of a clinical trial conducted by the National Institute of Allergy and Infectious Diseases (NIAID) concluded a decreased AZT dosage for treatment of “early symptomatic HIV infection” or “early AIDS-related complex” (i.e. compromised immunity, fever, weight loss)⁹³ was still effective and less toxic.⁹⁴ In November, an NIAID clinical trial combining AZT with another FDA-approved NRTI called dideoxycytidine (ddC), or zalcitabine, demonstrated that the two-drug combination was “more effective than AZT alone.”⁹⁵ This clinical trial is considered the dawn of combination antiretroviral therapy (cART), a viable alternative to just azidothymidine *and* something that is still frequently utilized in HIV treatment today.

By December 1995, a new class of antiretroviral drugs called protease inhibitors forever changed cART. In early 1996, it was demonstrated that a protease inhibitor in combination with NRTIs AZT and ddC significantly reduced viral load levels. This regimen involving two different drug classes (e.g. two NRTIs and one protease inhibitor) was what is called triple-drug therapy or highly-active antiretroviral therapy (HAART). HAART was ground-breaking; as mentioned, it suppressed HIV replication to “minimal levels” while managing to create a “high genetic barrier against the development of drug resistance,”⁹⁶ markedly reducing instances of opportunistic infection and development of AIDS-related cancers associated with immunodeficiency,⁹⁷ and cutting the AIDS death rate in the United States by 70%.⁹⁸

The crux of *The administration of azidothymidine, 1987* was a 2017 interview with HIV+ HIV/AIDS activist Eric Sawyer detailing the profound impact of protease inhibitors and HAART on his life.⁹⁹ Sawyer, co-founder of AIDS Coalition to Unleash Power (ACT UP), states that his

⁹³ The Editors of Encyclopedia Britannica, “Human sexual activity,” *Encyclopedia Britannica*, accessed April 21, 2023, <http://www.britannica.com/science/AIDS-related-complex>.

⁹⁴ National Institute of Allergy and Infectious Diseases, “The Safety and Effectiveness of Zidovudine in the Treatment of Patients with Early AIDS Related Complex,” *US National Library of Medicine ClinicalTrials.gov*, August 31, 2001, last modified November 4, 2021, <http://clinicaltrials.gov/ct2/show/NCT00001011>.

⁹⁵ “Antiretroviral Drug Discovery and Development,” National Institute of Allergy and Infectious Diseases, last modified November 26, 2018, <http://www.niaid.nih.gov/diseases-conditions/antiretroviral-drug-development>.

⁹⁶ “Antiretroviral Drug Discovery and Development,” National Institute of Allergy and Infectious Diseases.

⁹⁷ National Cancer Institute Center for Cancer Research, “The First AIDS Drug.”

⁹⁸ Max Levy, “Discovery of Highly Active Antiretroviral Therapy for HIV,” *American Chemical Society*, October 7, 2022, <http://www.acs.org/education/whatischemistry/landmarks/highly-active-antiretroviral-therapy-hiv.html#new-purpose>.

⁹⁹ John Paul Brammer, “Three decades later, men who survived the ‘gay plague’ speak out,” *NBC News*, December 1, 2017, <http://www.nbcnews.com/feature/nbc-out/three-decades-later-men-who-survived-gay-plague-speak-out-n825621>.

health “started rebounding pretty miraculously” after the administration of protease inhibitors, starting in 1996; he says he felt “the Lazarus effect.”¹⁰⁰

According to John 11:1-45, Lazarus of Bethany was resurrected by Jesus Christ four days following his death; he had succumbed to illness.^{101,102} The Lazarus effect or Lazarus phenomenon can also refer to the return of spontaneous circulation (autoresuscitation) well after cardiopulmonary resuscitation (CPR) has ended.¹⁰³ Essentially, it is a return to life.

In 1983, Eric Sawyer was diagnosed with HIV and told he had two years to live. In the years between his diagnosis and beginning ART, he lost his partner and multiple friends to AIDS-related illnesses; he was prepared for his own death.¹⁰⁴ When Sawyer’s health radically improved after beginning HAART, knowing he had been on death’s doors prior to it, he identified with Lazarus.¹⁰⁵ To me, this is a testament to the true vitality of HIV-1 research. A story like Sawyer’s humanizes biomedical research— to reestablish hope in someone and hand them another chance at life is a wonderful capability of science.

Lazarus’ resurrection appears multiple times in art history: Rembrandt depicts the miracle in a 1631 painting,¹⁰⁶ and in the same year, Jan Lievens creates a striking composition in *The Raising of Lazarus* (1631).^{107,108} Vincent Van Gogh inserts himself in *Raising of Lazarus (After Rembrandt)* (1890), indicated to us by the figure’s red hair and beard.^{109,110} I felt it was important

¹⁰⁰ John Paul Brammer, “Three decades later, men who survived the ‘gay plague’ speak out.”

¹⁰¹ The Editors of Encyclopaedia Britannica, “Lazarus,” Encyclopaedia Britannica, last modified August 29, 2022, <http://www.britannica.com/biography/Lazarus-biblical-figure>.

¹⁰² Vedamurthy Adhiyaman, Sonja Adhiyaman, and Radha Sundaram, “The Lazarus phenomenon,” *Journal of the Royal Society of Medicine* 100, no. 12 (2007): 552-557, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2121643/>.

¹⁰³ “Lazarus Effect/Phenomenon,” Cleveland Clinic, last modified April 4, 2023, <http://my.clevelandclinic.org/health/articles/24876-lazarus-effect>.

¹⁰⁴ John Paul Brammer, “Three decades later, men who survived the ‘gay plague’ speak out.”

¹⁰⁵ John Paul Brammer, “Three decades later, men who survived the ‘gay plague’ speak out.”

¹⁰⁶ “The Raising of Lazarus,” *LACMA*, accessed April 25, 2023, <http://collections.lacma.org/node/238402>.

¹⁰⁷ “The Raising of Lazarus, Jan Lievens, (1607-1674),” *Van GO Yourself*, accessed April 25, 2023, <http://vangoyourself.com/paintings/the-raising-of-lazarus/>.

¹⁰⁸ See Appendix 18.

¹⁰⁹ “The Raising of Lazarus (After Rembrandt),” *Van Gogh Museum*, accessed April 25, 2023, <http://www.vangoghmuseum.nl/en/collection/s0169V1962>.

¹¹⁰ See Appendix 19.

to reference this painting (its palette and composition) in my own work; Van Gogh's identification with Lazarus reminded me of Sawyer. I also reference Lievens' painting; he uses a grassy, golden hill to guide our eyes toward Lazarus' outstretched arms. My abstraction of Lievens' brush, also glinting with gold spots and brush strokes, guides the viewers' eyes in a triangle, from its point (AZT) to its base, one glowing corner being represented by protease inhibitors, and the other a third drug class integral to cART, integrase inhibitors.¹¹¹

In an effort to find agents which targeted different phases of the HIV-1 life cycle,¹¹² integrase inhibitors surfaced in the early 2000s. The FDA approved the first integrase inhibitor raltegravir in 2007.¹¹³ Integrase inhibitors interfere with the function of viral enzyme integrase, which integrates the viral genome into the human genome. This way, viral DNA gets replicated (the evolutionary goal).¹¹⁴ Although triple-drug therapy or cART varies greatly from patient to patient (it is *not* the case for every HIV+ person taking three ARVs that one is an NRTI, one is a protease inhibitor, and the third is an integrase inhibitor), I desired to represent the three different drug classes in my work, as they all had unique, incredible contributions to antiretroviral therapy.

While integrase inhibitors prevent the invasion of viral genetic material, protease inhibitors target the viral enzyme protease. HIV protease plays an integral role in virion maturation, chopping up long protein chains into active subunits (which, then, the virus uses for a variety of processes).¹¹⁵ Without functional protease, HIV cannot replicate. Much like the cells which interacted with AZT (the “burst” cells), there are cells in my work that have encountered both protease and integrase inhibitors.¹¹⁶ Towards the right (in the direction of the bottom right glow), protease inhibitors have rendered them incomplete— the cells have been wiped away/halved.¹¹⁷ In the other direction, integrase inhibitors have enacted revenge, cracking the

¹¹¹ See Appendix 20.

¹¹² Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic.”

¹¹³ “Antiretroviral Drug Discovery and Development,” National Institute of Allergy and Infectious Diseases.

