Saturation Trails

Three experiments exposing the technics of the digital image

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Laser Assay

The laser permeates the whole lab. It is not a discrete object or machine, but moves through machines and between objects. It passes, uncontained and invisible, between Ben's keyboard and screen. It is not only an invisible wavelength but its path through the lab is hard to discern to my untrained eye. It snakes its way through lenses mounted in the regular grid of threaded holes covering the workbench. The apparatus exceeds the room in which we sit: the laser originates next door. Optical parametric amplifiers, difference frequency generators, second and third harmonic generators. Equipment for its control and manipulation extends wall to wall and ceiling to floor. The lab is a bricolage of technical media. It combines consumer technologies and specialist science apparatus, the interaction of these domains is often improvised. The environment of the lab is ordered entirely around the requirements of the laser; the steel optical table sits on a two tonne oil-bed to prevent vibration: camera shake eliminated by sheer ballast. Electrical control gear is racked overhead. We move within this apparatus, surrounded and restricted by the equipment's dominance of the space.

My second hand ten mega-pixel compact camera is mounted on a stage with stepper-motor controlled micron-accurate movements in three dimensions. The conflicting economies of research science and creative practice bolted together on a 6mm thread. The camera moves beneath the laser, which, in spite of its mobility within and through the lab, has a fixed focal point. The camera is controlled spatially, the laser temporally. Their intra-action produces the phenomena encoded as video.

Distances and frequencies are worked out on the whiteboard. We use arbitrarily round numbers. The photosensitive area of the sensor has a width of six millimetres, the total pan time is set at sixty seconds, this gives us a speed of one hundred microns per second. Each pixel is estimated to be five microns square. A rate of ten pulses per second would theoretically break every second column on the array. A laser system capable of flickering 1000 times a second is slowed to less than half the rate of cinema. Pixel death just ten times a second. The power of the laser is modulated with Neutral Density filters, a system designed for controlling photographic exposure. If digitality has eliminated the risk of exposure from the photographic then here that risk is very much present again. We wear safety goggles.

Visibility in the lab is on the side of the scientist. The laser's perspective is reproduced on screen through the same lens that focuses the laser onto the experiment. Science invariably looks down. Placing a camera beneath the lens offers us a perspective back into the apparatus, a view up from the bench. A small adjustable spotlight usually floods the experiment with light, enabling its operator to watch the damage. This dazzles the camera, we switch it off, Ben's screen goes dark. We watch the experiments

between the contingent electrons in our technologies and the contingent signals in our galaxy merely one of scale? Radiation is the root cause of all phenomena.

X-ray assay

The Faxitron MultiRad 350 weighs in at 1500kgs. A large grey cabinet on wheels with a Microsoft Windows operating system, touch screen control panel, USB and ethernet ports. Imposing, it stands like a luxury fridge in a small, square basement room. Do all non-portable media aspire to the condition of domestic white goods? From a ubiquitous computational infrastructure its single purpose is to deliver dose-accurate X-ray radiation for immunology research. The cumulative effects of hours of exposure to radioactive isotopes can now be cut down to a few hundred seconds in its beam. Dosage is controlled by the parameters of voltage, current and distance from the source: Sieverts per hour can be calculated from kilovolts, milliamps and centimetres. Electricity is the root cause of all phenomena.

The room in which it stands is a remnant of a riskier experimental process, built to contain the radiation from Caesium 137, a fission product of an alkali metal. Equipped with two generations of now inactive CCTV cameras, hazard lights, emergency procedure notices and a leaden sliding door - mechanised due to its weight. Yellowed paint and general disrepair belie its outdated purpose, the cladding has been torn away around the door to squeeze the new machine through, revealing walls laminated with an 8mm sheet of lead between plywood. The MultiRad 350 ***FOR ALL YOUR IMAGING AND IRRADIATION NEEDS*** internalises all of this within itself, folding the features of a small laboratory inside its housing. Architecture into media: a lead-lined cabinet in a lead-lined room. A doubled leaden shroud to conceal an invisible light that sees so much it burns.

Inside the machine's brushed stainless steel enclosure, a circular platform marked with the concentric rings of a target can be raised into and lowered out of the conical beam. Various thicknesses of aluminium are used as filters. The camera is perched over the centre, clad in lead: one heavy metal shielding rare earth metal circuitry from a radioactive isotope of an alkali metal. Science rearranges these elements to produce, modulate, measure, and then deplete radiation. Immunologists place white blood cells among these techno-mineral strata, simulating bodily immersion. I introduce a further metal, an optical silicon semiconductor. Minerals are the root cause of all phenomena.

Blocking the integral dosimeter, the image sensor becomes its surrogate, visualising the intensity of radiation as a noise pattern. Sub-chromatic wavelengths rendered as saturated reds and blues. Might alpha, beta and gamma correlate with R, G and B? Radiation – photons – electrons – noise: all equated as specks of colour in the camera. Background noise is measured with respect to the signal, background radiation in millisieverts annually, they become indistinguishable in the machine eye. The noise within the system and the noise of the solar system both image as dappled colour-fields. Is the difference from beneath, gazing up into the beam. The sightlines in the lab have been inverted, Ben is disturbed by this. One square centimeter of mass-produced photosensitive silicon gazes through a state of the art hardware system assembled above, to blind it. A rectangular machine eye images the flickering aperture of machining optics. We watch it visibly dilate and contract between passes.

