

Vmesniški pristop k raziskovanju prek meja

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Članek obravnava tri teme: nujno potrebo po integriranih študijah; pojem »vmesnika«, kakor se je uporabljal v evropskem projektu »Acume 2: Interfacing Science and Humanities« pri problematiziranju statične ideje »vpliva« in zagovoru vmesnika kot izomorfizma dveh področij, ki v odgovor na svojo problematiko istočasno razvijata nova teoretska orodja; ter metodologijo in izsledke dveh vzorčnih študij, ki so ju izpeljali tako naravoslovci kakor humanisti: študije spomina in študije biokompleksnosti.

Ključne besede: integrirane študije / mreženje / vmesnik / potujoči koncepti / kompleksni sistemi / spomin / biokompleksnost

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Znanost je oblika poezije [...], v kateri sinergistično sodelujeta domišljija in razum.

(P. B. Medawar, *The Hope of Progress*, 1971)

Tako progresivni kot konvencionalni pisci se strinjajo z ugotovitvijo, da smo priče globoki in daljnosežni »krizi humanistike« (Nussbaum). Evropski raziskovalni svet, njegovi ustrezniki v posameznih državah in druge ustanove, na primer Evropska znanstvena fundacija, poudarjajo, da bo identiteto in namen humanistike treba temeljito pretestiti. Za povrh ima neoliberalno upravljanje univerz še slabše posledice za humanistiko kot za druge vede, kajti slednje so po vsem videzu bolj produktivne in tekmovalne, bolj združljive s podjetništvom, raziskovanjem in razvojem ter z neskončnimi vajami v vrednotenju raziskav.

Ko se strokovnjaki za primerjalno književnost soočajo s kompleksnimi pojavi, značilnimi za našo »planetarno« družbo, poudarjajo, da se mora humanist otresti svojega prдавnega strahu pred drugimi vedami, saj bi mu te zlahka ponudile nove interpretativne modele in hevristična orodja (Bassnett). Vede, kakršna je primerjalna književnost, se pod pritiskom kompleksnih problemov, ki jih prinašajo s sabo migracije, pospešena akulturacija, gibanja globalnega kapitala in razpršenost medijev in informa-

cijskih omrežij, že od osemdesetih let 20. stoletja vse bolj vprašujejo o svoji identiteti. Številni strokovnjaki ugotavljajo, da potrebuje primerjalna književnost nove vzorce, in kljub različnim pristopom se vsi zavedajo, da bo treba sprejeti izziv kompleksnosti; še več, poiskati bo treba teoretične in praktične rešitve za študij in pouk svetovne književnosti (Simonsen in Stoutgaard-Nielsen /ur./; Ascari; D'haen, Domínguez in Thomsen /ur./; Benvenuti in Ceserani). Če se hočemo osredotočiti na nove strategije, s katerimi bi premagovali humanistično krizo identitete, nujno potrebujemo nekaj ključnih besed; mednje sodijo mreženje, novi epistemološki vzorci in nove perspektive, preseki ali vmesniki med tradicionalnimi humanističnimi vedami in novimi področji, kot so študije spolov, postkolonialne študije in študije novih medijev, ter vpliv tehnologije na humanistično mišljenje in prakso.

V prispevku bom obravnavala naslednje teme:

1. Nujno potrebo po *integriranih študijah*. Današnji krizi v humanistiki je poleg finančnih težav botrovalo spoznanje, da kompleksnost sodobnega sveta zahteva nove pristope in metode. Kompleksnost našega današnjega kulturnega okolja lahko razumemo zgolj s pomočjo integrirane vednosti. Znanost in humanistika namreč nista več ločeni področji, temveč komplementarni in integrirani domeni: znanost mora upoštevati epistemološke in etične plati, humanistika pa priznavati nove znanstvene dosežke. Takšna praksa bi lahko koristila tako znanosti kot humanistiki.

2. *Pojem vmesnika*, kot smo ga pravkar začrtali.

3. *Vprašanje, ali je vmesnik metafora ali metodologija*. S pomočjo koncepta vmesnika iščem interdisciplinarna stična področja, ki tvorijo prvo linijo vsake vede. Na njih prihaja do kontaminacij in križanj, zato pa tudi do novih kognitivnih vzorcev.

4. Vzorčni študiji *spomina* in *biokompleksnosti*, izpeljani s pomočjo koncepta vmesnika.

Ad 1. Nujna potreba po *integriranih študijah*. Če želimo gojiti integrirano kulturo, moramo preseči stari spor med dvema kulturama in razgraditi stereotipe, ki jih reproducirajo tako znanstveniki kot humanisti. Ob branju C. P. Snowa (gl. Snow) se vprašujemo, ali so ti stereotipi o razlikah med humanisti in znanstveniki celo po skoraj petdesetih letih še vedno živi v javnem mnenju; ali javnost v znanstvenikih še vidi optimistične, napredne, levičarske liberalce, ki iščejo navdih v prihodnosti, v humanistih pa pesimistične, desničarske konservativce, ki se oklepajo preteklosti?

Italijanski matematik Piergiorgio Odifreddi je pred nedavnim zatrdil, da so »obstoječe kulture in vzorci zgolj različni obrazi intelektualnega podviga, ki jih vse presega, ker posamič ponujajo zgolj strukturno, družbeno

in zgodovinsko omejena gledišča« (Odifreddi 53). Vprašanje integrirane kulture je tesno povezano s potrebo po zrušenju interdisciplinarnih pregrad, ki jih še vedno varujejo univerze, pa tudi osnovne in srednje šole. Pred umetnimi pregradami je pogosto svaril že Ludovico Geymonat, pionir filozofije znanosti v Italiji, češ da so meje zato, da jih prestopamo. Dandanes se zavedamo, da razkosan tip kulture naši modernosti ne zadostuje več in da s preveč specializiranim znanjem ne moremo zajeti kompleksnosti modernega sveta; za ključna vprašanja, ki se porajajo ob tehnološkem in znanstvenem razvoju, od atomske energije pa do genskega inženiringa, je pri analizi potrebna jasnost, kakršno nam omogoča zgolj integrirana vednost.

Zastopniki različnih ved so zahtevali korenito reformo poučevanja v šolah in na univerzah z utemeljitvijo, da se iz čezmerne razdrobljenosti znanja poraja nevarna predstava o znanju kot o nizu ločenih, nepovezanih področij. Tu lahko navedemo filozofa Edgarja Morina in tudi Paola Daria, inženirju, ki se zanima za robotiko. Po Morinovih besedah naši vzgojno-izobraževalni sistemi ločujejo predmete in drobijo stvarnost, s tem pa nam onemogočajo, da bi razumeli svet in se zavedeli temeljnih problemov, ki zahtevajo transdisciplinarni pristop (gl. Morin). Podobno misel je zapisal Dario (263): »Dandanes se mora tehnologija stopiti s humanistiko, ta pa se mora usmeriti k inovativnosti in se radovedno in dojemljivo odpreti spodbudam tehnologije. Model inženiringa pod vodstvom znanosti terja visoko raven ustvarjalnosti in zmožnosti za *reševanje problemov*.«

Binarno nasprotje med znanostjo in književnostjo poskušajo raziskovalci že od sedemdesetih let 20. stoletja razgraditi s študijami o njunem medsebojnem razmerju in v ta namen iščejo morebitne kognitivne vzorce, ki bi bili skupni obema področjema. Pri iskanju sorodnosti med kulturama so opazili, da obe seka jezik. Torej je poleg književnosti tudi znanost diskurz z istimi vrstami retoričnih strategij, literarnih tropov in spremenljivih pomenov kot druge oblike pisanja. V sijajnem eseju iz leta 1968 je L. J. Jordanova, ugledna zgodovinarica znanosti, zapisala: »Naš glavni predmet preučevanja je jezik – posrednik sleherne misli, dejanja in izkustva. Osredotočamo se pretežno na diskurze, ki so lastni tako znanosti kot književnosti.« (Jordanova 17)

V tej zvezi lahko omenimo, da so dela Carla Levija, kemika, pesnika in izjemnega romanopisca, in Itala Calvina, pisatelja, vselej očaranega nad znanostjo, geometričnimi proporcijami, simetrijo in *ars combinatoria*, prava zakladnica trditev, da znanost in književnost še malo nista ločeni dejavnosti, temveč imata številne skupne značilnosti. Tudi Stefan Collini v svoji nedavni izdaji Snowovega dela poudarja, da se je od Snowovega časa predstava o fiziki že spremenila: nekoč je ta predmet veljal

za najtršo vseh »strdih znanosti«, vedo, ki je po tradiciji ponazarjala, kako z rigo-rozno deduktivno analizo peščice splošnih zakonitosti, potrjenih ali ovrženih s kontroliranimi eksperimenti, lahko spoznamo in celo napovemo fizikalne lastnosti vesolja. Ta model pa je tako imenovana »nova fizika« zadnjih dvajsetih let prikrojila na dva sorodna načina. Prvič, njena odkritja o naravi snovi ali o izvoru vesolja po vsem videzu vzpostavljajo nepredvidljivost, odprtost (Collini xlvii).