¹¹⁴ Max Levy, “Discovery of Highly Active Antiretroviral Therapy for HIV.”

¹¹⁵ Max Levy, “Discovery of Highly Active Antiretroviral Therapy for HIV.”

¹¹⁶ See Appendix 15.

¹¹⁷ See Appendix 21.

cells open and invading the viral genome as it would have invaded ours.¹¹⁸ Both inhibitors are represented like AZT: they are spots of light, symbolizing hope, yet they still battle with the darkness surrounding them.¹¹⁹ No antiretroviral is perfect, but when combined, they serve an underserved population and save lives.

D. Tragic Hero AZT

In some instances, humanizing the biomedical sciences must involve storytelling and narrativizing. Even in Greek Antiquity, efforts to grasp scientific concepts involved metaphorizing. The Greek philosopher Lucretius, a pioneer of philosophical poetry and the primary source of information on Epicurean physics, romanticizes scientific knowledge in his six-book Latin hexameter poem *On the Nature of Things*.¹²⁰ It would likely have been written close to his death in 50 BCE.¹²¹ He is said to have “glorified the factual, ordinary, and everyday,” comparing atomic energetic motion to the sexual union between Venus and Mars and “vivifying and sexualizing the basic elements of matter (atoms)” by referring to them as “bodies” or “generative seeds.”¹²² For Lucretius, writing about physics in an informative and comprehensive way involved metaphors and narratives. His poetic language was essential; it created art from science. I connect with Lucretius’ work, as my goals are similar: to make art from science and increase the likelihood it is comprehended and appreciated. A research paper is not always digestible— a story is.

The story I have chosen to tell in *The administration of azidothymidine, 1987* features a protagonist, an antagonist, and a conflict between them. It involves the burst, cracked, and halved cells; they sit at the core of a growing red mass.¹²³ I have already touched on their narratives (their battles with AZT, protease inhibitors, and integrase inhibitors), but I would like to delve further into their origin. As I mentioned, they resemble (what I perceive as) cell-like

¹¹⁸ See Appendix 22.

¹¹⁹ See Appendix 23.

¹²⁰ “Lucretius,” *Stanford Encyclopedia of Philosophy*, last modified October 17, 2018, <http://plato.stanford.edu/entries/lucretius/>.

¹²¹ “Lucretius,” *Stanford Encyclopedia of Philosophy*.

¹²² Richard Jenkyns, introduction to *The Nature of Things*, (London: Penguin Group, 2007).

¹²³ See Appendix 15.

structures in works by The Bambanani Women's Group—¹²⁴ only, their role has been inverted. The Bambanani Women's Group created artwork that depicts the triumphs of ARVs (recall the title of the graphic novel they are from, *Long Life... / Positive HIV Stories*). The cells in their works are bright white and red, whereas mine marry with the dark red mass.¹²⁵ My story is slightly different— it is not only about the individual's experience with ARVs but a battle between a tragic hero and a great evil, those being antiretrovirals and HIV, respectively.¹²⁶ I represent HIV as cells to represent the virus as alive, pulling inspiration from Bongiwe Mba and Ncedeka Mbune (as I strongly believe their stories must also be told).¹²⁷ Technically, viruses are non-living; on the other hand, cells are life itself, the smallest unit of it. In my story, HIV is alive— it is evil little cells and a bloody antagonist.

From a scientific/medical perspective, blood is an obvious representative of viral count; all three types of HIV diagnostic tests (antibody, antigen/antibody, and nucleic acid tests) examine the blood for signs of HIV infection.¹²⁸ What indicates to healthcare providers that antiretroviral therapy is effectively treating their patient's HIV is an undetectable viral load in the blood.¹²⁹

Significant in both HIV science/medicine *and* HIV art, there is a long (and controversial) history of the utilization of blood as an artistic medium in art about HIV/AIDS.¹³⁰ For many, such as Andres Serrano, Robert Sherer, and Jordan Eagles, blood is symbolic of life/death, viral count, HIV/AIDS stigmatization and deeply personal.^{131,132} In Sherer's "Victorian-inspired" HIV+ and

¹²⁴ See Appendix 16.

¹²⁵ See Appendix 15.

¹²⁶ I use the term "tragic hero" to refer to ARVs because they are imperfect and not without fatal flaws, much like the stereotypical tragic hero in literature.

¹²⁷ See Appendix 16.

¹²⁸ "HIV Testing," HIVinfo.NIH.gov, last modified August 16, 2021, <http://hivinfo.nih.gov/understanding-hiv/fact-sheets/hiv-testing#:~:text=There%20are%20three%20types%20of,appropriate%20HIV%20test%20for%20you.>

¹²⁹ "HIV Testing," HIVinfo.NIH.gov.

¹³⁰ Lydia Horne, "Bleeding Out: On the Use of Blood in Contemporary Art," *Art Papers*, accessed April 19, 2023, <http://www.artpapers.org/bleeding-out-on-the-use-of-blood-in-contemporary-art/>.

¹³¹ Ron Athey, "Ron Athey on the 'Post-AIDS Body,'" *Walker*, March 19, 2015, <http://walkerart.org/magazine/ron-athey-blood-polemic-post-aids-body>.

¹³² Lydia Horne, "Bleeding Out: On the Use of Blood in Contemporary Art."

HIV- blood drawings, it serves as memento mori. For Serrano, in *Semen and Blood III* (1990), it is a “self-referential” medium.^{133,134} In many cases, and certainly in Eagles’ *Jesus, Christie’s* (2018), its employment is activism.¹³⁵ All of these significances were considered when referencing blood as a medium in my own work; I have created a narrative that depicts HIV+ “blood” as an enemy of ARVs.

There is a physical interaction between the viral load (as represented by “bloodiness”) and AZT, a back-and-forth.¹³⁶ The viewer is left with the same question they may have been upon seeing *The discovery of human immunodeficiency virus (HIV), 1983*: which is winning, the evasive, drug-resistant retrovirus HIV or the ways in which we have found to combat it? While the light of the ARVs glows, is it bright enough? *Have we done enough?* Even in 2023, we cannot be certain which has the upper hand – HIV-1 research actively explores new means of treating HIV infection and improving the quality of life for those who are HIV+. Although our battle against HIV-1 continues, I hope that we can remember where it all began and acknowledge the “triumph for modern medicine” that is antiretroviral therapy.¹³⁷

IV. Conclusion

HIV-1 currently infects 38.4 million people globally, and we have lost 40.1 million people to HIV/AIDS.^{138,139} Needless to say, its cultural and emotional impact on both biomedical research and art has been enormous. Efforts to optimize the treatment of HIV-1 and relieve its burden are ongoing; motivated by their lack of and wish to regain control over the retrovirus and/or their altruism, researchers search for new ways to combat HIV-1. My work explores both of these motivations as a possibility but focuses on the moments in HIV-1 research history when virologists, biochemists, public health officials, and HIV/AIDS activists recognized and celebrated the humanitarian face of biomedical research. I acknowledge that our journey to

¹³³ Lydia Horne, “Bleeding Out: On the Use of Blood in Contemporary Art.”

¹³⁴ See Appendix 24.

¹³⁵ Jordan Eagles, “VIRAL\VALUE,” Jordan Eagles, accessed April 19, 2023, <http://jordaneagles.com/viral-value>.

¹³⁶ See Appendix 14.

¹³⁷ Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic.”

¹³⁸ “HIV,” *World Health Organization*.

¹³⁹ Robert Steinbrook, “The AIDS Epidemic in 2004.”

