

To steder samtidig

-

En introduktion til Virtual Reality



Af

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Introduktion

Mere end nogen anden type af IT-teknologi, tegner den nuværende udgave af Virtual Reality til at kunne realisere en gammel drøm.

Hvor ingen rigtig havde drømt om internettet, smartphonen eller endog de digitale computerspil, før de blev bygget og beviste, vi havde ønsket dem uden at være klar over det, så er Virtual Reality på mange måder svaret på en lang drøm, menneskeheden har haft igennem mange, mange år.

Fra den religiøse ekstase oplevet i menneskets helt tidlige samfunds meditationer og visioner til holodækkets kunstige virkeligheder af hårdt lys i Star Treks science fiction-univers, har mennesket været fascineret af ideen om at være til stede mere end et sted på samme tid.

Vi er splittede væsner. På den ene side bundet til kød, på den anden side frigjort af ånd, eller i mere moderne termer: splittet mellem organer, der optager eksterne sanseindtryk og hjernen, der bearbejder dem og oversætter dem til en oplevelse.

Men hjernen kan også bygge de oplevelser uden indtrykkene. Hvis vi lukker øjnene og forestiller os det, kan vi næsten mærke sandet under tæerne fra de strande, vi besøgte som børn, eller smage en ret, vi ikke har spist i årtier. Vi kalder det at dagdrømme. Når virkeligheden glider væk og vi har en fornemmelse af en anden, mere rigtig virkelighed. Det er den selvfølgelig ikke, men mens vi drømmer er den.

I Virtual Reality kan vi drømme med åbne øjne. Vi kan rejse til andre steder, gøre fantastiske ting, lege med verden på en måde, vi ellers kun har kunnet i fantasien. Det lyder – specielt når man bor i det skeptiske nord – som overdrivelser og salgstricks. Men uden fejl har jeg set det ske. Alle fra børn til ældre, fra den mest skeptiske til den mest teknologiparate har jeg set overgive sig til drømmen, når de har prøvet selv nogle af de mest basale af de nuværende teknologier. En Samsung Gear VR rakt rundt til en familiefest, hvor der kun er 360 graders fotografier på; et tre-årigt barn på vandring i Grønlands is, men stadig her i min sofa; at gå rundt i et maleri i Quills fra Oculus; at spænde buen med to kroppe på én gang i Vivens The Lab; eller at stå midt i en flygtningelejr i Syrien via UNICEFs overrumplende VR-film og –oplevelser. Vi er to steder samtidig.

Den dobbelte virkelighed af at være her og der samtidig er så overvældende og kan opnås med så relativt simple virkemidler, at det, der er blevet spået så mange gange i det tyvende århundrede her i begyndelsen af det enogtyvende rent faktisk er opnåeligt: vi lever i Virtual Reality's tid.

Det giver nye muligheder og nye udfordringer for alle, men ikke mindst for de udviklere, der skal bygge værktøjerne til at drømme disse drømme. I denne bog har vi fra Institut for Dansk Spiludvikling samlet en kort introduktion til den forskning og best practice, der eksisterer netop nu.

Bogens egen tekst giver værktøjerne til at navigere videre ud i udviklingen af og tankerne omkring Virtual Reality-oplevelser – for eksempel via den omfattende litteraturliste, vi har inkluderet, hvor langt de fleste kilder er frit tilgængelige.

Endelig har vi tilføjet en science fiction novelle fra 1935 – Pygmalion's Spectacles – der så vidt vi kan se er første gang en teknologi, der ligner den aktuelle, forbrugerorienterede Virtual Reality-teknologi bliver beskrevet. Det er fascinerende, hvor præcist tekstens forfatter, Stanley Gaumann Weinbaum, beskriver det løfte og de designmæssige udfordringer, Virtual Reality også i dag står overfor.

Vi håber meget, at denne bog kan være det første skridt for mange udviklere til at tage livtag med Virtual Reality og for mange brugere til at forstå, hvordan denne drømmemaskine, der efter alt at dømme vil ændre vores verden radikalt, egentlig fungerer.

Vi glæder os til at drømme sammen med jer.

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Grundlæggende VR-terminologi i forskningen

Der er forsket i VR siden engang i 60'erne, men den overordnede problematik i forhold til at anvende al den forskning, der er blevet bedrevet er, at meget af forskningen er centreret omkring enten specialbyggede VR-maskiner – der ikke nødvendigvis ligner vores nuværende teknologi nok til at man kan overføre resultaterne – eller at det er foretaget med henblik på at undersøge forskelle og ligheder imellem den digitale og den analoge verden i virtuelle sammenhænge på flade skærme, såsom via Second Life.

Ikke desto mindre er der en god håndfuld af brugbare konklusioner, der kan trækkes og som er relevante i dag. I 90'erne begyndte man også at forske i teknologier, der mere ligner vores nuværende, så der er en god mængde at tage fat i. Sidst i denne lille pamflet er der en linksamling til noget af det vigtigste forskning, men for at gøre det nemmere at navigere i det er her en gennemgang af de grundlæggende principper i forskningen og den grundlæggende terminologi, baseret primært på den nok mest betydelige forsker inden for VRs termer, nemlig *Mel Slater*. Termerne er markeret med kursiv første gang de optræder nedenfor.

Et VR-headset kaldes et head-mounted display (*HMD*) og det kan suppleres med forskellige typer af *haptics*, der er fysiske sanseindtryksapparater, som for eksempel en handske, der giver fornemmelsen af at holde om noget eller en stol med rystefunktion, der giver fornemmelsen af at køre i en bil eller et tog.

Når man tager et HMD på, transporteres man til et virtual environment (*VE*), mens man stadig beholder en vis fornemmelse af sin egen krop i den fysiske verden. Den fornemmelse af sin fysiske krop er der ikke et fast udtryk for. I VE har man et vist field of view – *FOV* – der betegner hvor man kan kigge hen i verdenen. For eksempel kunne man forestille sig, at man kan kigge 180 grader i et VE, men bagud mødes man af en sort mur.

Når man er i VE kan VR-udstyret realisere en eller anden mængde af *immersion*. Immersion er fornemmelsen af at være omgivet af en anden verden. Denne fornemmelse er et resultat af en række sanseindtryk, der fodres til brugeren. Tilsammen har disse sanseindtryk den effekt, at kroppen tror, at den er et andet sted, end den er rent fysisk, nemlig i det VE som udgøres af sanseindtrykkene.

Immersion måles på seks forskellige målepinde, der alle er strukturelle eller tekniske, nemlig:

- *Inclusive* – i hvilken grad HMD'et er i stand til at lukke sanseindtryk fra den virkelige verden ude (eller lukke brugeren inde i VE, om man vil)
- *Extensive* – hvor mange sanser VR-teknologien er i stand til at påvirke
- *Surrounding* – hvor bredt et FOV VR-oplevelsen har
- *Vivid* – hvor "livagtig" renderingen er, for eksempel hvor høj opløsning eller hvor hurtig frame rate, der kan opnås
- *Matching* – i hvor høj grad bevægelser i virkeligheden matches af bevægelser i VE
- *Plot* – hvorledes et narrativ i VE hjælper med at overbevise brugeren om VEs virkelighed

Hovedformålet med samtlige af disse punkter er at understøtte skabelsen af *place illusion*, altså det at kroppen tror på den illusion, at det VE som HMD'et præsenterer er en virkelig verden. Kernen i dette er mængden og kvaliteten af sanseindtryk, fordi kroppen behandler disse sanseindtryk på linje med andre og tror på deres ægthed, hvis de ikke afbrydes, hakker i det eller på anden måde gør opmærksom på sig selv som kunstige.