Novo pojmovanje fizike se ujema z našo predstavo o svetu humanisti-ke in književnosti.

Če želimo razumeti, v čem se svetova stikata, moramo znova pretresti nekatere klišeje o znanstvenih in pesniških jezikih, zlasti topos, po katerem so prvi denotativni in transparentni, drugi pa konotativni in nejasni. Take puhlice lahko za začetek ovržemo z analizo rabe metafor v obeh kulturah; pravzaprav je metaforika postala kar ena od osrednjih tem v analizah raz-merja med književnostjo in znanostjo (Black; Cornell Way; Swinburne). Kdor zna metafore uporabljati ali jih ustvarjati, s čimer dokazuje visoko stopnjo ustvarjalnosti, se živo zaveda, kako pomembne so za pridobivanje vednosti, saj nam odpirajo epifaniji podoben uvid v stvarnost. Metafora je sredstvo pomenske obogatitve, ki je skupno znanstvenim in pesniškim jezikom in obojim omogoča, da izvirno kartirajo svet. V tem pogledu sta sposobna »potujitve« oba, znanstvenik in pesnik: oba znata pogledati na stvarnost z očmi tujca in v svetu okoli nas odkriti skrite povezave, ki nasprotujejo naši intuiciji. Z metaforami redno pojasnjuje naravne pojave marsikatera naravoslovna veda, denimo imunologija.

Prav tako se pojavljajo trditve, da si znanstvenik pri »modeliranju« (ma-tematizaciji) sveta prizadeva vsrkati vse njegove brezštevne lastnosti in ustvariti model, v katerem bi nad kvalitetaми stvarnosti prevladala kvan-tifikacija, medtem ko se umetnik posveča detajlom in posamičnostim. A tudi to nasprotje je vprašljivo, ker opisi posamičnosti in drobcev nimajo nikakršne umetniške in splošne vrednosti, če vsaj med vrsticami ne nakaže-jo neke vizije sveta – z drugimi besedami, modela. Modeliranje sveta torej ni značilno zgolj za znanost, ampak tudi za književnost. Kot nas Calvino opomni (78–79) v predavanju o eksaktnosti (»Esattezza«), je »to vez med formalnimi odločitvami literarne kompozicije in potrebo po kozmološkem modelu [...] najti tudi pri avtorjih, ki tega ne povejo izrecno. [...] Poezija je velika sovražnica naključja, čeprav je tudi sama njegova hči.«

Naslednja lastnost, s katero sta obdarjena tako pesnik kot znanstvenik, je eksaktnost: v pesnikovem primeru gre za neskončno iskanje prave be-sede, v znanstvenikovem pa za natančnost pri opazovanju in opisovanju naravnih pojavov.

Calvinu (65) pomeni eksaktnost predvsem troje:

1. natanko določen in izdelan načrt literarnega dela;

2. evokacijo jasnih, izrazitih, zapomnljivih vizualnih podob; v italijanščini imamo pridevnik, ki ga v angleščini ni, »*vicastico*«, iz grškega *eikastikós*;
3. kar se da natančen jezik v leksiki in v podajanju miselnih in predstav-
nih odtenkov.

Druga pomembna misel se nanaša na današnjo predstavo o razmerju med kulturo in znanostjo, ki bi moralo biti kompleksnejše od Snowove predlagane različice. Filozofi znanosti, na primer, so veliko prispevali k boljšemu razumevanju znanstvene metode; pomislimo samo na idejo Thomasa Kuhna, da do znanstvenih sprememb ne pride nujno z vztrajnim kopičenjem vednosti v stabilnih parametrih, temveč se anomalije v gradivu kopičijo, dokler ne nastopi sprememba kot »pretrgan skok« ali »vzorčni premik«. Poleg tega so sociologi znanosti pokazali, da znanstveno vednost vzpostavljamo na osnovi kulturno spremenljivih norm in praks; to pomeni, da je znanost zgolj ena od obstoječih množic kulturnih dejavnosti, da izraža svetovno usmerjenost posamezne družbe prav toliko kot njena umetnost ali religija in da je prav tako neločljiva od ključnih vprašanj politike in morale. V znanosti torej vidijo »družbeni konstrukt«. S tega gledišča je treba pretehtati tudi diskurz o ustvarjalnosti: kdor pozorno spremlja velike prelomnice v znanstveni misli in tehnoloških inovacijah, ne more zanikati, da so najustvarjalnejše prakse porušile vse pregrade med vedami.

Ko raziskujemo razmerje med humanistiko in znanostjo (povezave, sorodnosti, razlike, vprašanja in probleme) onkraj podedovanih klišejev, vznikne ideja o vzajemnih vplivih, ki spodbuja bolj dinamično predstavo o »delovanju vmesnika« (*»interfacing«*). Zato moramo izhajati iz priznanja, da med področjema vlada izomorfizem (Hayles) in da pri odzivanju na svoje naloge marsikdaj istočasno razvijeta nove modele in strategije za raziskovanje kompleksnih znanstvenih in kulturnih (umetnostnih, književnih) pojavov. Ideja izomorfizma pa ni več povezana s tradicionalnimi idejami vzroka in učinka, temveč kaže na istočasnost, zato moramo opustiti predstavo, da eno področje vpliva na drugega ali ga pogojuje. Izomorfizem nakazuje skupna odkritja; obe domeni istočasno razvijata nove raziskovalne modele, ki nato postanejo analoška ogledala sveta v nenehnem razvoju. Pod vplivom te ideje preučujemo naravoslovne in humanistične vede skupaj, ker z medsebojnim delovanjem lahko sprožijo novo dinamiko na številnih področjih vednosti.

V zadnjih dveh stoletjih so se vzgojnoizobraževalne teorije razvijale okoli predstav o ločevanju in izbiri: na eni strani so stale humanistične, na drugi naravoslovne vede. Dandanes pa zahtevajo učenci in študentje nove izobraževalne modele, v katerih bi se zrcalili kompleksnost in vzajemnost sveta, zaznamovanega z drugačnim pojmovanjem vednosti in še zlasti s hitrim razvojem novih družbenih matrik. Ob razvoju novih družbenih pojavov, kakršni so globalizacija, spreminjanje politične sfere in razvoj

novih »medijskih pokrajin« (»mediascapes«), so namreč začeli nastajati novi vzorci, ustrezen vzorec, ki lahko sproži nove hevristične posledice, pa v tem spremenljivem kontekstu po vsem videzu ponuja ideja »vmesnika« ali »delovanja vmesnika«. Za nameček nas že sama ideja »delovanja vmesnika« privede k mikavnemu konceptu »kompleksnosti«, prav tako metafori, ki nakazuje izmenjavo in vzajemno prepletanje, in predvsem h konceptu »mreženja« (»networking«), torej novih strategij za opazovanje in potemtakem oblikovanje sveta. Pojem mreženja ne nakazuje zgolj novega načina za transverzalno raziskovanje med različnimi vedami, ampak tudi nov način konceptualiziranja in upodabljanja »stvarnosti«. Mreženje je v samem temelju kompleksnosti; gre za nov epistemološki vzorec, skupen tako znanosti kot humanistiki.