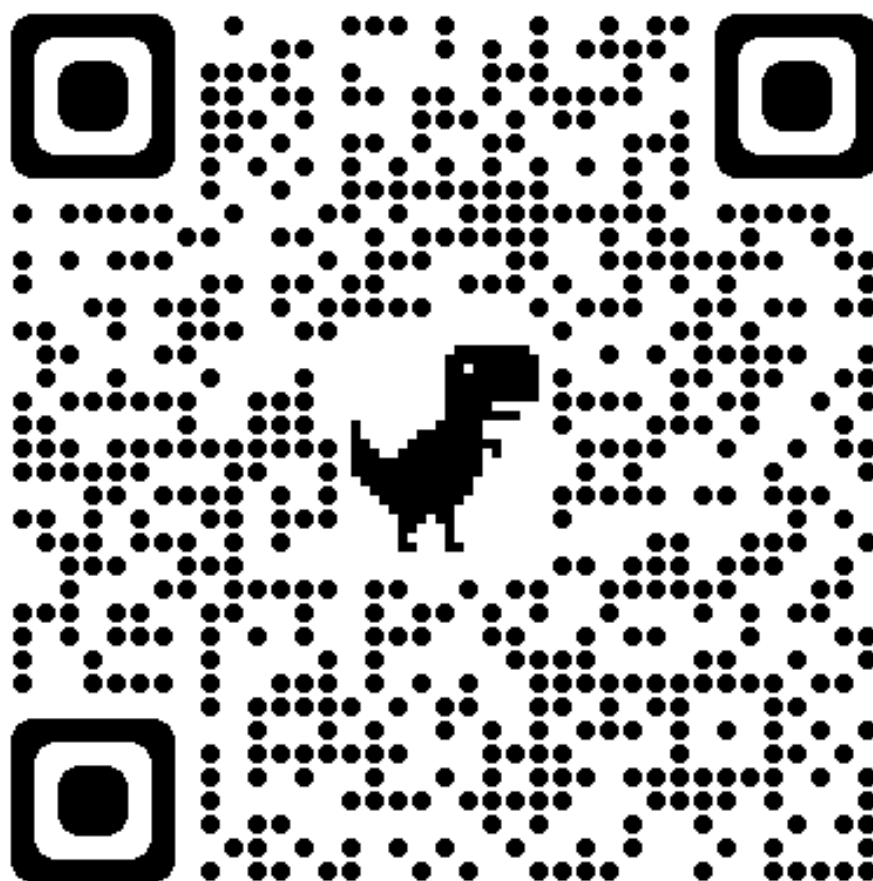
understanding and treating HIV was not always flawless but maintain that perfect is the enemy of good.¹⁴⁰

The discovery of human immunodeficiency virus (HIV), 1983 and *The administration of azidothymidine, 1987* abstract great moments in HIV research history and consider a balance between research triumphs and pitfalls/life and death, portrayed as light and darkness. Ultimately, I consider these scientific breakthroughs as hopeful, life-altering, life-saving events and choose to represent them as such.

I hope to have been successful at sparking conversation surrounding HIV-1/AIDS research, bridging a gap between art and science and representing biomedical research as something that is done for humans by humans— something that is approachable, narrative, humanitarian, altruistic, and artistic.

¹⁴⁰ Samuel Broder, “The development of antiretroviral therapy and its impact on the HIV-1/AIDS pandemic.”

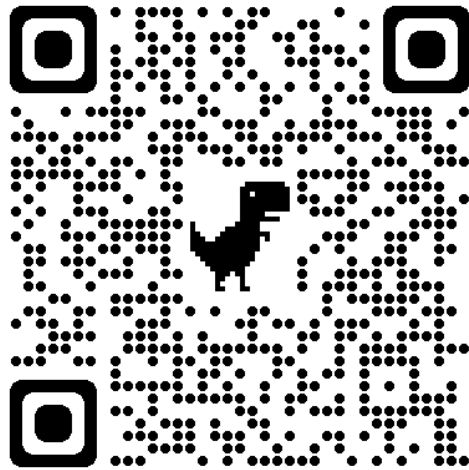
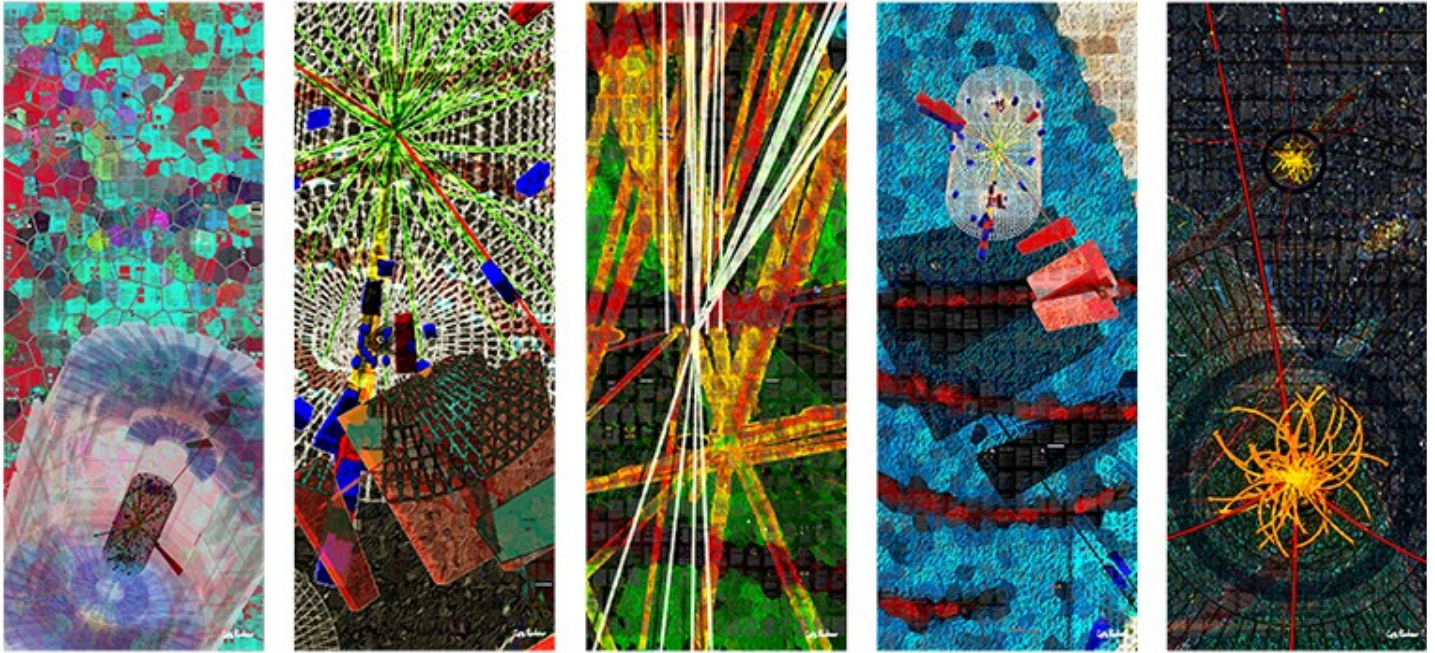
Photos of *The discovery of human immunodeficiency virus (HIV), 1983 (2023)*, *The administration of azidothymidine, 1987 (2023)* and work by The Bambanani Women's Group within the printed version of this paper can also be found as full color versions in a Google Drive folder using the following QR code



All other QR codes will also lead to full color versions of the respective photos. In some cases, it will lead to the artist's web page.