Når kroppen først har accepteret et andet sted som tilpas virkeligt til at tænke det som et sted, man principielt kunne være til i, kommer turen til et andet kernebegreb, nemlig *presence*. Presence er fornemmelsen af kropslig tilstedeværelse i et VE, altså at man faktisk også befinder sig i den verden, man nu har accepteret ægtheden af.

Presence måles på to forskellige måder i forskningen. Subjektivt, hvor VR-brugere bliver spurgt om deres fornemmelse af at være til stede, og objektivt via observationer af brugere i VE for at undersøge, om de opfører sig naturligt i den verden, der simuleres.

Presence og immersion hænger tæt sammen, forstået på den måde at en vis grad af immersion er nødvendig for at kunne opnå presence. Grundlæggende set er det altid en trussel imod presence, at der tilføjes andre sanseindtryk end dem, der støtter op omkring VE'et, selv om eksperimenter har vist, at for eksempel lyde, der ikke er en del af VE, integreres i oplevelsen af VE, hvis der ikke er nogen speciel grund for brugeren til at tro, lyden nødvendigvis kommer udefra. For eksempel bliver immersion brudt for en bruger, der går ind i en fysisk væg, der ikke er renderes i VE, men hvis der er nogen i virkeligheden, der taler lige bagved én, tænker kroppen typisk, at det er en del af VE – indtil man vender sig om.

Udover at hænge tæt sammen med immersion, hænger presence også tæt sammen med *cohesion*, der er den kvalitative fornemmelse af sammenhæng eller "realisme" i designet af et VE. Dette skal ikke forstås som en decideret fotorealisme, men snarere som en fornemmelse af, at et VE er forståeligt og giver mening. Det er for eksempel underligt i et fotorealistisk VE, at man kan hoppe 20 meter op i luften, men det ville ikke være underligt i et VE baseret på Super Mario.

Cohesion hænger således tæt sammen med opførsel (*behavior*). Dels objekters opførsel, der skal leve op til de forventninger, man har til VE ud fra designets indretning. Dels personers opførsel, der skal leve op til den forventning, man har til personer i den givne situation. Hvis man således spiller et stealth-spil, hvor man skal snige sig forbi vagter, er det ikke essentielt for coherence, at de kan diskutere metafysik på en overbevisende måde, men hvis de ikke opdager én, når man hopper op og ned foran dem, er der noget galt.

Fornemmelsen af cohesion er yderst skrøbelig og kan ødelægges uigenkaldeligt med et enkelt fejltrin i forhold til opførsel. Til gengæld kan den – fordi den bygger på menneskets evne til at udkaste mentale modeller snarere end sanseindtryk – realiseres med en relativt lav grad af immersion og kan forstærke oplevelsen af presence tilstrækkeligt til at kompensere.

Opnå følelsen af presence, kan den eventuelt kombineres med en fornemmelse af *co-presence*. Dette er oplevelsen af, at der er andre, virkelige personer til stede i VE sammen med én. Disse virkelige personer behøver ikke at være faktiske virkelige personer, men eksperimenter har vist, at

hvis muligheden for at møde andre mennesker i VE eksisterer, behandler brugere typisk også computerstyrede agenter som om de var mennesker.

Når de forskellige tiltag til at opnå presence lykkes, skabes *plausibility illusion*. Dette er den bevidsthedsmæssige accept af, at man er et andet sted. Man kan sige, at en succesrig *place illusion* får én til at acceptere, at VE er et virkeligt sted, mens *plausibility illusion* får én til at acceptere, at man også selv befinder sig der, eller at ens virtuelle krop er virkelig.

Med andre ord designer man et *HMD* – eventuelt med *haptics* – der realiserer et *VE*. Hvis det indeholder tilstrækkelige *immersion*-komponenter – såsom at det er *inclusive, extensive, surrounding, vivid, matching* og har et *plot* – faciliterer det *VE* en *place illusion*, og brugeren tror *VE* er virkeligt. Hvis *VE* samtidig er designet med høj *cohesion* – faciliteret via objekter og karakterers *behavior* – opnås formodentlig *presence* og dermed etableres en *plausibility illusion*, og brugeren tror at hun eller han er tilstede i *VE*.

Det er i store træk den grundlæggende forskningsmæssige teori om *VR*, og hvis I har de termer, der er markeret med kursiv ovenfor på rygraden, skulle det være nemt at navigere rundt i det meste forskning i *VR* produceret i de sidste 15 år. Det bør også gøre det nemmere at diskutere *VR* præcist.

Mere praktiske design-begreber

En del VR-producenter har udgivet best practice manualer omkring VR udvikling, og de fleste er at finde i litteraturlisten nedenfor. Dette kapitel forsøger at udtrække nogle generelle best practices herfra, primært baseret på Oculus' best practice manual. Der er fokuseret udelukkende på den visuelle del af VR.

For det første er det vigtigt at forstå, hvordan teknologien rent grundlæggende fungerer. Et HMD renderer to forskellige billeder, der sendes igennem hver sin linse til hver sit øje på brugeren. Dette er fordi en af de primære måder vi ser dybde på er gennem binokulære – altså to-øjede – dybdefænomener. Det vil sige at på grund af vores øjnes placering ser vi to lidt forskellige billeder af verden, et for hvert øje. Vores hjerne kombinerer disse to billeder til et stereoskopisk billede og skaber derigennem en fornemmelse af dybde. Dette udnyttes af HMD'et til at skabe fornemmelsen af dybde i en virtuel verden.



Foto: <https://www.apkgplay.com/da/vr-player-pro>

Afstanden mellem de to billeder, der renderes, skal naturligt nok helst være så tæt på den naturlige afstand imellem vores to øjne som muligt, og det opnår man ved at bruge to kameraer i stedet for et inde i den engine, man benytter til at renderere og så placere dem i en passende afstand fra hinanden. Afstanden mellem to øjne kaldes interpupillary distance (IPD), mens afstanden imellem de to kameraer kaldes for inter-camera distance (ICD). Endelig skal der helst ikke være for stor forskel på IPD, ICD og afstanden imellem de to linser, der er i HMD'et, eller interaxial distance (IAD). Den gennemsnitlige IPD er på 63,5mm, og det er også IAD i Oculus' HMD. ICD kan der eksperimenteres med, men bør aldrig være mindre end 52mm eller mere end 78mm, der er de to data outliers i målingerne, der førte til gennemsnittet på 63,5mm.

Men virtuelle verdener på en flad skærm har jo også en fornemmelse af dybde, og det er fordi ikke alle dybdeoplevelser er binokulære. Nogle er monokulære – en-øjede – bedst eksemplificeret ved perspektivmalingen. Når vi ser dybde i et maleri er det ikke fordi maleriet rent faktisk er dybt, men

fordi der gives en fornemmelse af dybde ved hjælp af ting som størrelsesforhold, linjers systematiske hældning og så videre.

I den virkelige verden fokuserer vi på ting, dyr og mennesker på forskellige dybdeplaner via to teknikker. Accommodation – der betyder at øjets linser rent fysisk stiller skarpt – og vergence – der betyder at øjnene roterer ind imod næsen for at bringe et bestemt sted i fokus.

I VE er accommodation det, som man kalder fixed – der er allerede stillet skarpt på alt, fordi det er renderet skarpt (i modsætning til film, hvor linsen kun stiller skarpt på dele af en situation ad gangen).