Obe domeni morata med drugim priznati dejstvo, da se moramo soočiti s položajem kulture v nenehnem razvoju. Med že obstoječa utelešenja tega priznanja sodijo novi univerzitetni programi na medicinskih univerzah, inženirskih fakultetah in drugih naravoslovnih ustanovah, ki ponujajo predmete s področij književnosti, umetnosti in filozofije, kot tudi takšne, ki spodbujajo ustvarjalnost. Pa tudi v humanistiki najdemo plodovito uporabo naravoslovnega raziskovanja in znanja: od bolj praktičnih načinov uporabe, kakršno je snovanje novih ved v humanistiki (pomislimo na »humanistično informatiko«, ustvarjanje novih infrastruktur, digitalnih arhivov, podatkovnih baz itn.), pa do novih teoretičnih dosežkov, ki združujejo literarne/literarnovedne teorije z naravoslovnimi modeli raziskovanja (od »teorije polja« do teorije kaosa). Še drugi zanimivi primeri prihajajo iz družboslovja, ključnega akterja pri razvoju novih raziskovalnih smeri in novih konceptov, ki rušijo pregrade in spodbujajo interdisciplinarne pristope. Dober primer je antropologija, ki uporablja naravoslovno idejo »gostega opisa« (»thick description«) kratkoma za analizo kulture. Sledeč podobnim vzorcem so humanistični strokovnjaki v zadnjih dveh desetletjih začeli ponovno razmišljati o ideji »književnih pojavov«, pri čemer književnosti niso jemali kot zaprt, ampak kot kompleksen sistem – kot omrežje dogodkov.

Ad 2. *Pojem vmesnika.* V drugi točki bom poskusila raziskati pojem »vmesnika«, kot se je uporabljal v delovni hipotezi evropskega projekta »Acume 2: Interfacing Science and Humanities« v moji koordinaciji.

Kaj pomeni angleški izraz za »vmesnik«, *interface*, ni težko razumeti, če ga tolmačimo kot skovanko iz predpone *inter* ali *intra* (»med /dvema ali večimi/«) in korena *face* (»površina«, »obraz«, »stična točka«). Ni pa ga mogoče pojasniti enovito.

Pomenska polja, pri katerih je mogoče uporabiti izraz »vmesnik«, segajo od informacijske tehnologije (IT) do geografije, od kemije do me-

taforike. Najprej so ga uporabili v IT; tu ni pomenil zgolj stične točke, ki omogoča komunikacijo, ampak tudi samo metodo komunikacije. Tega izraza –kot na dlani gre za krovni izraz, ki bolj namiguje kot opisuje – ne bom uporabljala zgolj kot preprosto metaforo, temveč kot metodološko izvirno točko. Za začetek bomo torej poskusili predlagati nekaj opredelitev izraza »vmesnik«.

V računalništvu oziroma IT je vmesnik vez, del strojne opreme, ki fizično povezuje različne komponente; pomislimo zgolj na USB (Universal Serial Bus) vhod pri računalniku. Obenem pa je vmesnik tudi del programske računalniške opreme, se pravi program, ki omogoča interakcijo, prevod med dvema jezikoma, in tako dovoljuje uporabniku, da komunicira s strojem. Strogo vzeto je vmesnik med človekom in strojem na primer program, ki nam omogoča, da uporabljamo svoj namizni ali prenosni računalnik. Z drugimi besedami, vmesnik je voz, minimum v širši kompleksnosti, poleg tega pa tudi opis izmenjave, specifikacija omejitev, ki veljajo za neko dejavnost. Sleherni izmenjava informacij torej predpostavlja navzočnost vmesnika in ta pojem ni namenjen poimenovanju, ampak prikazovanju.

Lahko na primer preučimo vmesnik med človekom in tehnološkim objektom. Ima tu vmes res prste vmesnik (če si smem privoščiti besedno igro)? Če je odgovor pritrdilen, moramo v njiju videti ločena in neodvisna sistema, ker med biološkim, človeškim, in ne-biološkim, ne-človeškim prostorom prihaja do nenehnih izmenjav. Primere slednjega vidimo na umetniških upodobitvah umetnega bivanja, najbolj pa v medicinskih tehnologijah, kjer po zaslugi računalniške tomografije in rentgena človeški prostor postane »čitljiv«.

Bolezni ali zdravju dobesedno sledimo s pripomočkom, po zaslugi katerega postanejo sledi očitne in zaznavne očem zdravnika, ki jih je nato zmožen prebrati. Vmesnik torej ne deluje zgolj v odmevnih primerih, ko pride do križanja med mehanskim in organskim, ampak tudi kot posrednik, kot komunikacijska rešitev med dvema akterjema, ki se sporazumevata, in celo kot nov jezik, izumljen prav za to komunikacijo. Za primer spet lahko vzamemo računalniško tomografijo, tehniko medicinskega slikanja: na osnovi tomografske analize, pridobljene tako, da pacienta obsijemo z laserskim žarkom, se izračuna tridimenzionalna rekonstrukcija tkiv. Pri tem zelo pogostem diagnostičnem postopku gredo sporočila skozi večkratno »posredovanje«, ko potujejo od pacientovih simptomov do diagnostika. Ta uporabi instrument analize in oblikuje končno poročilo na osnovi podatkov, pridobljenih iz slikanja pacientovega telesa, torej podatkov, ki jih zdravnik raztolmači in nato določi terapijo. Ne gre za golo diagnozo: različne stopnje postopka zajamejo različne ravni, ko postane pacientovo telo

omrežje, mnogoter sistem s fiziološko, organsko, psihološko in eksistencialno razsežnostjo. Vmesnik se nahaja tudi v sistemskem jedru medicinskega znanja kot končno srečevališče med epistemologijo (vsem, kar vemo o človeku in njegovem delovanju) in kulturo (načinom, kako gledata na bolezen subjekt sam in družba, kako si bolnik predstavlja posamezno bolezen, kako jo opisuje drugim ali kako jo opisujejo drugi). Vmesnik torej ni metafora, ampak metodološki pristop: gre za vprašanje zaznave, kako komunicirata dva sistema, človek in tehnologija, ter na kakšni ravni in kako se iz tega opazovanja lahko izluščijo vzorci: strukture, kontinuitete ali diskontinuitete.

Tu sta ključnega pomena temeljni študiji N. Katherine Hayles in Edwarda O. Wilsona (gl. Hayles; Wilson). Oba avtorja, humanistka (ki zdaj dela tudi pri ITC) in biolog, se zavedata potrebe po sodelovanju med obema področjema ter predlagata nove metode in vzorce vednosti.

Haylesova navezuje literarni znak ali znake na naravoslovne teorije; teorijo polja ali pojem polja predlaga kot sežetek novega načina, kako opazovati sočasno stvarnost s pomočjo obojega, znanstvenega raziskovanja ter umetniškega in literarnega uvida. Zanimivo in značilno za njeno knjigo je dejstvo, da se izogiba poenostavljenim in predvidljivim opazkam v slogu »znanost vpliva na književnost in jo odpira novemu podobju« ali »nova znanstvena odkritja nudijo književnosti nove modele izraza«. Namesto tega predlaga bolj poglobljeno opazovanje in novi pojem polja uvede v kompleksnejšem okviru. Predvsem opaža, da sta na prelomu med 19. in 20. stoletjem obe sferi vednosti, humanistika in znanost, začeli predlagati podobne načine raziskovanja, ki so se vse bolj oddaljevali od atomistične (kartezijanske) ideje vednosti in se približevali holistični predstavi, ki jo Haylesova dojema kot teorijo polja. Ti novi načini raziskovanja so temeljili na dveh bistvenih predpostavkah:

1. Vse stvari so povezane, vendar ne po urejeni, hierarhični logiki, temveč zaradi istočasne skupne navzočnosti.

2. Posledica tega je, da se jezik, ki jih izraža, nujno nanaša sam nase.

Pod temi pogoji se opazovanje zaplete: sleherna tradicionalna predstava o razliki med opazovalcem in opazovanim, ki je za atomistično (kartezijansko ali linearno) opazovanje bistvenega pomena, odpade, saj zdaj oba akterja pripadata istemu polju opazovanja in vzajemno vplivata drug na drugega:

Po atomističnem nazoru vrzeli med subjektom in objektom ne »kontaminirajo« krožni paradoksi samonanašalnosti, ker stvarnost domnevno lahko razčlenimo v posamične ločene komponente. Zato atomisti predpostavljajo, da z jezikom lahko opredelimo razmerje med subjektom in objektom na formalno eksakten način. Nasprotno pa pojem polja predpostavlja, da so te komponente med sabo povezane s pomočjo posredniškega polja. Kadar je jezik del posredniškega polja (tj.