Appendix 1

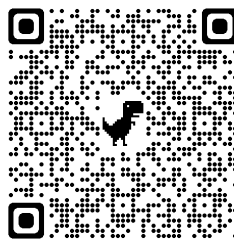
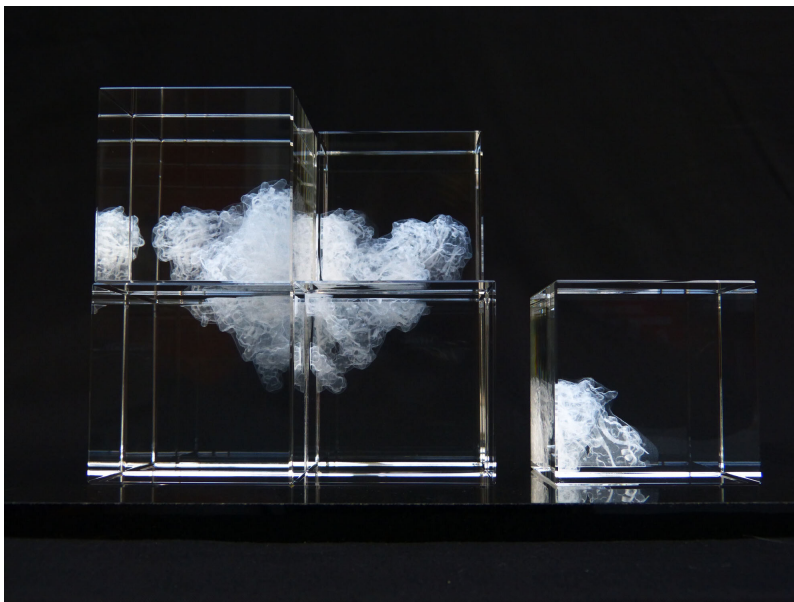
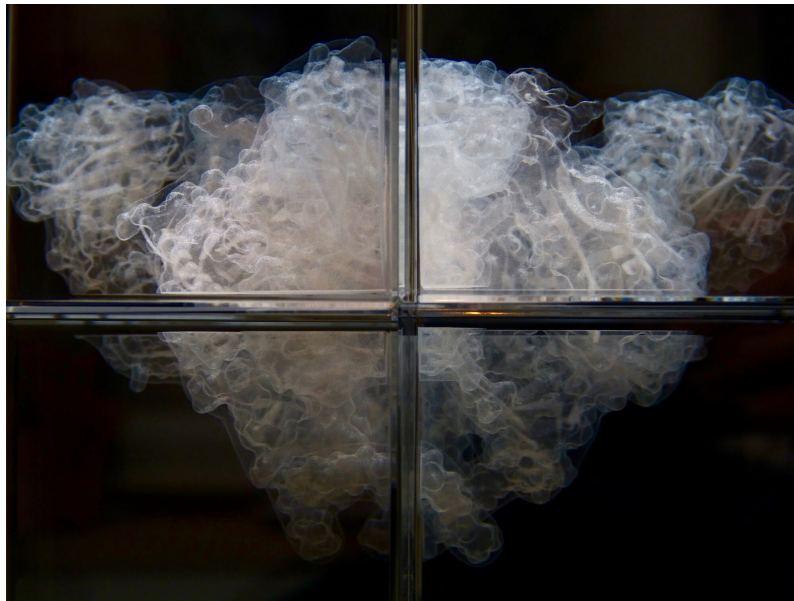
Xavier Cortada *In Search of the Higgs Boson* (2013)¹⁴¹



¹⁴¹ "Cern: In Search of Higgs Boson," Cortada, accessed April 26, 2023, <http://cortada.com/art2013/cern-in-search-of-higgs-boson/>.

Appendix 2

Katharine Dowson *A Window To A Future Of An HIV Vaccine*¹⁴²



¹⁴² “A Window to a Future of an HIV Vaccine,” Katharine Dowson, accessed April 26, 2023, <http://katharinedowson.com/dowson-gallery/2019/11/9/a-window-to-a-future-of-an-hiv-vaccine> .

Appendix 3

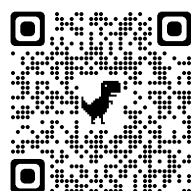
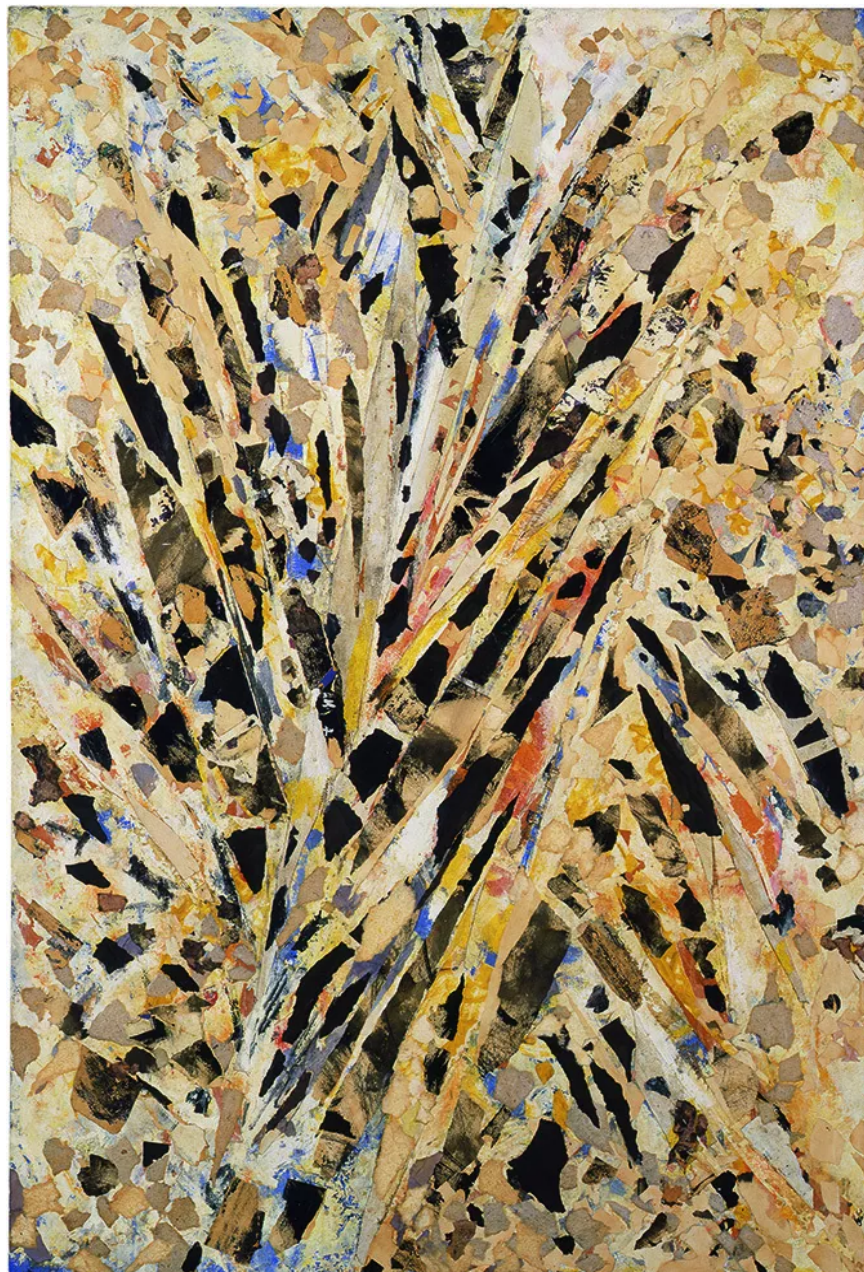
Allison Crouch *The discovery of human immunodeficiency virus (HIV)*, 1983 (2023)



Appendix 4
“Bleeding” cells in *The discovery of HIV*, 1983



Appendix 5
Lee Krasner *Burning Candles* (1955)

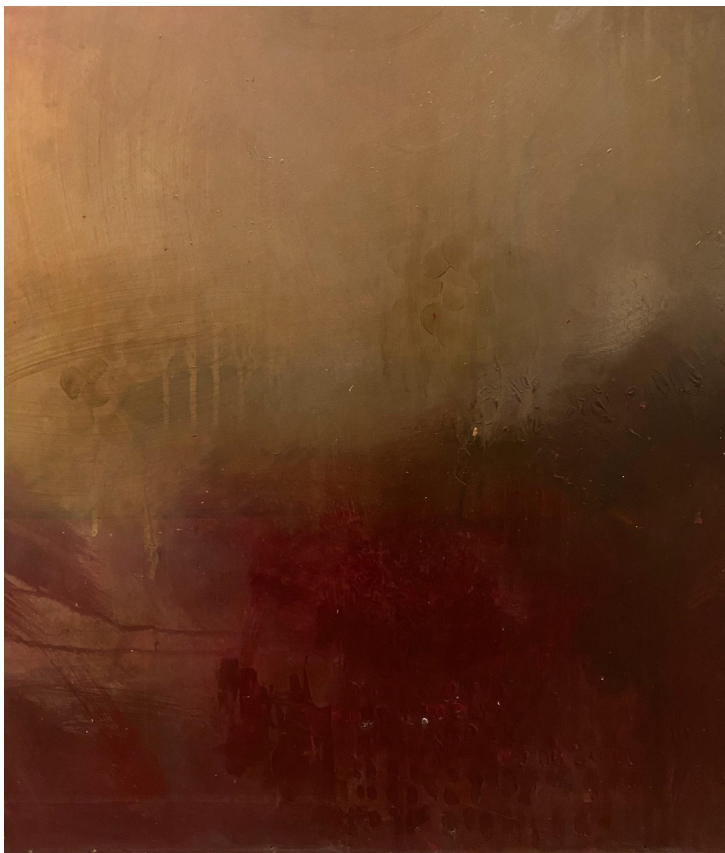
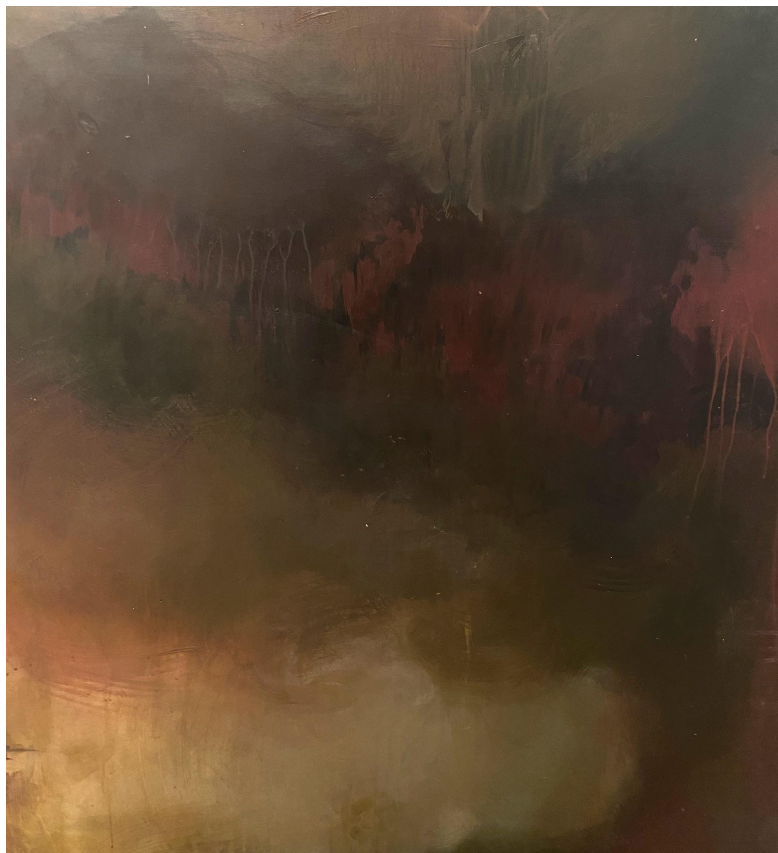