Til gengæld fungerer vergence stadig og er den primære måde, vi fokuserer på i VR. Det viser sig, at det er hårdt for øjnene at stille skarpt ved hjælp af vergence i længere perioder, medmindre den, man stiller skarpt på befinder sig inden for en bestemt afstand, nemlig mellem 0,75m og 3,5m. 2,5m er det bedste valg.

Resultatet af dette er, at Oculus fraråder, at man bruger det sædvanlige spil-UI trick med at rendere et HUD hen over en verden (såsom en ammunitions-tæller eller et sigtekorn), fordi sådanne objekter typisk vil være for tæt på til at det er behageligt i længden. I stedet opfordrer Oculus til, at man lægger UI ud i VE, sådan så man får informationerne på behørig afstand.

Oculus' best practices har derudover en lang række forslag til, hvordan man behandler bevægelse og undgår simulatorsyge, men de ovenfor nævnte begreber og koncepter er de vigtigste i forhold til en grundlæggende forståelse for teknisk VR-design.

Test af funktionalitet og brugeroplevelse i VR

Udviklingen af VR-oplevelser giver nogle udfordringer i forhold til det traditionelle set-up med udvikling af software. Hvor man i de fleste udviklingsmiljøer og engines kan arbejde med en ret hurtig test-cyklus for funktioner og basal brugeroplevelse – forstået på den måde, at nye implementeringer af kode hurtigt kan compiles og køres – er det mere kompliceret med VR.

Grunden til dette er, at selv om man nemt kan køre en VR-oplevelse i et vindue på en flad skærm, er det umuligt at vise hele FOV'et på en gang. Det betyder, at en VR-bruger typisk vil reagere på ting i sit FOV, der simpelthen ikke dukker op på udviklerens skærm, hvilket gør det meget svært at designe effektivt.

Det betyder, at der eksperimenteres en del med, hvordan man kan udvikle effektivt og hurtigt og med en rimeligt hurtig test-cyklus i VR.

Det tætteste, man kommer på den normale måde at gennemføre cyklussen på, er ved at lade udvikleren, der har skrevet eller rettet koden selv tage et HMD på og udføre testen. Dette giver imidlertid en rimeligt sløv proces, specielt i situationer, hvor der skal afprøves effekter af rimeligt små ændringer. Udvikleren skal

1. Implementere ændringerne i koden
2. Tage HMD'et på
3. Justere HMD'et, så oplevelsen er ordentlig
4. Køre testen
5. Tage HMD'et af
6. Notere testens resultater
7. Reagere på testens resultater ved ny-implementering

I en situation, hvor der skal foretages 10-15 små rettelser for at opnå det helt rigtige resultat – en situation, der ikke er usædvanlig, specielt i spiludvikling – er de 7 skridt en stor hurdle.

VR-udviklere har derfor forsøgt sig med at sætte forskellige fysiske test-miljøer op, typisk hvor de deler de 7 skridt ud på forskellige roller. Den i skrivende stund mest udbredte konstellation er at benytte tre personer, en programmør, en test-ansvarlig og en HMD-bruger. At have en dedikeret HMD-bruger skærer allerede punkt 2, 3 og 5 ovenfor væk. En test gennemført med disse roller ville se nogenlunde sådan her ud:

Programmør	Test-ansvarlig	HMD-bruger
Implementere ændringerne		
		Køre testen
	Notere testens resultater	
Reagere på testens resultater ved ny-implementering		

Kombineres denne test-tilgang med andre systemudviklingsmetoder – mest oplagt Kent Brock's eXtreme Programming, hvor den test-ansvarlige og programmøren kan indgå i et pair-programming forhold, mens en on-site customer kan spille rollen som HMD-bruger – kan man opnå en meget effektiv, iterativ tilgang til udviklingen.

Den iterative tilgang til udviklingen af software er specielt essentiel i forhold til spiludvikling. Da VR-oplevelser langt hen ad vejen har mest til fælles med digitale spil i forhold til andre klassiske, flade IT-systemer, er det fornuftigt at sikre en systemudviklings- og test-metodik, der inkorporerer denne praksis.

Der er stadig ikke nogen konsensus omkring, hvordan VR-udvikling bedst foretages, men det er oplagt, at tiltag som disse peger i den rigtige retning.

Markedet for Virtual Reality

Konsummarkedet for VR er længe blevet spået at skulle åbne op her i 2016, men selv om markedet er vokset støt og roligt i løbet af året er det store rykind udeblevet.

Her er en oversigt over den samlede installationsbase for forskellige typer af HMD'er, sådan som analytikere kan regne og gætte sig frem til, det ser ud i slutningen af 2016:

- Oculus Rift: 355.000
- HTC Vive: 420.000
- Samsung Gear VR: 2.3 mio
- PS VR: 745.000
- Daydream: 261.000
- Google Cardboard: 88.4 mio

Det betyder, at den samlede installationsbase for VR HMD'er (uden cardboard) er 4.081.000. Til sammenligning har PlayStation 4 en installationsbase på 53 millioner.

Samtidig er der stor forskel på at udvikle til de forskellige platforme. Bag de 88.4 millioner Google Cardboard HMD'er gemmer sig support for intet mindre end 4000 forskellige telefoner, hvilket gør effektiv udvikling hertil rimeligt problematisk, når man har med spil at gøre. Cardboard'en kunne imidlertid være en god platform at satse på i forbindelse med 360 graders video.

De forskellige input-muligheder for Vive, Rift og PS VR gør det også vanskeligt at lave meget cross-platform udvikling. Khronos arbejder på at udvikle en standard, der skulle løse disse problemer, men det er rimeligt at antage, at denne løsning ikke vil være klar før tidligst sent i 2019.

I dette øjeblik – januar 2017 – er den mest lovende platform Samsung Gear VR, der også bringer den app, man udvikler, ind i Oculus' butik-univers. I 2017 kunne Daydream blive en rival, når flere telefoner er understøttet, så længe der stadig bevares et vist fokus. Fordelen ved disse to platforme er, at hardwaren er velkendt og installationsbasen er stor – reelt ved Gear VR, potentielt ved Daydream.

Der kan være mange grunde til den manglende installationsbase, men den analyse, jeg hører i branchen er:

1. Der er en ret lille installationsbase på den nødvendige hardware til de fleste løsninger (high-end gaming PC)
2. Der er ingen killer-app
3. VR er en meget specialiseret funktion, som man ikke som forbruger kan forklare væk som andet end et underholdningskøb – og så er de fleste løsninger stadig meget dyre.

Når det så er sagt, så er det værd at fremhæve, at der er ca. 16 millioner brugere, men genererer en omsætning bredt på 2,7 milliarder dollars. Det tyder på, at VR har fat i en kerne af brugere, der

ligner det publikum, der drev Apples succes i 2000'erne og de tidlige 2010'ere – innovators, der vil bruge penge.

Bag konsummarkedet ligger der desuden en række B2B markeder og spirer. Force Field – der også udvikler spil – udvikler for eksempel VR-baserede reklamer, mens SAP har en hel afdeling kun dedikeret til at finde nye use cases for teknologi som VR. Her kunne der være en spændende mulighed for at bruge spiludviklingskompetencer inden for et andet felt.

Litteratur:

De følgende kilder repræsenterer en introduktion til den meget ekstensive litteratur inden for området. Der er en del forskning fra tiden før 1990'erne, der ikke er umiddelbart brugbart, fordi den er foretaget med specialbygget VR-teknologi, der ikke substantielt ligner den teknologi, der bruges nu. De følgende kilder skulle give en sikker fornemmelse for, hvordan man navigerer i yderligere materiale.