sredstvo, s katerim opišemo razmerje med subjektom in objektom), je tudi sam soudeležen pri medsebojni povezanosti, ki jo, kot trdi, obenem opisuje. Če priznamo pojem polja, zato priznamo tudi, da samonanašalnost jezika ni naključna, temveč bistvena posledica, ki izvira iz tega polja. (Hayles 41)

Pojem polja je torej gledišče, na katerem temeljita tako znanstveno kot umetniško raziskovanje; kot smo že omenili, ga ne moremo več razlagati kot preprosto razmerje med vzrokom in učinkom, saj ga istočasno zaznavata obe polji. Haylesova poudarja, kako pomembno je opazovati to novo idejo v luči kompleksnega kulturnega ozadja, ki se nenehno spreminja:

Večja verjetnost je, da se nam bo pojem polja izrisal podrobno in izčrpno, če bomo opazovali oboje skupaj, književnost in znanost, ne zgolj eno ali drugo. [...] Točnejši in ustrežnejši model za takšen vzporedni razvoj bi bil poljski pojem kulture, družbena matrika, ki bi jo tvorila [...] »mnenjska klima«, pod vplivom katere se je z nekaterimi vprašanji zanimivo ukvarjati, medtem ko so druga nezanimiva ali nepomembna. (Hayles 10–22)

Ideja »konsilience«, ki jo raziskuje Wilson, predlaga, da bi obe kulture združili in s tem celovito zajeli tako kulturne kot naravne procese: »Konsilienca [je] konsilienca vednosti, ki nastopi, ko transdisciplinarno povežemo dejstva in na njih utemeljeno teorijo, s čimer ustvarimo skupni temelj za razlage.« (Wilson 8)

Ad 3. *Vmesnik kot strategija: nova metoda pristopanja k literarni vedi.* Haylesova predlaga novo metodo literarne analize, ki bi bila osnovana na matematičnih modelih. Po njeni temeljni hipotezi je sprememba znanstvenega vzorca v dvajsetem stoletju prinesla novo konceptualizacijo stvarnosti, ta pa ni vplivala le na znanstveno okolje, temveč tudi na družbo, kulturo in umetnost. Vendar ne govorimo o preprostem vplivanju med znanstvenim in med umetnostnim ali družbenim okoljem; revidirati moramo sam pojem »primerjave«. Ne gre več za to, da prilagajamo naravoslovno metodo literarni vedi in uporabljamo metafore, ampak da vidimo obe področji vednosti kot neločljivo prepleteni, soudeleženi v »kozmični mreži«, ki povezuje celovito, mnogoplastno vesolje znanosti, tehnologije in umetnosti. Po besedah Haylesove sta nam teoriji kaosa in kompleksnih sistemov v dvajsetem stoletju priskrbeli raziskovalne modele in miselna ogrodja (*brainframes*),¹ ki jih lahko prenesemo na vsa študijska področja. Z drugimi besedami, staro verigo vzrokov in učinkov moramo nadomestiti s hkratnimi, ne-posledičnimi razmerji in s področji izomorfizma, na katerih vzajemno delujejo različne ravni in gradiva.

Haylesova nas torej vabi, naj preoblikujemo pojem »primerjave«. Zdaj ne postavljamo po dveh ali več besedil na isto raven, ampak ohranjamo

njihove meje prožne in odprte za tematske konstrukcije, jezike in strukture iz sodobnega »diskurza«, ker na ta način med ljudmi, tehnologijo in umetnostjo poteka neprekinjena vez.

Izhajajoč iz študij posameznih primerov je evropski projekt »Acume 2« poskusil pokazati, kako nekateri koncepti, metafore in pripovedi ob selitvi iz ene vede v drugo dobijo nove pomene, s tem pa izzovejo nove konfiguracije znanj in odprejo nove meje vednosti. V poskusu, da bi razumeli rekonfiguracijo vednosti, ki je posledica te selitve, so postali izrazi kot »prilaščanje«, »prevajanje« in »ponovno vrednotenje« ključne besede. Zato je bil eden od pomembnih uvidov projekta, da pri selitvenem procesu ne smemo izgubiti spred oči različnih zgodovinskih in nacionalnih kontekstov.

Koncepti, metafore in pripovedi niso zgolj najpomembnejša teoretična in analitična orodja univerzitetnega diskurza, ampak ponujajo tudi kritične vmesnike med naravoslovjem, književnostjo in humanistiko ter na osnovi skupnega jezika omogočajo debato, raziskovanje in dinamično izmenjavo. Pogosto pa se pomen in operativna vrednost konceptov, metafor in pripovedi, celo tistih, ki se nam zdijo samoumevni, razlikujeta od ene vede, univerzitetne in nacionalne kulture ali zgodovinske dobe do druge. Koncepti, kakršni so »komunikacija«, »koda«, »kompleksnost«, »življenje« in »sistem«, metafore, kot so »kriza«, »omrežje«, »telo« in »tekst«, in kulturne pripovedi, kot so »evolucija«, »staranje« in »digresija«, ki se skrivajo v jedru tako naravoslovja kot humanistike, niso enoznačni, trdno vzpostavljeni koncepti. Ne: ko potujejo sem in tja med univerzitetnimi konteksti in vedami, so dinamični in izmenljivi. Zato so »potujoči koncepti« (»travelling concepts«), kot jih je posrečeno poimenovala Mieke Bal (Bal).

S premikom proti rigoroznejši transdisciplinarnosti sta se okrepila dinamična izmenjava konceptov med različnimi vedami ter prevajanje konceptov v metafore in pripovedi. Ob stalnem medpodročnem prilaščanju, prevajanju in ponovnem vrednotenju so koncepti, metafore in pripovedi dobili nove pomene, to pa je sprožilo reorganizacijo prevladujočih redov vednosti in odprlo nova raziskovalna obzorja. Ker se moramo o njihovih pomenih v vsaki vedi potemtakem vedno znova dogovarjati, lahko potujoči koncepti, metafore in pripovedi spodbudijo samorefleksiven pristop k transdisciplinarnemu študiju kulture.

Ad 4. Pojem transdisciplinarnih študij. Tu bi želela predstaviti dve knjigi, *Memoria e saperi: Pervorsi transdisciplinari* (Agazzi in Fortunati /ur./) in *Biocomplexity at the Cutting Edge of Physics, Systems Biology and Humanities* (Castellani idr. /ur./), ki sta plod naših prizadevanj, da bi eksperimentirali s konceptom vmesnika; s to strategijo naj bi pristopili k epistemološkim

vzorcem, ki bi si jih potencialno lahko delili znanost in humanistika. Obe knjigi sta se rodili iz ideje transdisciplinarnosti. Medtem ko vede pri interdisciplinarnih študijah delujejo druga ob drugi in se vsaka posveča skupnemu vprašanju v okviru lastnih kompetenc, se pri transdisciplinarnih študijah raziskovalne metode – in zato tudi meje med vedami – zasnujejo na novo.

Naša prva knjiga raziskuje naj sodobnejše študije spomina na šestih disciplinskih makro področjih: v družboslovju, biomedicinskih vedah, umetnosti, medijih, humanistiki in religiologiji. Vsa področja se sekajo s »ključnimi besedami« iz konceptualizacije spomina, ki se je oblikovala v zadnjih dvajsetih letih; vsako področje se mora torej soočiti s ključnimi besedami, ki sestavljajo skupni vzorec za vso paleto ved:

1. evolucija;
2. individualni in kolektivni spomin/i;
3. spomin in travma;
4. spomin kot dinamičen proces;
5. kontekst;
6. spomin in informacije;
7. spomin in pozaba.

Ideja transdisciplinarnosti je zgrajena na dinamični kombinaciji navpičnosti (makro področij) in vodoravnosti (skupnih ključnih besed). Tradicionalna disciplinarnost tako ostaja obvezni preskusni kamen (za oboje, pisce in bralce), vendar je »revidirana« s pomočjo skupnih ključnih besed, ki pridobijo izrazito hevristično relevantnost.