The laser inscribes a line across the centre of the image. A horizon in a depthless landscape whose sun is perpetually half-set. A single white zip across a field of infrared: light cutting through silicon. As columns are broken clean white lines fracture the image vertically. Some appear to cast shadows to their right as the camera tries to build an image from the damage. It hallucinates a haze of granular noise in the empty space, sodium streetlights illuminating a codec cloud. Enigmatic artifacts begin to appear in the intra-action between micro-temporal laser pulses and the clocking rate of the sensor. Horizontal bands jitter beneath the horizon, a lozenge of saturated white flutters beneath the strafing lens, rising in staccato phase to the steady horizontal glide of the laser. Pulses of infrared so brief that the sensor struggles to place them in its temporal matrix.

The density of broken columns increases, a venetian blind drawn slowly across the frame, the panning lens still visible behind it. The sensor's physical layers are inverted: what remains of the optical image above it appears shrouded beneath the vertical channels of its microelectronic substrate. We see as though from the back - through the whole chip. As the damage increases a gridded area is revealed beneath the horizon, electronic etchings of cyan, yellow, violet. Single pulses switch the colour space of the whole image, jerking us between a lurid artificial evening, night, and dawn.

We switch the lights back on and pan camera beneath camera, a satellite over silicon. Microlens debris is scattered evenly across the surface, a pattern of regular craters. The physical consequences of optical over-exposure, photonic excess.

Acid assay

The Integrated Clean Room facility is a space insulated and isolated from the dust, dirt and mess of the world. It reproduces within itself the conditions of digital technologies, sealed and equipped with systems for the exclusion and evacuation of contaminants. Its floor is punctured with a regular grid of holes opening onto an empty cavity beneath, into which all dust falls. Around its perimeter a walkway acts as a clinical cloister allowing the work within to be observed and for limited communication between outside and inside. A thermostat maintains a constant temperature day and night. High-efficiency particulate air filtered ventilation and extraction: a system of total environmental control.

Within the clean room, the acid etching wet bench comprises another similar system. It isolates itself from the room in which it stands, diluting and containing toxicity. Laminar air flow and deionised water supply maintain its distinction from its environment. The grid of holes in the floor is mirrored in the bench to drain spillage. The experiments take place here; on an environmentally controlled tabletop within an environmentally controlled room, all behind access controlled card locks.

The gowning room is the interface with the outdoor world, a space of strict protocols in which the human is treated as matter to be contained. The work is protected from our corporeality just as we are protected from its corrosion. All objects passing through are wiped down with a waxed cloth. No cardboard boxes are allowed: a clear plastic tub is provided. Shoes are wrapped in overshoes while stepping over the metal threshold, then double wrapped in over-boots. Facemask, hood, coverall, safety glasses, nitrile gloves: all bodily borders are doubly reinforced. Regular users grow accustomed to recognising one another by gait and glasses. Once inside Neil dons a further layer of overgarments: plastic full-facemask, elbow-length thick rubber gloves, ankle-length wraparound apron.

The chemical composition of hydrofluoric acid necessitates all of these precautions, but to the video signal coming from the sensor its liquidity is more of a problem. Neil places a full drop from the pipette, flooding the surface and instantly shorting the signal. The image cuts to black. The substrate bubbles and smokes for several minutes. The clean room functions by establishing and maintaining barriers: between outside and inside, between volumes of air within the lab, between body and experiment. But the boundary between the electrons in the sensor's substrate and the video flow in the surrounding single strand gold wires is unenforceable.

We now work with minute quantities, much smaller than Neil is accustomed to. He develops a technique for dabbing the smallest drop onto the sensor's surface. Facing upwards inside the wet bench it focuses on nothing but is sensitive to all light in the 180 degree hemisphere above. It flickers, adjusting to shadows cast by our movement. My dated portable tripod holding the camera horizontal is incongruous among clean plastic sterility. Success at the third attempt: bubbles appear within the droplet and slowly swell. The drop of acid shifts through colours like a rapid bruise. Speckles of pink rise to the surface before darkening through purple towards black. We watch the image fracture vertically with clean white lines, before a hallucinated rainbow collapses through the bottom of the frame.

I return with a larger camera. After months of scrutinising the technical specifications of various sensors its physical dimensions have become the defining factor. The physics governing the shrinkage of semiconductors are under constant revision but a drop of liquid can only be so small.

We watch damage relayed to the camera's screen. Gentle ripples in the sensor's strata are rendered radiant. A machine-pupil scorched white by fuming nitric. Acid refractions of blue and orange around its dilating purple iris. A matrix of rectilinear cells emerges as pixels crumble. Green and magenta channels run respectively north–south to a perpendicular black. Is chrominance extracted vertically and luminance horizontally? Seduced by the visual representation, Neil almost dabs acid onto the screen. The liquid seepage eventually reaches the signal strands. A brief, familiar monochrome flicker... ***THE MOVIE COULD NOT BE SAVED***