Skønlitteratur:

Den første beskrivelse af VR blev begået i 1935 af S. G. Weinbaum. Teksten er få sider lang, men kortlægger tydeligt de løfter og udfordringer, VR i vore dage giver og står overfor. Derfor er den inkluderet som et appendix og den kan anbefales varmt, selv om den tydeligt på mange områder er et produkt af 1930'ernes science fiction-miljø.

Weinbaum, S. G. (1935) : *Pygmalion's Spectacles* (<http://www.gutenberg.org/files/22893/22893-h/22893-h.htm>)

Derudover er tre andre skønlitterære bøger værd at kigge på, på grund af deres fremstilling af VR og den effekt de har på branchen, men alle tre er en del længere:

Gibson, William (1984): *Neuromancer*

Scalzi, John (2014): *Lock In*

Stephenson, Neal (1992): *Snow Crash*

Videnskabelige artikler:

Freina, Laura og Michela Ott: A Literature Review on Immersive Virtual Reality in Education (<http://www.itd.cnr.it/download/eLSE%202015%20Freina%20Ott%20Paper.pdf>)

Usoh, Martin, Catena, Ernest, Arman, Sima og Slater, Mel: Using Presence Questionnaires in Reality (<http://www.cise.ufl.edu/research/lok/teaching/ve-s09/papers/questionnaire-paper.pdf>)

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<http://www8.informatik.umu.se/~jwworth/PresenceMeasurement.pdf>

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Websites:

De websites, der er nedenfor er dels ressourcer (Slater, Ux of VR og VR Wiki) og dels nyhedssites. De virker alle nyttige.

Mel Slater's blog: <http://presence-thoughts.blogspot.dk>
Road to VR: <http://www.roadtovr.com>
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Brightman, James: *VR the Biggest Loser This Holiday?*:
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Searles, Rebecca: *Virtual Reality Can Leave You With an Existential Hangover*:
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Bøger:

Generelt er VR-feltet stadig for ungt til at have produceret virkeligt brugbare bøger, og derfor giver det bedre mening at holde sig til en lang række kortere tekster. Imidlertid giver *infinite Reality* en solid orientering i grundlæggende eksperimenter om virtuelle verdener og deres effekt og sammenhænge socialt og cognitivt. Der eksisterer en nyere version, der ikke er blevet undersøgt til denne rapport.

Bailenson, Jeremy and Blasovich, Jim (2011): *Infinite Reality: Avatars, Eternal Life, New Worlds, and the Dawn of the Virtual Revolution*, HarperCollins

Appendix: Pygmalion's Spectacles

PYGMALION'S SPECTACLES

Af Stanley Graumann Weinbaum

"But what is reality?" asked the gnomelike man. He gestured at the tall banks of buildings that loomed around Central Park, with their countless windows glowing like the cave fires of a city of Cro-Magnon people. "All is dream, all is illusion; I am your vision as you are mine."

Dan Burke, struggling for clarity of thought through the fumes of liquor, stared without comprehension at the tiny figure of his companion. He began to regret the impulse that had driven him to leave the party to seek fresh air in the park, and to fall by chance into the company of this diminutive old madman. But he had needed escape; this was one party too many, and not even the presence of Claire with her trim ankles could hold him there. He felt an angry desire to go home—not to his hotel, but home to Chicago and to the comparative peace of the Board of Trade. But he was leaving tomorrow anyway.

"You drink," said the elfin, bearded face, "to make real a dream. Is it not so? Either to dream that what you seek is yours, or else to dream that what you hate is conquered. You drink to escape reality, and the irony is that even reality is a dream."

"Cracked!" thought Dan again.

"Or so," concluded the other, "says the philosopher Berkeley."

"Berkeley?" echoed Dan. His head was clearing; memories of a Sophomore course in Elementary Philosophy drifted back. "Bishop Berkeley, eh?"

"You know him, then? The philosopher of Idealism—no?—the one who argues that we do not see, feel, hear, taste the object, but that we have only the sensation of seeing, feeling, hearing, tasting."

"I—sort of recall it."

"Hah! But sensations are *mental* phenomena. They exist in our minds. How, then, do we know that the objects themselves do not exist only in our minds?" He waved again at the light-flecked buildings. "You do not see that wall of masonry; you perceive only a *sensation*, a feeling of sight. The rest you interpret."

"You see the same thing," retorted Dan.

"How do you know I do? Even if you knew that what I call red would not be green could you see through my eyes—even if you knew that, how do you know that I too am not a dream of yours?" Dan laughed. "Of course nobody *knows* anything. You just get what information you can through the windows of your five senses, and then make your guesses. When they're wrong, you pay the

penalty." His mind was clear now save for a mild headache. "Listen," he said suddenly. "You can argue a reality away to an illusion; that's easy. But if your friend Berkeley is right, why can't you take a dream and make it real? If it works one way, it must work the other."

The beard waggled; elf-bright eyes glittered queerly at him. "All artists do that," said the old man softly. Dan felt that something more quivered on the verge of utterance.

"That's an evasion," he grunted. "Anybody can tell the difference between a picture and the real thing, or between a movie and life."

"But," whispered the other, "the realer the better, no? And if one could make a—a movie—*very* real indeed, what would you say then?"

"Nobody can, though."

The eyes glittered strangely again. "I can!" he whispered. "I *did*!"

"Did what?"

"Made real a dream." The voice turned angry. "Fools! I bring it here to sell to Westman, the camera people, and what do they say? 'It isn't clear. Only one person can use it at a time. It's too expensive.' Fools! Fools!"

"Huh?"

"Listen! I'm Albert Ludwig—*Professor* Ludwig." As Dan was silent, he continued, "It means nothing to you, eh? But listen—a movie that gives one sight and sound. Suppose now I add taste, smell, even touch, if your interest is taken by the story. Suppose I make it so that you are in the story, you speak to the shadows, and the shadows reply, and instead of being on a screen, the story is all about you, and you are in it. Would that be to make real a dream?"

"How the devil could you do that?"

"How? How? But simply! First my liquid positive, then my magic spectacles. I photograph the story in a liquid with light-sensitive chromates. I build up a complex solution—do you see? I add taste chemically and sound electrically. And when the story is recorded, then I put the solution in my spectacle—my movie projector. I electrolyze the solution, break it down; the older chromates go first, and out comes the story, sight, sound, smell, taste—all!"

"Touch?"

"If your interest is taken, your mind supplies that." Eagerness crept into his voice. "You will look at it, Mr.—?"

"Burke," said Dan. "A swindle!" he thought. Then a spark of recklessness glowed out of the vanishing fumes of alcohol. "Why not?" he grunted.

He rose; Ludwig, standing, came scarcely to his shoulder. A queer gnomelike old man, Dan thought as he followed him across the park and into one of the scores of apartment hotels in the vicinity. In his room Ludwig fumbled in a bag, producing a device vaguely reminiscent of a gas mask. There were goggles and a rubber mouthpiece; Dan examined it curiously, while the little bearded professor brandished a bottle of watery liquid.

"Here it is!" he gloated. "My liquid positive, the story. Hard photography—infernally hard, therefore the simplest story. A Utopia—just two characters and you, the audience. Now, put the spectacles on. Put them on and tell me what fools the Westman people are!" He decanted some of the liquid into the mask, and trailed a twisted wire to a device on the table. "A rectifier," he explained. "For the electrolysis."

"Must you use all the liquid?" asked Dan. "If you use part, do you see only part of the story? And which part?"