Drug primer našega sodelovanja z naravoslovci je knjiga, nastala na osnovi seminarja, pri katerem smo raziskovali vzorec »biokompleksnosti« kot možen hevristični model za tolmačenje kompleksnih sistemov v drugih vedah. V tej knjigi pomeni biološka kompleksnost izziv in potencialni vzorec za druga področja vednosti, ki se ukvarjajo z ne-biološkimi »kompleksnimi sistemi« (na primer s književnostjo). Model biokompleksnosti služi kot vzorec, kako opazovati kompleksne sisteme v humanistiki in znanosti: od biologije do ekonomije, od književnosti do fizike. Temeljna ideja knjige se glasi, da je z nekaterimi koncepti mogoče poudariti skupne značilnosti celega niza kompleksnih sistemov, čeprav so ti na videz raznorodni in pripadajo različnim področjem vednosti. Pojem biološke kompleksnosti, denimo, zna priti prav pri raziskovanju literature, če jo obravnavamo kot kompleksen sistem. Potrdilo se je, da je v humanistiki vzorec biokompleksnosti uporabno analitično orodje; z globalnega gledišča književnih sistemov namreč začenjamo pri primerjalni književnosti in v postkolonialnih študijah raziskovati predstavo, po kateri so evropske in transevropske literature in kulture kompleksni sistemi, ki vzajemno delujejo v sistemu omrežij. Če hočemo preučevati literaturo z globalnega

gledišča, moramo zaradi kompleksnosti predmeta poseči po modelih iz drugih ved, na primer po kvantitativnih zgodovinskih grafih, geografskih zemljevidih in genealoškem drevesu iz evolucijske teorije; zgolj tako bomo razpoznali razmerja, strukture in oblike književnih makro sistemov.

Najnaprednejše konceptualizacije biološke kompleksnosti predpostavljajo naslednje značilnosti živih organizmov:

1. Žive organizme sestavlja velika množica elementov, ki delujejo vzajemno in se organizirajo v funkcionalna in dinamična *omrežja*.

2. Živi organizmi imajo različne *ravni* ali *plasti kompleksnosti*, od molekul do podceličnih organelov in naposled do *celice*. Ta temeljna enota živih organizmov ni le vzorčen kompleksni sistem sama po sebi, ampak je tudi zidak na višjih ravneh organizacije, ker je zmožna proizvesti množico različnih tkiv in organov, iz katerih se v končni fazi oblikuje enkratno telo.

3. Različna telesa (organizmi) se organizirajo v *zdržbe*, te pa tvorijo ekološke sisteme, ki so še kompleksnejši – sisteme, kjer v dinamičnem ravnovesju sobiva na stotine ali celo na tisoče vrst.

4. Živi organizmi so sistemi z lastno *evolucijsko zgodovino*, ki pogojuje njihovo strukturo in funkcionalne zmožnosti ter prinaša s sabo množico *omejitev*.

5. Nastali so z odbiranjem *glede na prilagojenost* – odbiranjem, ki optimizira omrežja s strukturnega in funkcionalnega gledišča ter poteka na vseh omenjenih ravneh kompleksnosti, od molekul in celic pa do organizmov.

6. Organizirani so v *module*, tj. v skupke omrežij z jasno določeno funkcijo. Moduli so s *povezavami* organizirani v supramodularne organizacije.

7. Živi organizmi so *dinamični, odprti in nelinearni sistemi*, ki jim vladajo *naključna odstopanja in motnje*.

8. Zanje je značilno pojavljanje *nepričakovanih lastnosti in funkcij*, kot sta simbolni jezik in zavest.

9. Zmožni so *učnja in pomnjenja* na vseh ravneh, od molekularne vse do najvišje ravni biološke organizacije z najbolj prefinjenimi kognitivnimi funkcijami vred.

10. Vedénje vsakega elementa je določeno s *kontekstom*: vsakega od elementov pogojujejo vsi drugi, saj tvorijo neprekinjen interaktiven in dinamičen sistem.

Ti knjigi dokumentirata prednosti pristopa, ki problematizira tradicionalne razlike med vedami in kaže, da se dozdevno nezdružljive vede ubadajo s podobnimi metodološkimi problemi, ki jih lahko analiziramo s skupnim naborom instrumentov. Za znanstvene ustanove – na primer za univerze, še vedno organizirane v skladu z vizijo, ki ne odslikava današnje dinamike vednosti – to ni zanemarljiva lekcija. Vzorčni študiji spomina in

biokompleksnosti torej kažeta, da bi morali oporekati tradicionalnim delitvam, ki ne morejo izkoristiti hevrističnih in epistemoloških potencialov transdisciplinarne metode.

Naj sklenem svoj prispevek z dvema mislima, ki emblematično povzemata delovno hipotezo moje raziskave o kompleksnosti v književnosti in znanosti. Po besedah Itala Calvina (53) je »funkcija literature komunikacija med tem, kar je drugačno [...], s tem da te drugačnosti in razlike ne zabrisuje, temveč jo poudarja«. Ilya Prigogine (74) pa je zapisal: »Medtem ko je klasična znanost privilegirala red in stabilnost, se dandanes zavedamo temeljne vloge odstopanj in nestabilnosti na vseh ravneh opazovanja [...], [kar kaže na] mnogoterost izbire in omejeno predvidljivost obzorij.«

Prevedla Nada Grošelj

OPOMBA

¹ Miselno ogrodje (*brainframe*) je struktura, namenjena fiziološkemu, kognitivnemu in čutnemu sprejemanju in interpretaciji stvarnosti, ki jo ustvarjajo in določajo informacijske tehnologije. Kot trdi ta model, komunikacijska sredstva spreminjajo miselno konfiguracijo udeležencev v komunikaciji. Pojem je razvil Derrik de Kerckhove, študent Marshalla McLuhana, sama pa ga v prispevku uporabljam na nekoliko prikrojen način: za povzročitelje sprememb v ogrodju štejem pravzaprav vse tehnologije in naravoslovne vede z njihovimi vzorci vred.

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The Interfacing Approach to Investigation Beyond Boundaries

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The paper addresses the following three issues: the urgent need for integrated studies; the concept of 'interface' as it was used in the European project 'Acume2: Interfacing Science and Humanities' to question the static idea of 'influence' on behalf of the interface as isomorphism of two fields that have developed new theoretical tools simultaneously by responding to their respective problematics; and the methodology and results of two case studies carried on by both scientists and humanists: a study of memory and a study of bio-complexity.

Keywords: integrated studies / networking / interface / travelling concepts / complex systems / memory / bio-complexity

UDK 001.3

Science is that form of poetry [...] in which imagination and reason act together synergistically.
(P. B. Medawar, *The Hope of Progress*, 1971)

There is a clear consensus, put forward by progressive as well as mainstream publications, that the current 'crisis of the humanities' is deep and far-reaching (Nussbaum). The European Research Council, its national equivalents and, say, the European Science Foundation stress the need to discuss the identity and purpose of the humanities. At the same time, however, in the humanities, the consequences of the neoliberal, profit-oriented management of the universities are even more negative than in other academic fields, which seem more productive and competitive, more compatible with entrepreneurship, research and development, and endless research assessment exercises.

Faced with the complex phenomena characterising our 'planetary' society, comparative literary scholars stress the need for eliminating the humanist's age-old fear of other disciplines; they argue that these disciplines might very well furnish new interpretative models and heuristic tools (Bassnett). Under the pressure of complex problems of migration, the accelerated processes of acculturation, the movements of global capi-

tal, the diffusion of media and information networks, disciplines such as comparative literature have been since the 1980s increasingly questioning their own identities. Many scholars realise that comparative literature needs new paradigms; regardless of the differences in their approaches, they all share the awareness that they must not only accept the challenge of complexity, but also search for theoretical and practical solutions for studying and teaching world literature (Simonsen and Stoutgaard-Nielsen [eds.]; Ascari; D'haen, Domínguez and Thomsen [eds.]; Benvenuti and Ceserani). Some keywords are essential to focus on new strategies for overcoming this identity crisis of the humanities: networking, new epistemological paradigms and new perspectives, intersections, or interfaces, between the traditional disciplines of the humanities and the new fields such as gender studies, postcolonial studies and new media studies, and the impact of technology on the humanist thinking and practice.