Appendix 7

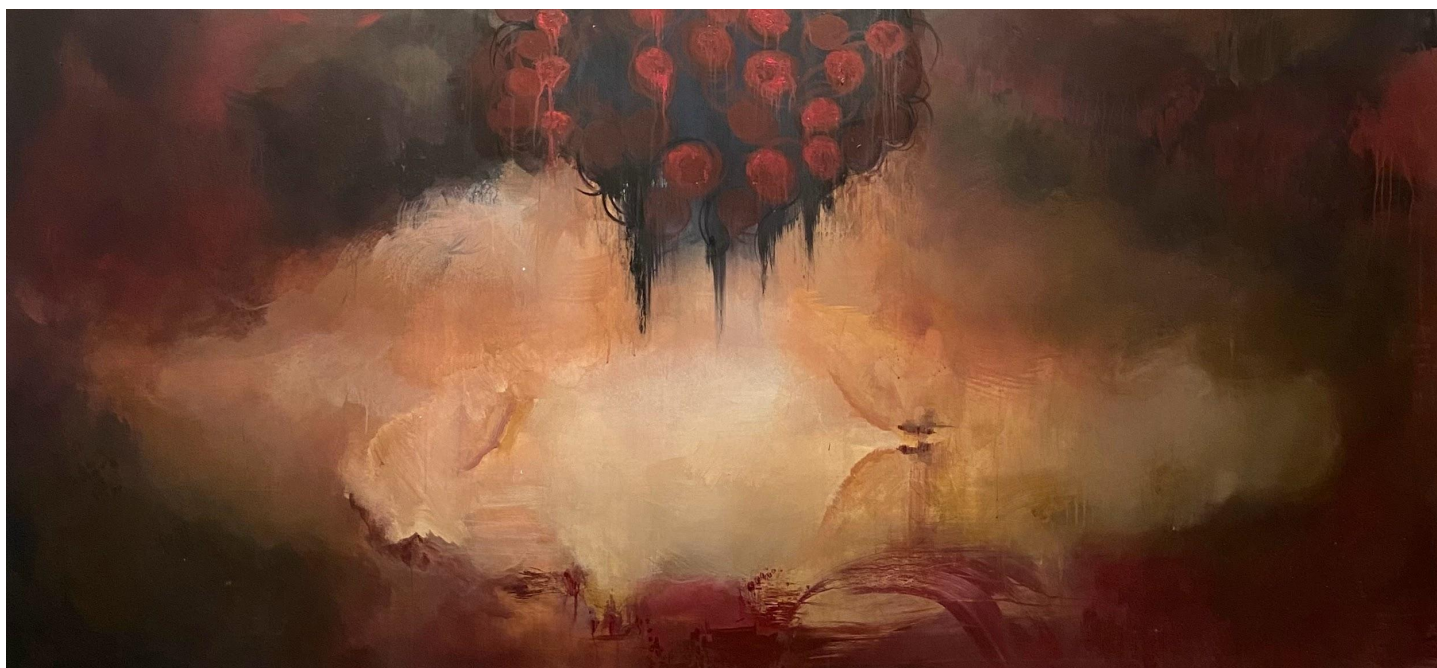
Jay DeFeo *Untitled (Everest)* (1955) and *The Annunciation* (1957-1959)



Appendix 7
“Viral complexity” as depicted in *The discovery of HIV, 1983*

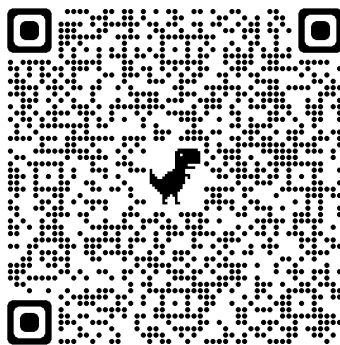


Appendix 8
The discovery of HIV, 1983 Close-up



Appendix 9

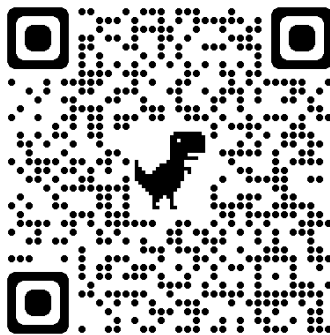
Peter Paul Rubens *The Massacre of the Innocents* (1610)¹⁴³



¹⁴³ “Massacre of the Innocents,” Wikipedia, last modified April 3, 2023, http://en.wikipedia.org/wiki/Massacre_of_the_Innocents.

Appendix 10

Théodore Géricault *The Raft of the Medusa* (1818-1819)¹⁴⁴



¹⁴⁴ “The Raft of the Medusa,” Wikipedia, last modified March 18, 2023, http://en.wikipedia.org/wiki/The_Raft_of_the_Medusa.