"Every drop has all of it, but you must fill the eye-pieces." Then as Dan slipped the device gingerly on, "So! Now what do you see?"

"Not a damn thing. Just the windows and the lights across the street."

"Of course. But now I start the electrolysis. Now!"

There was a moment of chaos. The liquid before Dan's eyes clouded suddenly white, and formless sounds buzzed. He moved to tear the device from his head, but emerging forms in the mistiness caught his interest. Giant things were writhing there.

The scene steadied; the whiteness was dissipating like mist in summer. Unbelieving, still gripping the arms of that unseen chair, he was staring at a forest. But what a forest! Incredible, unearthly, beautiful! Smooth boles ascended inconceivably toward a brightening sky, trees bizarre as the forests of the Carboniferous age. Infinitely overhead swayed misty fronds, and the verdure showed brown and green in the heights. And there were birds—at least, curiously lovely pipings and twitterings were all about him though he saw no creatures—thin elfin whistlings like fairy bugles sounded softly.

He sat frozen, entranced. A louder fragment of melody drifted down to him, mounting in exquisite, ecstatic bursts, now clear as sounding metal, now soft as remembered music. For a moment he forgot the chair whose arms he gripped, the miserable hotel room invisibly about him, old Ludwig, his aching head. He imagined himself alone in the midst of that lovely glade. "Eden!" he muttered, and the swelling music of unseen voices answered.

Some measure of reason returned. "Illusion!" he told himself. Clever optical devices, not reality. He groped for the chair's arm, found it, and clung to it; he scraped his feet and found again an

inconsistency. To his eyes the ground was mossy verdure; to his touch it was merely a thin hotel carpet.

The elfin buglings sounded gently. A faint, deliciously sweet perfume breathed against him; he glanced up to watch the opening of a great crimson blossom on the nearest tree, and a tiny reddish sun edged into the circle of sky above him. The fairy orchestra swelled louder in its light, and the notes sent a thrill of wistfulness through him. Illusion? If it were, it made reality almost unbearable; he wanted to believe that somewhere—somewhere this side of dreams, there actually existed this region of loveliness. An outpost of Paradise? Perhaps.

And then—far through the softening mists, he caught a movement that was not the swaying of verdure, a shimmer of silver more solid than mist. Something approached. He watched the figure as it moved, now visible, now hidden by trees; very soon he perceived that it was human, but it was almost upon him before he realized that it was a girl.

She wore a robe of silvery, half-translucent stuff, luminous as starbeams; a thin band of silver bound glowing black hair about her forehead, and other garment or ornament she had none. Her tiny white feet were bare to the mossy forest floor as she stood no more than a pace from him, staring dark-eyed. The thin music sounded again; she smiled.

Dan summoned stumbling thoughts. Was this being also—illusion? Had she no more reality than the loveliness of the forest? He opened his lips to speak, but a strained excited voice sounded in his ears. "Who are you?" Had he spoken? The voice had come as if from another, like the sound of one's words in fever.

The girl smiled again. "English!" she said in queer soft tones. "I can speak a little English." She spoke slowly, carefully. "I learned it from"—she hesitated—"my mother's father, whom they call the Grey Weaver."

Again came the voice in Dan's ears. "Who are you?"

"I am called Galatea," she said. "I came to find you."

"To find me?" echoed the voice that was Dan's.

"Leucon, who is called the Grey Weaver, told me," she explained smiling. "He said you will stay with us until the second noon from this." She cast a quick slanting glance at the pale sun now full above the clearing, then stepped closer. "What are you called?"

"Dan," he muttered. His voice sounded oddly different.

"What a strange name!" said the girl. She stretched out her bare arm. "Come," she smiled.

Dan touched her extended hand, feeling without any surprise the living warmth of her fingers. He had forgotten the paradoxes of illusion; this was no longer illusion to him, but reality itself. It seemed to him that he followed her, walking over the shadowed turf that gave with springy crunch beneath his tread, though Galatea left hardly an imprint. He glanced down, noting that he himself wore a silver garment, and that his feet were bare; with the glance he felt a feathery breeze on his body and a sense of mossy earth on his feet.

"Galatea," said his voice. "Galatea, what place is this? What language do you speak?"

She glanced back laughing. "Why, this is Paracosma, of course, and this is our language."

"Paracosma," muttered Dan. "Para—cosma!" A fragment of Greek that had survived somehow from a Sophomore course a decade in the past came strangely back to him. Paracosma! Land-beyond-the-world!

Galatea cast a smiling glance at him. "Does the real world seem strange," she queried, "after that shadow land of yours?"

"Shadow land?" echoed Dan, bewildered. "*This* is shadow, not my world."

The girl's smile turned quizzical. "Poof!" she retorted with an impudently lovely pout. "And I suppose, then, that *I* am the phantom instead of you!" She laughed. "Do I seem ghostlike?"

Dan made no reply; he was puzzling over unanswerable questions as he trod behind the lithe figure of his guide. The aisle between the unearthly trees widened, and the giants were fewer. It seemed a mile, perhaps, before a sound of tinkling water obscured that other strange music; they emerged on the bank of a little river, swift and crystalline, that rippled and gurgled its way from glowing pool to flashing rapids, sparkling under the pale sun. Galatea bent over the brink and cupped her hands, raising a few mouthfuls of water to her lips; Dan followed her example, finding the liquid stinging cold.

"How do we cross?" he asked.

"You can wade up there,"—the dryad who led him gestured to a sun-lit shallows above a tiny falls—"but I always cross here." She poised herself for a moment on the green bank, then dove like a silver arrow into the pool. Dan followed; the water stung his body like champagne, but a stroke or two carried him across to where Galatea had already emerged with a glistening of creamy bare limbs. Her garment clung tight as a metal sheath to her wet body; he felt a breath-taking thrill at the sight of her. And then, miraculously, the silver cloth was dry, the droplets rolled off as if from oiled silk, and they moved briskly on.

The incredible forest had ended with the river; they walked over a meadow studded with little, many-hued, star-shaped flowers, whose fronds underfoot were soft as a lawn. Yet still the sweet pipings followed them, now loud, now whisper-soft, in a tenuous web of melody.

"Galatea!" said Dan suddenly. "Where is the music coming from?"

She looked back amazed. "You silly one!" she laughed. "From the flowers, of course. See!" she plucked a purple star and held it to his ear; true enough, a faint and plaintive melody hummed out of the blossom. She tossed it in his startled face and skipped on.

A little copse appeared ahead, not of the gigantic forest trees, but of lesser growths, bearing flowers and fruits of iridescent colors, and a tiny brook bubbled through. And there stood the objective of their journey—a building of white, marble-like stone, single-storied and vine covered, with broad glassless windows. They trod upon a path of bright pebbles to the arched entrance, and here, on an intricate stone bench, sat a grey-bearded patriarchal individual. Galatea addressed him in a liquid language that reminded Dan of the flower-pipings; then she turned. "This is Leucon," she said, as the ancient rose from his seat and spoke in English.

"We are happy, Galatea and I, to welcome you, since visitors are a rare pleasure here, and those from your shadowy country most rare."

Dan uttered puzzled words of thanks, and the old man nodded, reseating himself on the carved bench; Galatea skipped through the arched entrance, and Dan, after an irresolute moment, dropped to the remaining bench. Once more his thoughts were whirling in perplexed turbulence. Was all this indeed but illusion? Was he sitting, in actuality, in a prosaic hotel room, peering through magic spectacles that pictured this world about him, or was he, transported by some miracle, really sitting here in this land of loveliness? He touched the bench; stone, hard and unyielding, met his fingers.