In this article, I will address the following issues:

1. The urgent need for *integrated studies*. The current crisis of the humanities was brought about by financial problems but also by the awareness that the complexity of contemporary world demands new approaches and methods. Integrated knowledge is necessary to understand the complexity of our current cultural environment. Science and the humanities are no longer two separate spheres of knowledge, but two complementary and integrated ambits. Science has to take into account the epistemological and ethical issues, and the humanities need to acknowledge the new scientific developments. Both science and the humanities could benefit from such practices.

2. *The notion of interface* as sketched above.

3. *The question whether the interface is a metaphor or a methodology*. I use the notion of interface to locate the contact zones between disciplines, since they represent the disciplinary spearheads. From these contact areas, in which contaminations and hybrids emerge, new cognitive paradigms arise.

4. The case studies of *memory* and of *bio-complexity* using the notion of interface.

Ad 1. The urgent need for *integrated studies*. In order to foster an integrated culture, one needs to go beyond the old controversy between the two cultures, and to deconstruct the stereotypes reproduced by both scientists and humanists. Reading C. P. Snow (see Snow), one wonders whether, after almost fifty years, these stereotypes about the differences between humanists and scientists are still present in public opinion, which sees scientists as optimistic, progressive, left wing liberals who look into the future for inspiration, and humanists as pessimistic, right wing conservatives who dwell on the past.

The Italian mathematician Piergiorgio Odifreddi claimed recently that ‘the existing cultures and paradigms are but so many faces of an intellectual enterprise that transcends them all, as each of them offers merely a structurally, socially and historically limited point of view’ (Odifreddi 53). The issue of an integrated culture is intimately connected to the necessity of eliminating the fences between disciplines, which are still being protected by universities as well as primary and secondary schools. And Ludovico Geymonat, the pioneer of the philosophy of science in Italy, often warned against artificial barriers, saying that borders exist to be crossed. Today, there is an awareness that a parcelled type of culture is no longer adequate to our modernity, and that excessively specialised knowledge is unable to grasp the complexity of the modern world: the crucial questions raised by technological and scientific development, from atomic energy to genetic engineering, require a kind of clarity of analysis that only integrated knowledge can offer.

Various disciplines have demanded a profound reform of teaching in schools and universities, arguing that excessive fragmentation of knowledge transmits a dangerous vision of knowledge as a series of separate, rather than communicating, fields. Here, one may turn to the philosopher Edgar Morin, but also to Paolo Dario, an engineer interested in robotics. Morin argues that our educational systems separate subjects and fragment reality, rendering an understanding of the world impossible and preventing the awareness of fundamental problems that demand a transdisciplinary approach (see Morin). And Dario (263) writes: ‘Today, technology must melt with the humanities, which should in their turn proceed in the direction of innovation and open up, with curiosity and receptiveness, to the stimuli of technology. The model of engineering guided by science requires a high level of creativity and *problem-solving* capacity.’

Since the 1970s, studies on the relationship between science and literature have tried to deconstruct this binary opposition by searching for potential cognitive paradigms common to both spheres. Striving to find affinities between the two cultures, these studies have noted that both are crossed by language. Not only literature, then, but even science is a discourse involving the same kinds of rhetorical strategies, literary tropes and unstable meanings as other forms of writing. In a beautifully written essay from 1968, L. J. Jordanova, an eminent historian of science, writes: ‘Our primary object of study is language—that which mediates all thought, action and experience. We focus largely on the discourses common to science and literature’. (Jordanova 17)

In this respect, the works of Carlo Levi, a chemist, poet and extraordinary novelist, as well as of Italo Calvino, a writer constantly fascinated by

science, geometric proportions, symmetries and *ars combinatoria*, are rich with assertions that science and literature, far from being two separate activities, share many characteristics. Similarly, Stefan Collini, in his recent edition of Snow's work, stresses that the notion of physics has changed since Snow's times: from the notion of a subject considered

[a]s the hardest of 'the hard sciences', a discipline traditionally taken to exemplify how rigorously deductive analysis of a few general laws confirmed or falsified by induction from controlled experiment, provided predictive knowledge of the behaviour of the physical properties of the universe. The so-called 'new physics' of the last twenty years has modified this model in two related ways. First [of all], its actual findings about the nature of matter or the origins of the universe appear to install unpredictability, open-endedness (Collini xlvii).

The new conception of physics harmonises with our notion of the world of the humanities and literature.

In order to understand this contiguity, it is necessary to rethink some of the clichés about scientific and poetic languages, particularly the *topos* according to which the former are denotative and transparent, and the latter connotative and ambiguous. One can start falsifying such commonplaces by analysing the use of metaphors in both cultures. The study of metaphors has indeed become one of the central themes of analyses of the relationship between literature and science (Black; Cornell Way; Swinburne). Those who know how to use metaphors, or are capable of inventing them, thus showing that they possess a high level of creativity, are very much aware of the fact that metaphors are a powerful instrument of knowledge, providing an epiphany-like insight into reality. A metaphor is a means of semantic enrichment that is shared by scientific and poetic languages and that renders them capable of producing original mappings of the world. In this respect, the scientist and the poet possess this power of 'estrangement', of looking at reality with a stranger's eyes, and consequently, of discovering counterintuitive and hidden links in the world that surrounds us. In fact, many sciences, such as immunology, regularly use metaphors to explain natural phenomena.

Furthermore, it is claimed that the 'modelling' (the mathematicisation) of the world aspires to soak up the world's infinite characteristics in order to produce a model in which the qualities of reality are surpassed in favour of quantification, while the artistic attitude is one of attention to detail and singularity. This opposition is questionable as well, since descriptions of singularities and fragments lack any artistic or universal value if they fail to at least implicitly propose a vision of the world, that is, a model. Thus, a modelling of the world is a feature of science as well as of literature. As Calvino (687–688) reminds us in his lecture on exactitude ('Esattezza'):

‘The formal choices of each artist always presuppose a cosmological model [...]; poetry is a great enemy of chance, although she herself is a daughter of chance.’

The other quality that both the poet and the scientist are endowed with is exactitude, the infinite quest for the right word, in the case of the poet, and for precision in the observation and description of natural phenomena, in the case of the scientist.

For Calvino (677), exactitude means above all three things:

1. A well calculated and defined plan of the work;
2. an evocation of incisive and memorable visual images (the Italian language offers here an adjective that is missing in English: *icastico*, from the Greek *eikastikos*).
3. A language as precise as possible, both in its lexicon and its nuances of thought and imagination.

Another important point concerns the current notion of the relation between culture and science, which ought to be more complex than the one proposed by Snow. Philosophers of science, for instance, have importantly contributed to a better understanding of the scientist’s method; consider Thomas Kuhn’s idea that scientific change does not invariably take the form of a steady accumulation of knowledge within stable parameters: anomalies in the evidence accumulate to the point at which change takes the form of a ‘discontinuous jump’ or ‘paradigm shift’. Furthermore, sociologists of science have demonstrated that the constitution of scientific knowledge itself is dependent upon culturally variable norms and practices, which means that science is merely one set of cultural activities among others, as much an expression of a society’s orientation in the world as the art or religion in this society, and equally inseparable from the key issues of politics and morality; science is thus seen as a ‘social construct’. In this respect, the discourse on creativity should also be considered: those who watch closely the great watersheds in scientific thought and technological innovations cannot deny that the most creative practices have overthrown all disciplinary fences.

By investigating the humanities–science relationship (the links, affinities, differences, questions and problems) beyond inherited clichés, the idea of mutual influences arises that favours a more dynamic idea of interfacing. Therefore, the starting point must be the acknowledgement of the isomorphism of the two fields (Hayles), which, in order to respond to their own tasks, often simultaneously develop new models and strategies of investigating complex scientific and cultural (artistic, literary) phenomena. This idea of isomorphism is no longer linked to the traditional ideas of cause and effect, but instead implies simultaneity due to which one of the two fields is

no longer seen as influencing or conditioning the other one. Isomorphism implies joint discoveries, as both domains tend to develop, at the same time, new investigative models, which in their turn become analogical mirrors of a world in constant progress. This idea leads us to view sciences and the humanities together, since their mutual interfacing can trigger new dynamics in various fields of knowledge.

