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How Do Israel's Tech Firms Do Business in Saudi Arabia? Very Quietly

Good deals (and plausible deniability) make good neighbors.

by **Jonathan Ferziger** and **Peter Waldman**

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Over the course of 30 years working in Israeli intelligence, Shmuel Bar immersed himself in the hermeneutics of terrorism. Using techniques of literary analysis more familiar to Koranic scholars and Bible critics, he came to recognize the distinctive language and religious phrases that suicide bombers used in their farewell videos. "Victory is with the patient" appeared frequently in the martyrdom declarations of Hamas recruits. Al-Qaeda adherents favored the call "God, count them, kill them, and don't leave any of them."

Shmuel Bar.

Photographer: Yaakov Israel

Bar, a tousle-haired 62-year-old with a wry sensibility, emerged from government service in 2003 amid the

proliferation of global terrorism, and in the rising sense of doom he saw a business opportunity. He founded a company called IntuView, a miner of data in the deep, dark web—a sort of Israeli version of Palantir, the Silicon Valley security contractor. Tapping engineering talent in Israel's startup hub of Herzliya, he adapted his analyst's ear for language to custom algorithms capable of sifting through unending streams of social media messages for terrorist threats. He sold his services to police, border, and intelligence agencies across Europe and the U.S.

Then, two years ago, an e-mail arrived out of the blue. Someone from the upper echelons of power in Saudi Arabia, Bar says, invited him to discuss a potential project via Skype. The Saudis had heard about his technology and wanted his help identifying potential terrorists. There was one catch: Bar would have to set up a pass-through company overseas to hide IntuView's Israeli identity. Not a problem, he said, and he went to work ferreting out Saudi jihadis with a software program called IntuScan, which can process 4 million Facebook and Twitter posts a day. Later, the job expanded to include public-opinion research on the Saudi royal family.

"It's not as if I went looking for this," Bar says, still bemused by the unexpected turn in a life spent confronting Israel's enemies. "They came to me."

"If it's a country

which is not hostile to Israel that we can help, we'll do it"

Bar says he meets freely these days with Saudis and other Gulf Arabs at overseas conferences and private events. Trade and collaboration in technology and intelligence are flourishing between Israel and a host of Arab states, even if the people and companies involved rarely talk about it publicly. When a London think tank recently disinvited Bar from speaking on a panel, explaining that a senior Saudi official was also coming and it wasn't possible to have them appear together, Bar told the organizers that he and the Saudi gentleman had in fact been planning to have lunch together at a Moroccan restaurant nearby before walking over to the event together. "They were out-Saudi-ing the Saudis," he says.

Peace hasn't come to the Middle East. This isn't beating swords into plowshares but a logical coalescence of interests based on shared fears: of an Iranian bomb, jihadi terror, popular insurgency, and an American retreat from the region. IntuView has Israeli export licenses and the full support of its government to help any country facing threats from Iran and militant Islamic groups. "If it's a country which is not hostile to Israel that we can help, we'll

do it," Bar says. Only Syria, Lebanon, Iran, and Iraq are off-limits.

The Saudis and other oil-rich Arab states are only too happy to pay for the help. "The Arab boycott?" Bar says. "It doesn't exist."