"Leucon," said his voice, "how did you know I was coming?"

"I was told," said the other.

"By whom?"

"By no one."

"Why—*someone* must have told you!"

The Grey Weaver shook his solemn head. "I was just told."

Dan ceased his questioning, content for the moment to drink in the beauty about him and then Galatea returned bearing a crystal bowl of the strange fruits. They were piled in colorful disorder, red, purple, orange and yellow, pear-shaped, egg-shaped, and clustered spheroids—fantastic, unearthly. He selected a pale, transparent ovoid, bit into it, and was deluged by a flood of sweet liquid, to the amusement of the girl. She laughed and chose a similar morsel; biting a tiny puncture in the end, she squeezed the contents into her mouth. Dan took a different sort, purple and tart as Rhenish wine, and then another, filled with edible, almond-like seeds. Galatea laughed delightedly

at his surprises, and even Leucon smiled a grey smile. Finally Dan tossed the last husk into the brook beside them, where it danced briskly toward the river.

"Galatea," he said, "do you ever go to a city? What cities are in Paracosma?"

"Cities? What are cities?"

"Places where many people live close together."

"Oh," said the girl frowning. "No. There are no cities here."

"Then where are the people of Paracosma? You must have neighbors."

The girl looked puzzled. "A man and a woman live off there," she said, gesturing toward a distant blue range of hills dim on the horizon. "Far away over there. I went there once, but Leucon and I prefer the valley."

"But Galatea!" protested Dan. "Are you and Leucon alone in this valley? Where—what happened to your parents—your father and mother?"

"They went away. That way—toward the sunrise. They'll return some day."

"And if they don't?"

"Why, foolish one! What could hinder them?"

"Wild beasts," said Dan. "Poisonous insects, disease, flood, storm, lawless people, death!"

"I never heard those words," said Galatea. "There are no such things here." She sniffed contemptuously. "Lawless people!"

"Not—death?"

"What is death?"

"It's—" Dan paused helplessly. "It's like falling asleep and never waking. It's what happens to everyone at the end of life."

"I never heard of such a thing as the end of life!" said the girl decidedly. "There isn't such a thing."

"What happens, then," queried Dan desperately, "when one grows old?"

"Nothing, silly! No one grows old unless he wants to, like Leucon. A person grows to the age he likes best and then stops. It's a law!"

Dan gathered his chaotic thoughts. He stared into Galatea's dark, lovely eyes. "Have you stopped yet?"

The dark eyes dropped; he was amazed to see a deep, embarrassed flush spread over her cheeks. She looked at Leucon nodding reflectively on his bench, then back to Dan, meeting his gaze.

"Not yet," he said.

"And when will you, Galatea?"

"When I have had the one child permitted me. You see"—she stared down at her dainty toes—"one cannot—bear children—afterwards."

"Permitted? Permitted by whom?"

"By a law."

"Laws! Is everything here governed by laws? What of chance and accidents?"

"What are those—chance and accidents?"

"Things unexpected—things unforeseen."

"Nothing is unforeseen," said Galatea, still soberly. She repeated slowly, "Nothing is unforeseen." He fancied her voice was wistful.

Leucon looked up. "Enough of this," he said abruptly. He turned to Dan, "I know these words of yours—chance, disease, death. They are not for Paracosma. Keep them in your unreal country."

"Where did you hear them, then?"

"From Galatea's mother," said the Grey Weaver, "who had them from your predecessor—a phantom who visited here before Galatea was born."

Dan had a vision of Ludwig's face. "What was he like?"

"Much like you."

"But his name?"

The old man's mouth was suddenly grim. "We do not speak of him," he said and rose, entering the dwelling in cold silence.

"He goes to weave," said Galatea after a moment. Her lovely, piquant face was still troubled.

"What does he weave?"

"This," She fingered the silver cloth of her gown. "He weaves it out of metal bars on a very clever machine. I do not know the method."

"Who made the machine?"

"It was here."

"But—Galatea! Who built the house? Who planted these fruit trees?"

"They were here. The house and trees were always here." She lifted her eyes. "I told you everything had been foreseen, from the beginning until eternity—everything. The house and trees and machine were ready for Leucon and my parents and me. There is a place for my child, who will be a girl, and a place for her child—and so on forever."

Dan thought a moment. "Were you born here?"

"I don't know." He noted in sudden concern that her eyes were glistening with tears.

"Galatea, dear! Why are you unhappy? What's wrong?"

"Why, nothing!" She shook her black curls, smiled suddenly at him. "What could be wrong? How can one be unhappy in Paracosma?" She sprang erect and seized his hand. "Come! Let's gather fruit for tomorrow."

She darted off in a whirl of flashing silver, and Dan followed her around the wing of the edifice. Graceful as a dancer she leaped for a branch above her head, caught it laughingly, and tossed a great golden globe to him. She loaded his arms with the bright prizes and sent him back to the bench, and when he returned, she piled it so full of fruit that a deluge of colorful spheres dropped around him. She laughed again, and sent them spinning into the brook with thrusts of her rosy toes, while Dan watched her with an aching wistfulness. Then suddenly she was facing him; for a long, tense instant they stood motionless, eyes upon eyes, and then she turned away and walked slowly around to the arched portal. He followed her with his burden of fruit; his mind was once more in a turmoil of doubt and perplexity.

The little sun was losing itself behind the trees of that colossal forest to the west, and a coolness stirred among long shadows. The brook was purple-hued in the dusk, but its cheery notes mingled still with the flower music. Then the sun was hidden; the shadow fingers darkened the meadow; of a sudden the flowers were still, and the brook gurgled alone in a world of silence. In silence too, Dan entered the doorway.

The chamber within was a spacious one, floored with large black and white squares; exquisite benches of carved marble were here and there. Old Leucon, in a far corner, bent over an intricate, glistening mechanism, and as Dan entered he drew a shining length of silver cloth from it, folded

it, and placed it carefully aside. There was a curious, unearthly fact that Dan noted; despite windows open to the evening, no night insects circled the globes that glowed at intervals from niches in the walls.

Galatea stood in a doorway to his left, leaning half-wearily against the frame; he placed the bowl of fruit on a bench at the entrance and moved to her side.

"This is yours," she said, indicating the room beyond. He looked in upon a pleasant, smaller chamber; a window framed a starry square, and a thin, swift, nearly silent stream of water gushed from the mouth of a carved human head on the left wall, curving into a six-foot basin sunk in the floor. Another of the graceful benches covered with the silver cloth completed the furnishings; a single glowing sphere, pendant by a chain from the ceiling, illuminated the room. Dan turned to the girl, whose eyes were still unwontedly serious.

"This is ideal," he said, "but, Galatea, how am I to turn out the light?"

"Turn it out?" she said. "You must cap it—so!" A faint smile showed again on her lips as she dropped a metal covering over the shining sphere. They stood tense in the darkness; Dan sensed her nearness achingly, and then the light was on once more. She moved toward the door, and there paused, taking his hand.

"Dear shadow," she said softly, "I hope your dreams are music." She was gone.

Dan stood irresolute in his chamber; he glanced into the large room where Leucon still bent over his work, and the Grey Weaver raised a hand in a solemn salutation, but said nothing. He felt no urge for the old man's silent company and turned back into his room to prepare for slumber.