During the last two centuries, theories of education developed around the ideas of distinction and choice: the humanities on the one hand, sciences on the other. Today, students are asking for new educational models, models capable of reflecting the complexity and interplay of a world characterised by a different understanding of knowledge and, especially, by the rapid development of new social matrices. As a consequence, new paradigms have begun to emerge in the light of the development of new social phenomena such as globalisation, the changing political sphere and the development of new 'mediascapes'. In such a shifting context, the idea of 'interface', or 'interfacing', seems to offer a suitable paradigm capable of triggering new heuristic implications. Moreover, the very idea of 'interfacing' leads us to the intriguing notion of 'complexity', which is itself a metaphor implying exchange, mutual interlinking, and above all to the notion of 'networking', that is, of new strategies of observing and therefore shaping the world. The notion of networking implies not only a new way of conducting transversal research among different disciplines, but also a new way of conceptualising and representing 'reality'. Networking is at the basis of complexity; it is a new epistemological paradigm common to science and the humanities.

One of the things that both domains have to acknowledge is the fact that we are facing a constantly evolving cultural situation. Among the already existing materialisations of this acknowledgment are the new university programs in medical schools, faculties of engineering and other scientific institutions that offer specific courses in literature, arts, philosophy, as well as courses encouraging creativity. Moreover, there are examples of positive applications of scientific research and knowledge in the humanities, too: from more practical applications, such as the creation of new disciplines within the humanities (consider the case of the 'Humanistic Informatics', the creation of new infrastructures, e-archives, new databases, etc.), to new theoretical developments combining theories of literature/criticism and scientific models of investigation (from 'field theory' to chaos theory). Other interesting examples come from social sciences, which have been playing a pivotal role in developing new lines of research and new concepts capable of breaking down barriers and encouraging interdisciplinary approaches. Anthropology is a case in point as it applies the scientific idea of 'thick description' to analyse culture *tout court*. Following similar patterns, during the last two decades

scholars in the humanities have started to reconsider the idea of ‘literary phenomena’, with literature perceived as a complex rather than a closed system, that is, as a network of events.

Ad 2. *The concept of interface.* As the second point I will try to investigate the concept of ‘interface’ as it was employed in the working hypothesis of the European project ‘Acume 2: Interfacing Science and Humanities’, which I coordinated.

It is not difficult to understand the meaning of the term ‘interface’ if one reads it as being composed by the prefix *inter*, or *intra* (‘between two or more parties’), and of the root *face* (‘surface’, ‘face’, ‘point of contact’). It is a term, however, that defies monolithic explanations.

The semantic fields to which ‘interface’ can be applied range from information technology (IT) to geography, from chemistry to metaphor. Generally speaking, it is in IT that the term was used initially; therein, interface was understood as not only a point of contact allowing communication but also as a method of communicating itself. I will use this term, which is obviously an umbrella term that possesses the power of suggesting more than describing, as a methodological point of origin rather than as a simple metaphor. Let us try, then, first of all to propose a few definitions of the term ‘interface’.

In computer sciences, or in IT, it is a circuit, a part of the hardware that physically links to different components; consider, for instance, the USB (Universal Serial Bus) port of a computer. But an interface is also a part of a computer’s software, that is, a program enabling the interaction, the translation between two languages, and thus allowing the user to interact with the machine. The ‘man-machine’ interface in the strict sense is then, for instance, the program allowing someone to use his or her desktop or laptop. In other words, an interface is a knot, a minimum in a wider complexity. It is also a description of an exchange, a specification of the limits of a given activity. All information exchange therefore implies the presence of an interface. The utility of this notion is then not that of naming something, but rather of making it visible.

We can examine, for instance, our ‘human being–technology item’ interface. Are we really facing an interface here (if I may be allowed a pun at this point)? If the answer is yes, then one must view the two systems as distinct and independent because there are continuous exchanges between what is biological, human, and non-biological and non-human space. This last case is evident in artistic representations of artificial being, and especially in medical technologies, with, say, CAT (Computer Axial Tomography) scans and X-rays allowing human space to become readable, as it were.

Sickness or health are literally traced by a tool that allows these traces to become evident, visible, to the eyes of the doctor, who is then capable of reading them. The interface thus works not only in the striking cases in which a hybridisation of the mechanical and the organic occurs, but also as a mediator, as a communication solution between two actors communicating with each other, and even as a new language invented for this communication. The example can again be CAT scanning, a technique for medical imagining that consists of calculating a 3D reconstruction of tissues on the basis of a tomographical analysis obtained by having the patient swept over by an X-ray beam. In this much used diagnostic process there are many 'mediations' of messages on the path from the patient's symptoms to the diagnostician using an instrument of analysis and styling a final report on the basis of data obtained from scanning the patient's body, that is, the data that are in turn interpreted by the practitioner, who will then formulate a therapy. It is no mere diagnosis: in the different stages of the procedure, different levels are involved as the patient's body becomes a network, a multiple system comprising a physiological, an organic, a psychological and an existential dimension. It is also at the heart of the system of medical knowledge, a final point of the meeting between epistemology (all that is known on man and his functioning) and culture (the way illness is perceived by the subject itself, by society, the way a particular illness is imagined by the patient and described to or by others). Interface is thus not a metaphor, but a methodological approach: it is a question of seeing how the two systems, man and technology, interact, and at what level and how, from this observation, patterns, that is, structures, continuities or discontinuities, may arise.

Here, the seminal studies by N. Katherine Hayles and Edward O. Wilson are vital (see Hayles and Wilson, respectively). Both authors, the first being a humanities scholar (who now works also in ITC) and the second a biologist, recognise the need for cooperation between the two fields, proposing new methods and paradigms of knowledge.

Hayles relates literary sign/signs to scientific theories and proposes the idea of field theory, or the field concept, as the epitome of the new way of observing contemporary reality by employing both scientific research and artistic and literary insight. What is interesting and characteristic about her book is the fact that it avoids simplistic and predictable remarks such as 'science influences literature and opens it to new imagery' or 'new scientific discoveries offer literature new models of expression'; rather, Hayles proposes a deeper observation and introduces the new concept of field against a more complex backdrop. In particular, she observes that around *fin de siècle*, the two spheres of knowledge, the humanities and science, both

started to propose similar modes of investigation, less and less attached to an atomistic (Cartesian) idea of knowledge and increasingly linked to a holistic idea, which Hayles grasps as field theory. These new modes of inquiry were built on two fundamental assumptions:

1. All things are linked not by a tidy, hierarchic logic, but by their simultaneous, joint presence.
2. As a consequence, the language that expresses these things is, inevitably, self-referential.

These conditions make observation more complex: any traditional notion of the difference between the observer and the observed – the difference crucial for atomistic (Cartesian or linear) observation – is eliminated, as both actors now belong to the same field of observation, and mutually influence each other:

In the atomistic view, the gap between subject and object is not ‘contaminated’ by the circular paradoxes of self-referentiality, because it is assumed that reality can be divided into separate, discrete components. Consequently, it is assumed that language can be used to define the relation between subject and object in a formally exact way. But the field concept assumes that these components are interconnected by means of a mediating field. When language is part of the mediating field (i.e., the means by which the relation between subject and object is described), it participates in the interconnection at the same time that it purports to describe it. To admit the field concept thus entails admitting that the self-referentiality of language is not accidental, but an essential consequence from within the field. (Hayles 41)

The field concept is hence a viewpoint that underpins both scientific and artistic research and that, as mentioned above, can no longer be explained in the terms of a simple cause and effect relationship, since it is perceived simultaneously by both fields. Hayles stresses the importance of observing this new idea in the light of a complex and ever changing cultural background:

A comprehensive picture of the field concept is more likely to emerge from the literature and from science viewed together than from either one alone. [...] A more accurate and appropriate model for such parallel development would be a field notion of culture, a societal matrix which consists [...] of a ‘climate of opinion’ that makes some questions interesting to pursue and renders others uninteresting or irrelevant. (Hayles 10–22)

In turn, the idea of ‘consilience’ investigated by Wilson proposes a union of the two cultures in order to holistically grasp cultural as well as natural processes: ‘Consilience [is] a jumping together of knowledge by the linking of fact and fact-based theory across disciplines to create a common ground-work of explanation.’ (Wilson 8)

Ad 3. *Interface as a strategy: a new method of approaching literary studies.* Hayles proposes a new method of literary analysis based on mathematical models. Her basic hypothesis is the idea that the change of the scientific paradigm in the twentieth century determined a new conceptualisation of reality, which necessarily affected the scientific as well as the social, cultural and artistic milieus. However, it is not a case of simple influence between the scientific and the artistic or the social. A revisiting of the notion of comparison thus becomes necessary. It is no longer the case of adapting a scientific method to literary studies, of using metaphors, but rather of seeing the two spheres of knowledge as indissolubly linked, as taking part in the 'cosmic web' that connects a holistic, multi-stratified universe of science, technology and art. According to Hayles, the twentieth-century theories of chaos and of complex systems have supplied investigative models and brainframes¹ that can be applied to all fields of studies. In other words, the old cause-and-effect chain is to be replaced with the simultaneity of non-consequential relations and with areas of isomorphism in which different levels and materials interact.