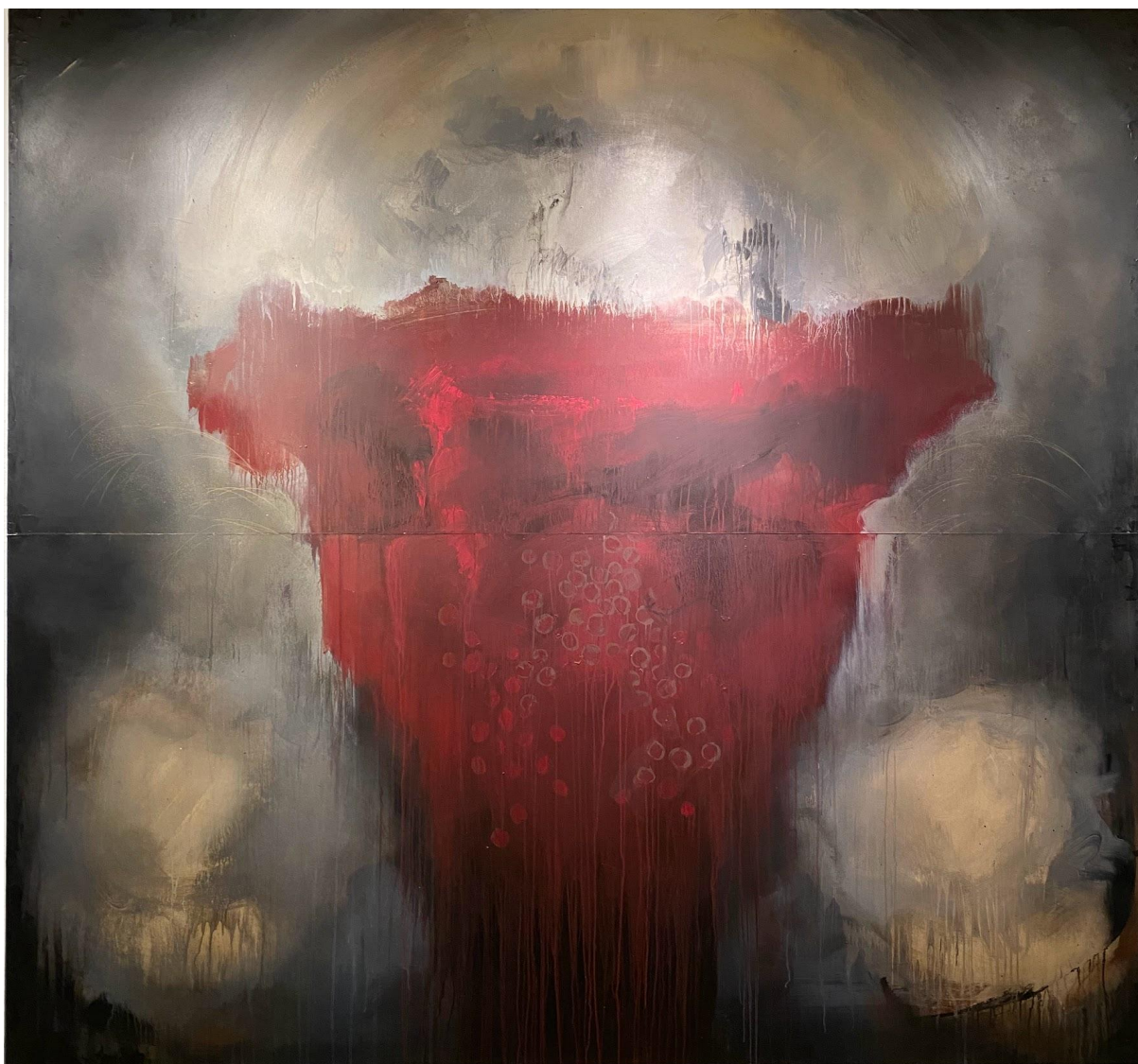
Appendix 11

“Flowers” shrouded in light in contrast to “bleeding” cells in *The discovery of HIV*, 1983



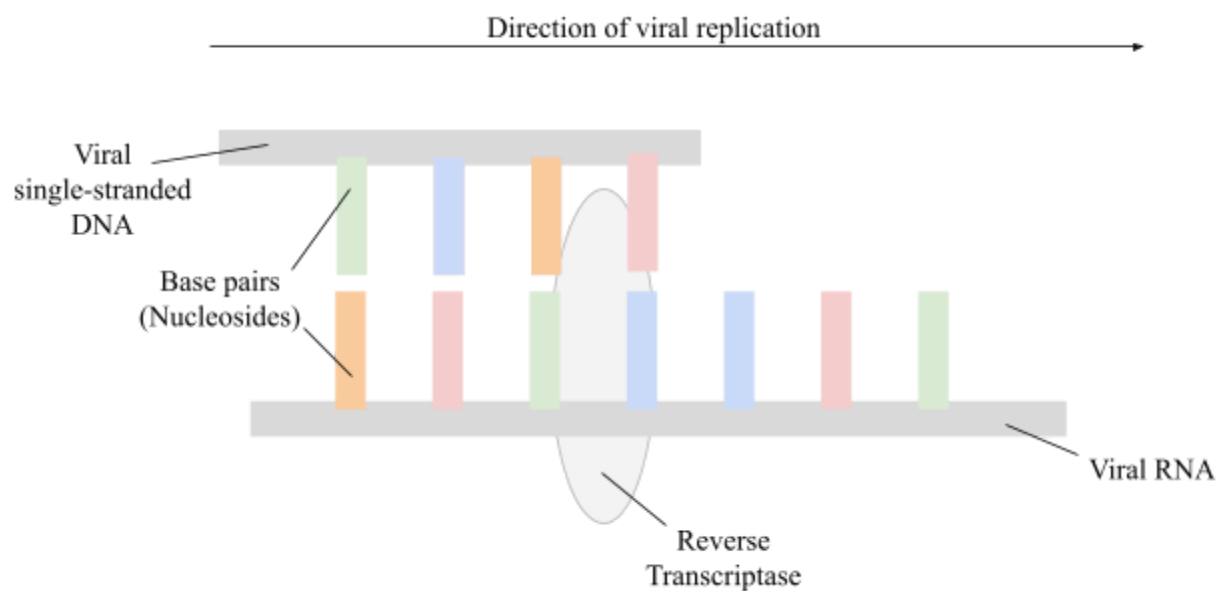
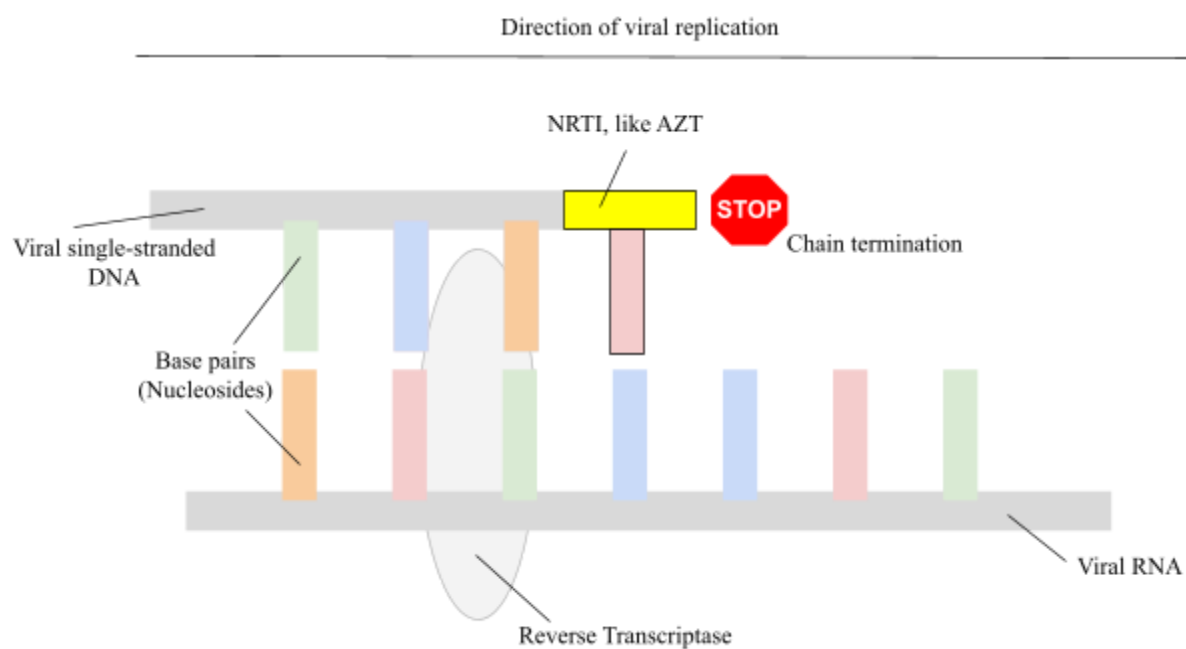
Appendix 12

Allison Crouch *The administration of azidothymidine, 1987* (2023)



Appendix 13

Reverse transcription and nucleoside reverse transcriptase inhibitor (NRTI) mechanism of action