Almost instantly, it seemed, the dawn was upon him and bright elfin pipings were all about him, while the odd ruddy sun sent a broad slanting plane of light across the room. He rose as fully aware of his surroundings as if he had not slept at all; the pool tempted him and he bathed in stinging water. Thereafter he emerged into the central chamber, noting curiously that the globes still glowed in dim rivalry to the daylight. He touched one casually; it was cool as metal to his fingers, and lifted freely from its standard. For a moment he held the cold flaming thing in his hands, then replaced it and wandered into the dawn.

Galatea was dancing up the path, eating a strange fruit as rosy as her lips. She was merry again, once more the happy nymph who had greeted him, and she gave him a bright smile as he chose a sweet green ovoid for his breakfast.

"Come on!" she called. "To the river!"

She skipped away toward the unbelievable forest; Dan followed, marveling that her lithe speed was so easy a match for his stronger muscles. Then they were laughing in the pool, splashing about until Galatea drew herself to the bank, glowing and panting. He followed her as she lay

relaxed; strangely, he was neither tired nor breathless, with no sense of exertion. A question recurred to him, as yet unasked.

"Galatea," said his voice, "Whom will you take as mate?"

Her eyes went serious. "I don't know," she said. "At the proper time he will come. That is a law."

"And will you be happy?"

"Of course." She seemed troubled. "Isn't everyone happy?"

"Not where I live, Galatea."

"Then that must be a strange place—that ghostly world of yours. A rather terrible place."

"It is, often enough," Dan agreed. "I wish—" He paused. What did he wish? Was he not talking to an illusion, a dream, an apparition? He looked at the girl, at her glistening black hair, her eyes, her soft white skin, and then, for a tragic moment, he tried to feel the arms of that drab hotel chair beneath his hands—and failed. He smiled; he reached out his fingers to touch her bare arm, and for an instant she looked back at him with startled, sober eyes, and sprang to her feet.

"Come on! I want to show you my country." She set off down the stream, and Dan rose reluctantly to follow.

What a day that was! They traced the little river from still pool to singing rapids, and ever about them were the strange twitterings and pipings that were the voices of the flowers. Every turn brought a new vista of beauty; every moment brought a new sense of delight. They talked or were silent; when they were thirsty, the cool river was at hand; when they were hungry, fruit offered itself. When they were tired, there was always a deep pool and a mossy bank; and when they were rested, a new beauty beckoned. The incredible trees towered in numberless forms of fantasy, but on their own side of the river was still the flower-starred meadow. Galatea twisted him a bright-blossomed garland for his head, and thereafter he moved always with a sweet singing about him. But little by little the red sun slanted toward the forest, and the hours dripped away. It was Dan who pointed it out, and reluctantly they turned homeward.

As they returned, Galatea sang a strange song, plaintive and sweet as the medley of river and flower music. And again her eyes were sad.

"What song is that?" he asked.

"It is a song sung by another Galatea," she answered, "who is my mother." She laid her hand on his arm. "I will make it into English for you." She sang:

"The River lies in flower and fern,
In flower and fern it breathes a song.

It breathes a song of your return,
Of your return in years too long.
In years too long its murmurs bring
Its murmurs bring their vain replies,
Their vain replies the flowers sing,
The flowers sing, 'The River lies!'"

Her voice quavered on the final notes; there was silence save for the tinkle of water and the flower bugles. Dan said, "Galatea—" and paused. The girl was again somber-eyed, tearful. He said huskily, "That's a sad song, Galatea. Why was your mother sad? You said everyone was happy in Paracosma."

"She broke a law," replied the girl tonelessly. "It is the inevitable way to sorrow." She faced him. "She fell in love with a phantom!" Galatea said. "One of your shadowy race, who came and stayed and then had to go back. So when her appointed lover came, it was too late; do you understand? But she yielded finally to the law, and is forever unhappy, and goes wandering from place to place about the world." She paused. "I shall never break a law," she said defiantly.

Dan took her hand. "I would not have you unhappy, Galatea. I want you always happy."

She shook her head. "I *am* happy," she said, and smiled a tender, wistful smile.

They were silent a long time as they trudged the way homeward. The shadows of the forest giants reached out across the river as the sun slipped behind them. For a distance they walked hand in hand, but as they reached the path of pebbly brightness near the house, Galatea drew away and sped swiftly before him. Dan followed as quickly as he might; when he arrived, Leucon sat on his bench by the portal, and Galatea had paused on the threshold. She watched his approach with eyes in which he again fancied the glint of tears.

"I am very tired," she said, and slipped within.

Dan moved to follow, but the old man raised a staying hand.

"Friend from the shadows," he said, "will you hear me a moment?"

Dan paused, acquiesced, and dropped to the opposite bench. He felt a sense of foreboding; nothing pleasant awaited him.

"There is something to be said," Leucon continued, "and I say it without desire to pain you, if phantoms feel pain. It is this: Galatea loves you, though I think she has not yet realized it."

"I love her too," said Dan.

The Grey Weaver stared at him. "I do not understand. Substance, indeed, may love shadow, but how can shadow love substance?"

"I love her," insisted Dan.

"Then woe to both of you! For this is impossible in Paracosma; it is a confliction with the laws. Galatea's mate is appointed, perhaps even now approaching."

"Laws! Laws!" muttered Dan. "Whose laws are they? Not Galatea's nor mine!"

"But they are," said the Grey Weaver. "It is not for you nor for me to criticize them—though I yet wonder what power could annul them to permit your presence here!"

"I had no voice in your laws."

The old man peered at him in the dusk. "Has anyone, anywhere, a voice in the laws?" he queried.

"In my country we have," retorted Dan.

"Madness!" growled Leucon. "Man-made laws! Of what use are man-made laws with only man-made penalties, or none at all? If you shadows make a law that the wind shall blow only from the east, does the west wind obey it?"

"We do pass such laws," acknowledged Dan bitterly. "They may be stupid, but they're no more unjust than yours."

"Ours," said the Grey Weaver, "are the unalterable laws of the world, the laws of Nature. Violation is always unhappiness. I have seen it; I have known it in another, in Galatea's mother, though Galatea is stronger than she." He paused. "Now," he continued, "I ask only for mercy; your stay is short, and I ask that you do no more harm than is already done. Be merciful; give her no more to regret."

He rose and moved through the archway; when Dan followed a moment later, he was already removing a square of silver from his device in the corner. Dan turned silent and unhappy to his own chamber, where the jet of water tinkled faintly as a distant bell.

Again he rose at the glow of dawn, and again Galatea was before him, meeting him at the door with her bowl of fruit. She deposited her burden, giving him a wan little smile of greeting, and stood facing him as if waiting.

"Come with me, Galatea," he said.

"Where?"

"To the river bank. To talk."

They trudged in silence to the brink of Galatea's pool. Dan noted a subtle difference in the world about him; outlines were vague, the thin flower pipings less audible, and the very landscape was queerly unstable, shifting like smoke when he wasn't looking at it directly. And strangely, though he had brought the girl here to talk to her, he had now nothing to say, but sat in aching silence with his eyes on the loveliness of her face.

Galatea pointed at the red ascending sun. "So short a time," she said, "before you go back to your phantom world. I shall be sorry, very sorry." She touched his cheek with her fingers. "Dear shadow!"

"Suppose," said Dan huskily, "that I won't go. What if I won't leave here?" His voice grew fiercer. "I'll not go! I'm going to stay!"

The calm mournfulness of the girl's face checked him; he felt the irony of struggling against the inevitable progress of a dream. She spoke. "Had I the making of the laws, you should stay. But you can't, dear one. You can't!"

Forgotten now were the words of the Grey Weaver. "I love you, Galatea," he said.