Hayles invites us then to reformulate the notion of 'comparison'. It is no longer a question of placing two or more texts on the same level, but rather of keeping the borders of texts fluid and permeable to thematic constructions, languages and structures that make up the contemporary 'discourse', by way of which human beings, technology and art overlap in a continuum.

Starting from specific case studies, the European project 'Acume 2' tried to demonstrate how some concepts, metaphors and narrations acquired new meanings by migrating from one discipline to another, thus provoking new configurations of *savoirs* and opening new frontiers of knowledge. Terms such as 'appropriation', 'translation' and 'reassessment' have become keywords in an attempt to understand the reconfiguration of knowledge that results from this migration from one discipline to another. Hence, an important insight of the project was that in this process of migration the different historical and national contexts must be kept in mind.

Concepts, metaphors and narratives are not only the most important theoretical and analytical tools of academic discourse, but they also provide critical interfaces between sciences, literature and the humanities, enabling debate, research and dynamic exchange on the basis of a common language. However, more often than not, the meaning and operational value of concepts, metaphors and narratives, even of those which appear to be self-explanatory, differ from one discipline, or academic and national culture, or historical period, to another. Notions such as 'communication', 'code', 'complexity', 'life' and 'system', metaphors such as

‘crisis’, ‘network’, ‘body’ and ‘text’, and cultural narratives such as ‘evolution’, ‘ageing’ and ‘digression’, which are at the core of both sciences and the humanities, are not univocal and firmly established concepts. They are rather dynamic and exchangeable as they travel back and forth between academic contexts and disciplines. In this way, they constitute what Mieke Bal has felicitously called ‘travelling concepts’ (Bal).

With the move towards a more rigorous transdisciplinarity, the dynamic exchange of concepts between different disciplines as well as the translation of concepts into metaphors and narratives have surged. Through constant appropriation, translation and reassessment across various fields, concepts, metaphors and narratives have acquired new meanings, triggering a reorganisation of prevalent orders of knowledge and opening up new horizons of research. To the extent that their meanings must therefore be constantly renegotiated between different disciplines, travelling concepts, metaphors and narratives can foster a self-reflexive approach to the transdisciplinary study of culture.

Ad 4. The notion of transdisciplinary studies. At this point, I would like to introduce two books, *Memoria e saperi: Percorsi transdisciplinari* (Agazzi and Fortunati [eds.]) and *Biocomplexity at the Cutting Edge of Physics, Systems Biology and Humanities* (Castellani et al. [eds.]), which are the result of our effort to experiment with the notion of interface as a strategy for approaching epistemological paradigms that could potentially be shared by science and the humanities. Both of these books were born from the idea of transdisciplinarity. While in interdisciplinarity studies the various disciplines operate at each other’s side, each addressing their common question from its own field of competence, in transdisciplinary studies the research methods and hence the disciplinary boundaries themselves are re-envisaged.

Our first book investigates the state of the art of the studies on memory in six disciplinary macro-areas: social sciences, biomedical sciences, arts and media, the humanities, and religion studies. These are crossed by ‘keywords’ of the conceptualisation of memory that has taken place in the last twenty years; this means that every area must confront the keywords that constitute a sort of paradigm running across the various disciplines:

1. evolution;
2. individual and collective memory/memories;
3. memory and trauma;
4. memory as a dynamic process;
5. the context;
6. memory and information;
7. memory and oblivion.

The idea of transdisciplinarity is built on the dynamic combination of verticality (macro-areas) and horizontality (common keywords). In this way, traditional disciplinarity remains a compulsory touchstone (for both the writers and the readers), but is 'revisited' by means of common keywords that acquire marked heuristic relevance.

Another example of the work we are carrying out in collaboration with scientists is a book born from a seminar aimed at investigating the paradigm of 'bio-complexity' as a possible heuristic model for the interpretation of complex systems in other disciplines. In this book biological complexity presents a challenge and a possible paradigm for other fields of knowledge whose objects are non-biological 'complex systems' (such as literature). The model of bio-complexity is used as the paradigm for observing complex systems in both the humanities and science: from biology to economics, from literature to physics. The basic idea of the book is the following: There are concepts able to highlight common characteristics of a whole series of complex systems, despite their apparent diversity and their belonging to different fields of knowledge. For instance, the concept of biological complexity may prove as a useful tool for investigating literature considered as a complex system. In the humanities, the paradigm of bio-complexity has been confirmed as a useful analytical tool: in a global perspective of literary systems, the idea of the European and the trans-European literatures and cultures as complex systems interacting with each other in a system of networks is starting to be explored in comparative literature and postcolonial studies. Due to its complexity, the study of literature from a global perspective needs models produced in other disciplines, such as quantitative historical graphs, geographical maps and the genealogical tree of evolutionary theory; only in this way can relations, structures and forms of the literary macro-systems be identified.

The most advanced conceptualisations of biological complexity have proposed the following characteristics of living organisms:

1. Living organisms are constituted by a high number of elements that mutually interact, organising themselves in functional and dynamic *networks*.

2. They possess different *levels* or *strata of complexity*, from molecules, to sub-cellular organelles, to *the cell*. This fundamental unit of living organisms not only constitutes in itself a complex system *par excellence*, but is also the building block of higher levels of organisation, as it is capable of generating a whole series of different tissues and organs that finally constitute a unique body.

3. The different bodies (organisms) organise themselves in *societies* that in their own turn constitute ecological systems that are even more com-

plex, systems in which hundreds or even thousands of different species coexist or cohabit in a dynamic balance.

4. Living organisms are systems with their own *evolutionary history* that conditions their structure and their functional capacities, entailing a series of *constraints*.

5. They are the result of a selection *for fitness*, which optimises networks from the structural and the functional point of view and is exercised at all the above-mentioned levels of complexity, from molecules and cells to organisms.

6. They are organised in *modules*, that is, aggregations of networks with a defined function. Modules are organised by *links*, which organise them in supra-modular organisations.

7. Living organisms are *dynamic, open and non-linear systems* dominated by *stochastic fluctuations and noise*.

8. They are characterised by *the emergence of unexpected properties and functions* such as symbolic language and awareness.

9. They possess the capacity of *learning* and of remembering (*memory*) at all levels, from the molecular to the highest level of biological organisation, including the most sophisticated cognitive functions.

10. The behaviour of every given element is determined by its *context*: each element is conditioned by all other elements, as they form a continuous interactive and dynamic system.

These two books document the advantages of an approach that questions traditional disciplinary distinctions and demonstrates that seemingly incompatible disciplines share similar methodological problems analysable by a shared set of instruments. This is not a trivial lesson for scientific institutions such as universities, which are still organised according to a vision that does not represent the current dynamics of knowledge. The cases of memory and bio-complexity thus render apparent the need to challenge the traditional separations that are unable to grasp the heuristic and epistemological potentials of a transdisciplinary method.

I would like to conclude by citing two thoughts that emblematically summarise the working hypothesis of my research on complexity in literature and science: according to Italo Calvino (668), ‘the function of literature is communication between what is different [...], not dulling but exalting the difference’; and Ilya Prigogine (74) writes: ‘While classical science used to privilege order, stability, today we recognise the primal role of fluctuation and instability at every level of observation [demonstrating] the multiple choice and the horizons of limited predictability’.

NOTE

¹ A brainframe is a structure designed for the physiological, cognitive and sensorial reception and interpretation of reality created and determined by information technologies. According to this model, the means of communication change the mental configuration of those who take part in communication. Derrick de Kerckhove, a student of Marshall McLuhan, developed this concept, which I use here, modifying, however, its application. All technologies and sciences with their paradigms are in fact considered here as agents of changes in the frame.

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