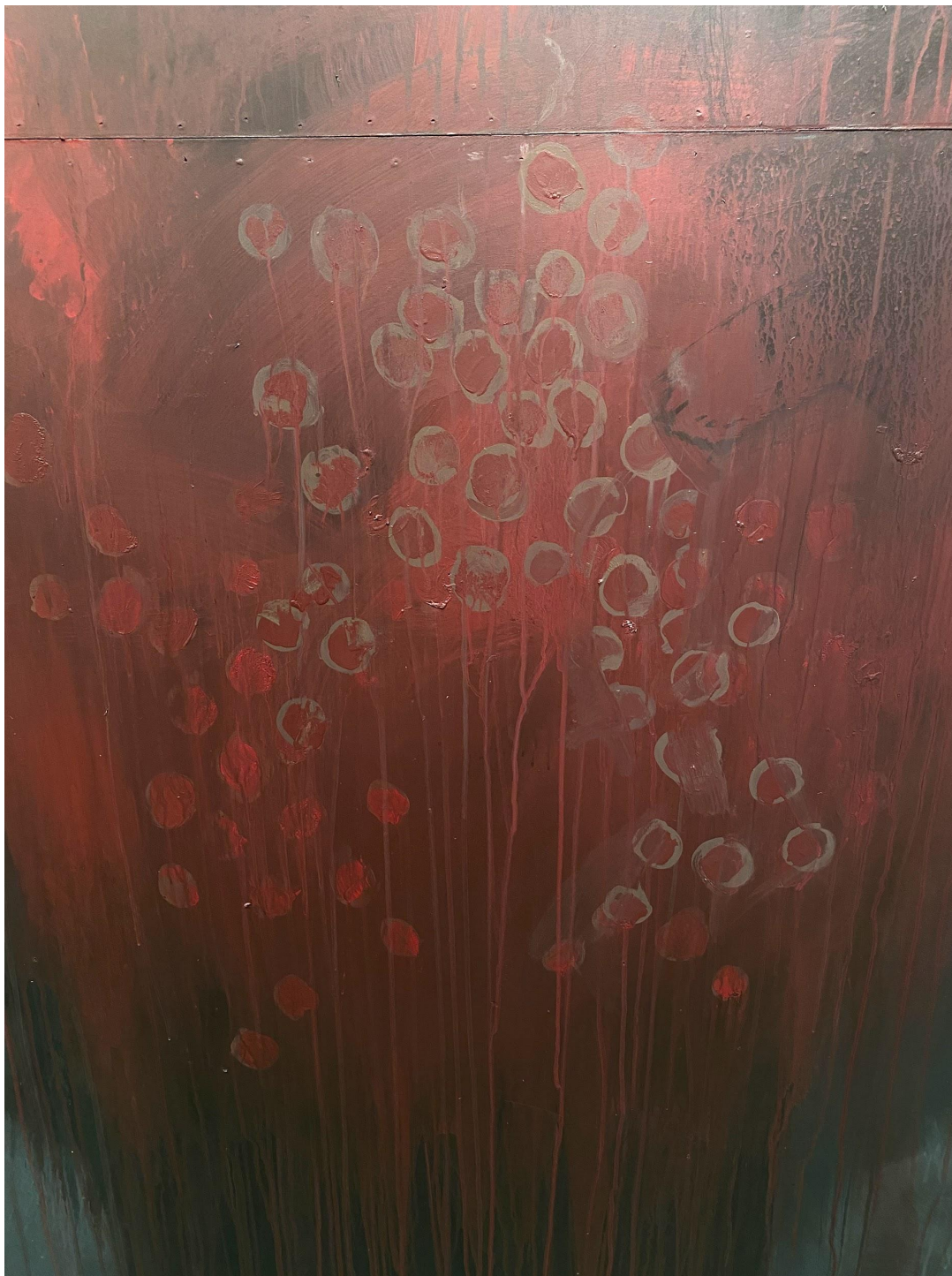
Viral replication (in process)**Viral replication suppressed by azidothymidine (AZT)**

Appendix 14
Administration of azidothymidine, 1987 Close-up



Appendix 15

Cells at core of red mass in *Administration of azidothymidine*, 1987



Appendix 16

Work by Bongiwe Mba and Ncedeka Mbune of the Bambanani Women's Group, co-authors of the graphic novel *Long Life... / Positive HIV Stories*

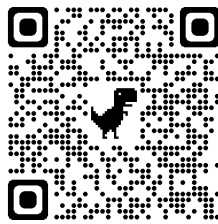


Appendix 17

Carbon black applied with palette knife in *Administration of azidothymidine*, 1987



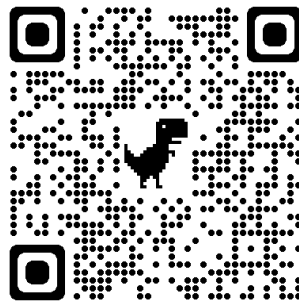
Appendix 18
Jan Lievens' *The Raising of Lazarus* (1631)¹⁴⁵



¹⁴⁵ “The Raising of Lazarus, Jan Lievens, (1607-1674),” *Van GO Yourself*, accessed April 25, 2023, <http://vangoyourself.com/paintings/the-raising-of-lazarus/>.

Appendix 19

Vincent Van Gogh's *The Raising of Lazarus (After Rembrandt)* (1890)¹⁴⁶



¹⁴⁶ "The Raising of Lazarus (After Rembrandt)," *Van Gogh Museum*.

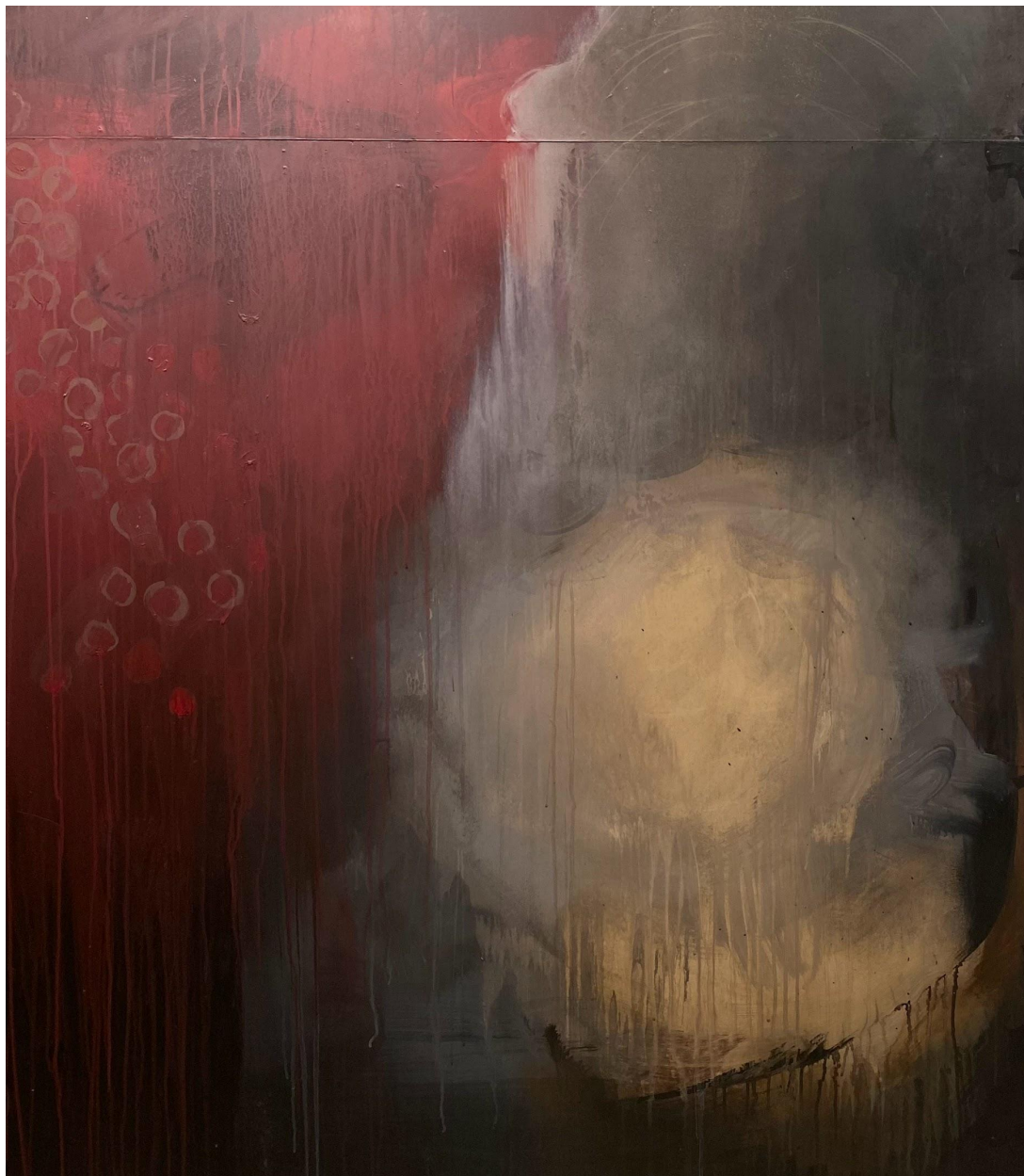
Appendix 20

“Brush” inspired by Lievens’ *Raising of Lazarus* (1631) in *Administration of azidothymidine*,
1987