"And I you," she whispered. "See, dearest shadow, how I break the same law my mother broke, and am glad to face the sorrow it will bring." She placed her hand tenderly over his. "Leucon is very wise and I am bound to obey him, but this is beyond his wisdom because he let himself grow old." She paused. "He let himself grow old," she repeated slowly. A strange light gleamed in her dark eyes as she turned suddenly to Dan.

"Dear one!" she said tensely. "That thing that happens to the old—that death of yours! What follows it?"

"What follows death?" he echoed. "Who knows?"

"But—" Her voice was quivering. "But one can't simply—vanish! There must be an awakening."

"Who knows?" said Dan again. "There are those who believe we wake to a happier world, but—" He shook his head hopelessly.

"It must be true! Oh, it must be!" Galatea cried. "There must be more for you than the mad world you speak of!" She leaned very close. "Suppose, dear," she said, "that when my appointed lover arrives, I send him away. Suppose I bear no child, but let myself grow old, older than Leucon, old until death. Would I join you in your happier world?"

"Galatea!" he cried distractedly. "Oh, my dearest—what a terrible thought!"

"More terrible than you know," she whispered, still very close to him. "It is more than violation of a law; it is rebellion! Everything is planned, everything was foreseen, except this; and if I bear no child, her place will be left unfilled, and the places of her children, and of *their* children, and so on

until some day the whole great plan of Paracosma fails of whatever its destiny was to be." Her whisper grew very faint and fearful. "It is destruction, but I love you more than I fear—death!"

Dan's arms were about her. "No, Galatea! No! Promise me!"

She murmured, "I can promise and then break my promise." She drew his head down; their lips touched, and he felt a fragrance and a taste like honey in her kiss. "At least," she breathed. "I can give you a name by which to love you. Philometros! Measure of my love!"

"A name?" muttered Dan. A fantastic idea shot through his mind—a way of proving to himself that all this was reality, and not just a page that any one could read who wore old Ludwig's magic spectacles. If Galatea would speak his name! Perhaps, he thought daringly, perhaps then he could stay! He thrust her away.

"Galatea!" he cried. "Do you remember my name?"

She nodded silently, her unhappy eyes on his.

"Then say it! Say it, dear!"

She stared at him dumbly, miserably, but made no sound.

"Say it, Galatea!" he pleaded desperately. "My name, dear—just my name!" Her mouth moved; she grew pale with effort and Dan could have sworn that his name trembled on her quivering lips, though no sound came.

At last she spoke. "I can't, dearest one! Oh, I can't! A law forbids it!" She stood suddenly erect, pallid as an ivory carving. "Leucon calls!" she said, and darted away. Dan followed along the pebbled path, but her speed was beyond his powers; at the portal he found only the Grey Weaver standing cold and stern. He raised his hand as Dan appeared.

"Your time is short," he said. "Go, thinking of the havoc you have done."

"Where's Galatea?" gasped Dan.

"I have sent her away." The old man blocked the entrance; for a moment Dan would have struck him aside, but something withheld him. He stared wildly about the meadow—there! A flash of silver beyond the river, at the edge of the forest. He turned and raced toward it, while motionless and cold the Grey Weaver watched him go.

"Galatea!" he called. "Galatea!"

He was over the river now, on the forest bank, running through columned vistas that whirled about him like mist. The world had gone cloudy; fine flakes danced like snow before his eyes;

Paracosma was dissolving around him. Through the chaos he fancied a glimpse of the girl, but closer approach left him still voicing his hopeless cry of "Galatea!"

After an endless time, he paused; something familiar about the spot struck him, and just as the red sun edged above him, he recognized the place—the very point at which he had entered Paracosma! A sense of futility overwhelmed him as for a moment he gazed at an unbelievable apparition—a dark window hung in midair before him through which glowed rows of electric lights. Ludwig's window!

It vanished. But the trees writhed and the sky darkened, and he swayed dizzily in turmoil. He realized suddenly that he was no longer standing, but sitting in the midst of the crazy glade, and his hands clutched something smooth and hard—the arms of that miserable hotel chair. Then at last he saw her, close before him—Galatea, with sorrow-stricken features, her tear-filled eyes on his. He made a terrific effort to rise, stood erect, and fell sprawling in a blaze of coruscating lights. He struggled to his knees; walls—Ludwig's room—encompassed him; he must have slipped from the chair. The magic spectacles lay before him, one lens splintered and spilling a fluid no longer water-clear, but white as milk.

"God!" he muttered. He felt shaken, sick, exhausted, with a bitter sense of bereavement, and his head ached fiercely. The room was drab, disgusting; he wanted to get out of it. He glanced automatically at his watch: four o'clock—he must have sat here nearly five hours. For the first time he noticed Ludwig's absence; he was glad of it and walked dully out of the door to an automatic elevator. There was no response to his ring; someone was using the thing. He walked three flights to the street and back to his own room.

In love with a vision! Worse—in love with a girl who had never lived, in a fantastic Utopia that was literally nowhere! He threw himself on his bed with a groan that was half a sob. He saw finally the implication of the name Galatea. Galatea—Pygmalion's statue, given life by Venus in the ancient Grecian myth. But *his* Galatea, warm and lovely and vital, must remain forever without the gift of life, since he was neither Pygmalion nor God.

He woke late in the morning, staring uncomprehendingly about for the fountain and pool of Paracosma. Slow comprehension dawned; how much—*how much*—of last night's experience had been real? How much was the product of alcohol? Or had old Ludwig been right, and was there no difference between reality and dream?

He changed his rumpled attire and wandered despondently to the street. He found Ludwig's hotel at last; inquiry revealed that the diminutive professor had checked out, leaving no forwarding address.

What of it? Even Ludwig couldn't give what he sought, a living Galatea. Dan was glad that he had disappeared; he hated the little professor. Professor? Hypnotists called themselves "professors." He dragged through a weary day and then a sleepless night back to Chicago.

It was mid-winter when he saw a suggestively tiny figure ahead of him in the Loop. Ludwig! Yet what use to hail him? His cry was automatic. "Professor Ludwig!"

The elfin figure turned, recognized him, smiled. They stepped into the shelter of a building.

"I'm sorry about your machine, Professor. I'd be glad to pay for the damage."

"*Ach*, that was nothing—a cracked glass. But you—have you been ill? You look much the worse."

"It's nothing," said Dan. "Your show was marvelous, Professor—marvelous! I'd have told you so, but you were gone when it ended."

Ludwig shrugged. "I went to the lobby for a cigar. Five hours with a wax dummy, you know!"

"It was marvelous!" repeated Dan.

"So real?" smiled the other. "Only because you co-operated, then. It takes self-hypnosis."

"It was real, all right," agreed Dan glumly. "I don't understand it—that strange beautiful country."

"The trees were club-mosses enlarged by a lens," said Ludwig. "All was trick photography, but stereoscopic, as I told you—three dimensional. The fruits were rubber; the house is a summer building on our campus—Northern University. And the voice was mine; you didn't speak at all, except your name at the first, and I left a blank for that. I played your part, you see; I went around with the photographic apparatus strapped on my head, to keep the viewpoint always that of the observer. See?" He grinned wryly. "Luckily I'm rather short, or you'd have seemed a giant."

"Wait a minute!" said Dan, his mind whirling. "You say you played my part. Then Galatea—is *she* real too?"

"Tea's real enough," said the Professor. "My niece, a senior at Northern, and likes dramatics. She helped me out with the thing. Why? Want to meet her?"

Dan answered vaguely, happily. An ache had vanished; a pain was eased. Paracosma was attainable at last!

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