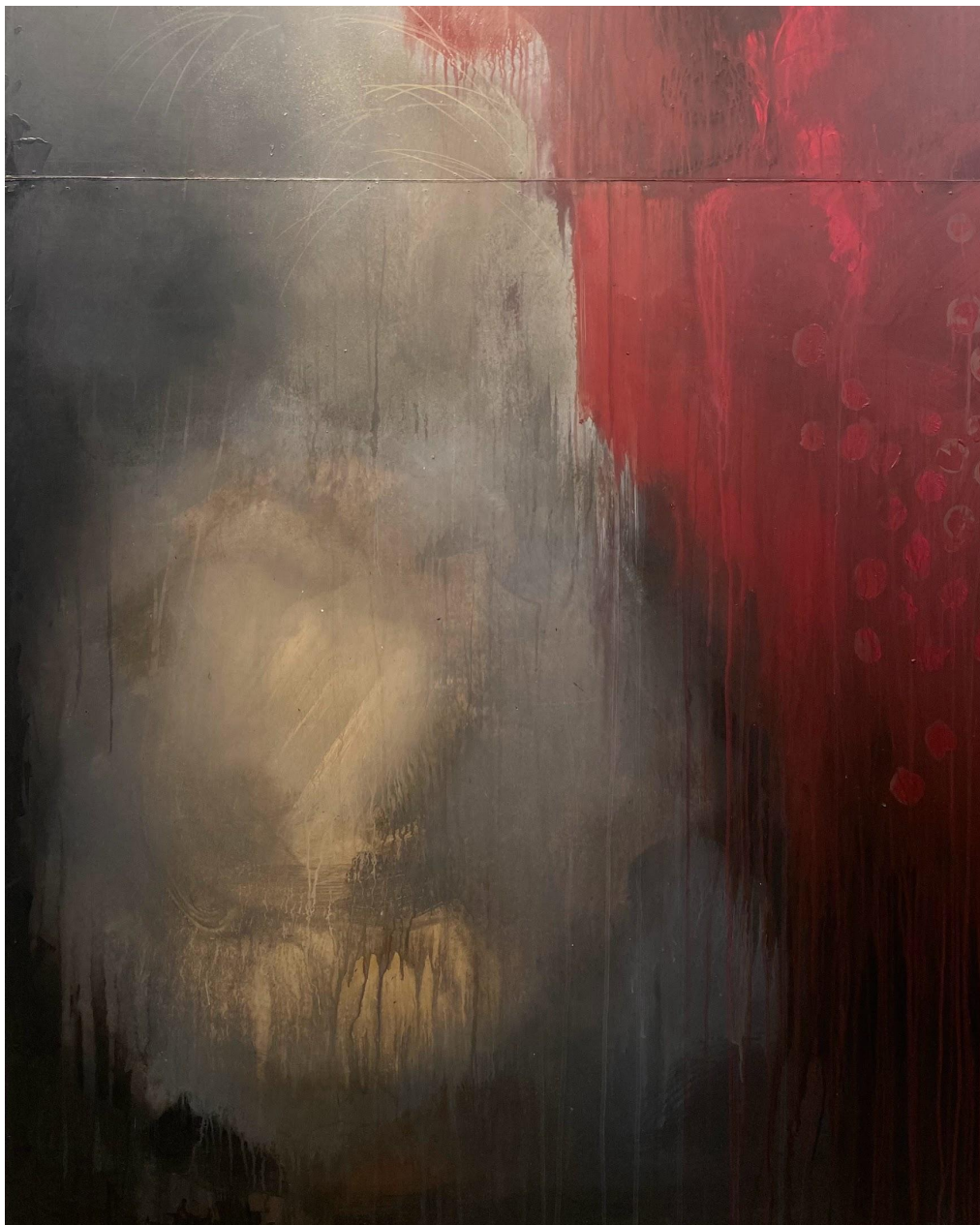
Appendix 21

The “protease inhibitor” bottom right corner in *Administration of azidothymidine*, 1987



Appendix 22

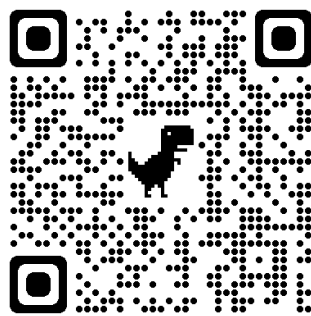
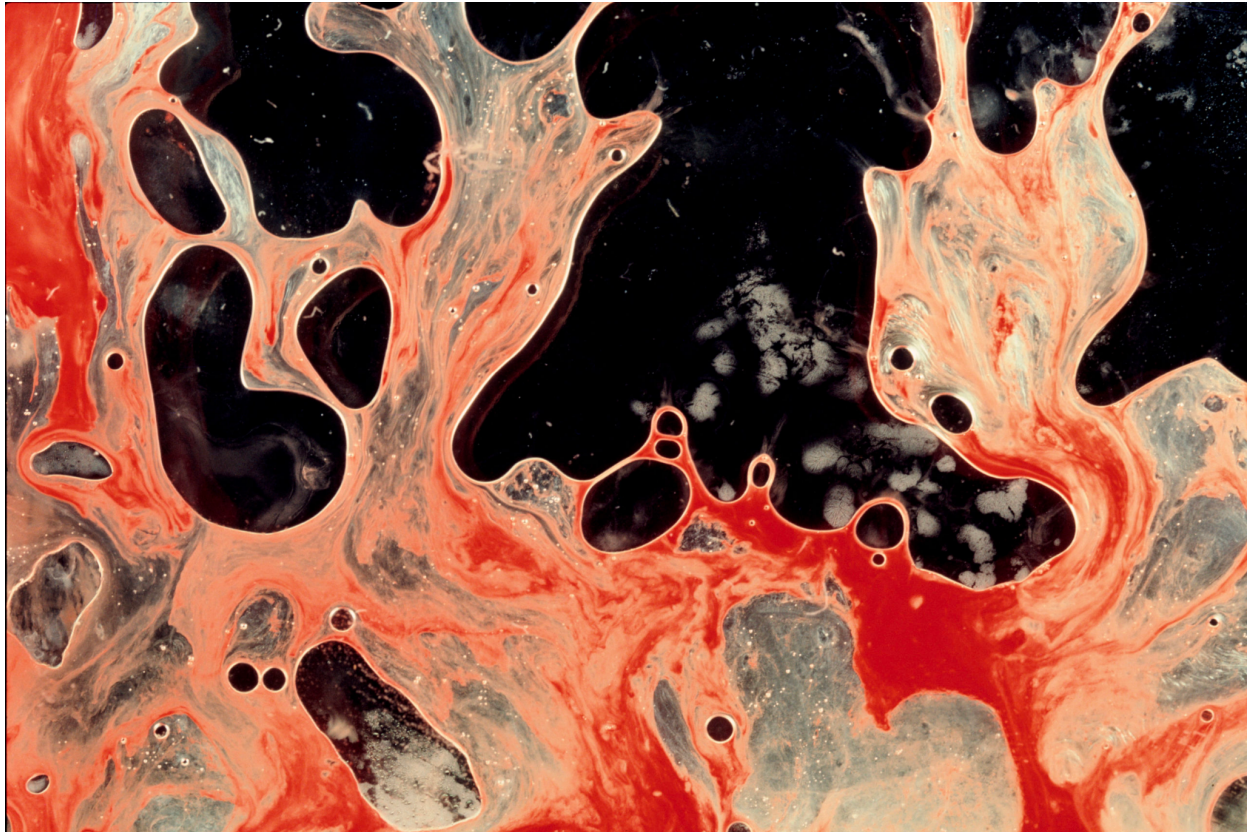
The “integrase inhibitor” bottom left corner in *Administration of azidothymidine*, 1987



Appendix 23
Administration of azidothymidine, 1987 Close-up



Appendix 24
Andres Serrano *Semen and Blood III* (1990)¹⁴⁷



¹⁴⁷ Lydia Horne, "Bleeding Out: On the Use of Blood in Contemporary Art," *Art Papers*, accessed April 19, 2023, <http://www.artpapers.org/bleeding-out-on-the-use-of-blood-in-contemporary-art/>.

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