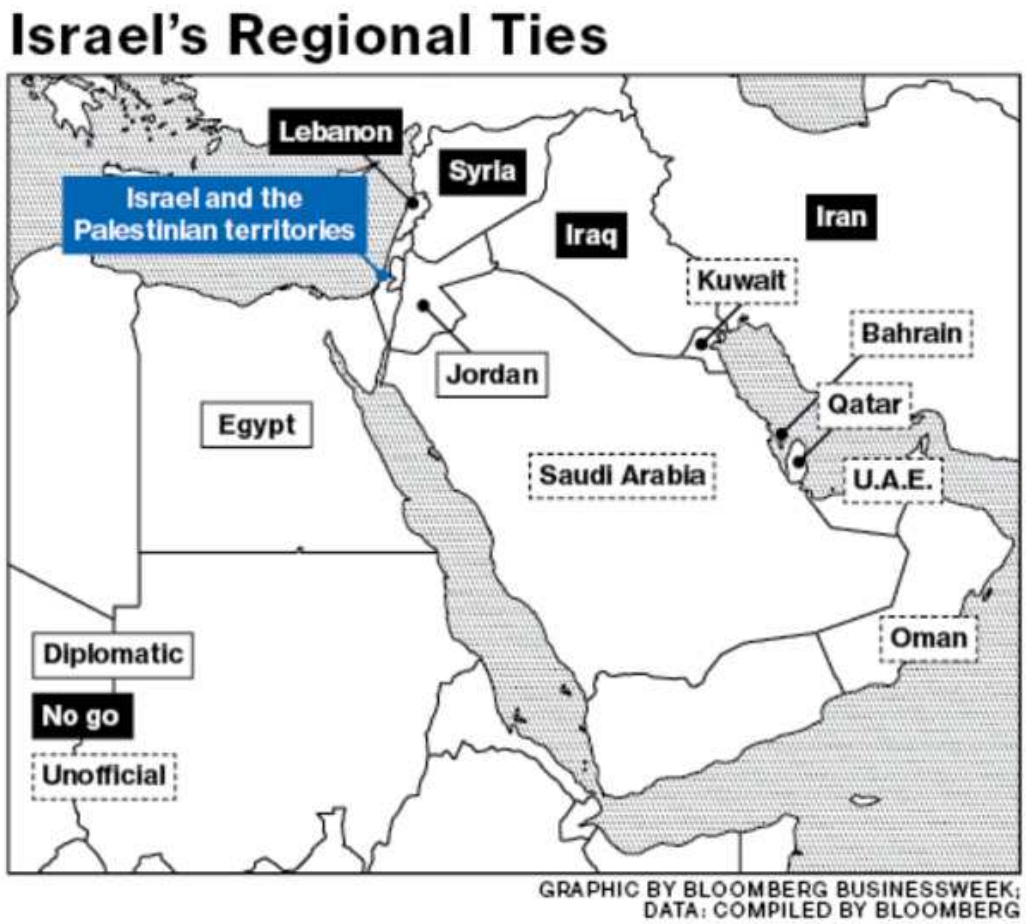
Cybersecurity is particularly ripe for collaboration. In 2012, when hackers breached the computer system of Saudi Aramco, the national oil company, Israeli businesses were called to help unlock the jam, and "some are involved in an ongoing basis" through offshore companies, says Erel Margalit, a venture capitalist and member of the Israeli parliament. Expect more of this, said Rudy Giuliani, in a late January interview in Israel, where he met with Prime Minister Benjamin Netanyahu on behalf of President Donald Trump. "I see it as well beyond [cyber] in terms of areas of cooperation," added the former New York City mayor, who's advising Trump on cyber matters.

Saudi officials declined to speak on the record about possible ties to Israel. Questions e-mailed to the kingdom's interior ministry and its embassy in Washington for this article were unanswered. A source in Riyadh, insisting on anonymity, e-mailed a statement denying any trade links between Israel and Saudi Arabia:

> "In regard to defense systems technology, Saudi Arabia has never dealt with Israel in this field or any other field. Moreover,

> common sense tells us that in order for Saudi Arabia to get any weapon systems, they have to be bought under trade agreements made with friendly countries that manufacture those systems with official and approved export trade certificates from their governments. It is also certain that Israel is not among the countries that have commercial relations with the Kingdom."

The Arab embargo of Israel, nominally in force since the Jewish state's founding in 1948, necessitates that all business between Israel and most Arab states remain strictly off the books, cloaked by intermediaries in other countries. But the volume and range of Israeli activity in at least six Gulf countries is getting hard to hide. One Israeli entrepreneur set up companies in Europe and the U.S. that installed more than $6 billion in security infrastructure for the United Arab Emirates, using Israeli engineers. The same companies then pitched Saudi Arabia to manage overcrowding in Mecca. Other Israeli businesses are working in the Gulf, through front companies, on desalination, infrastructure protection, cybersecurity, and intelligence gathering.



"All the big ones are active and some of the small ones," says Shabtai Shavit, who ran the Mossad from 1989 to 1996 and is chairman of the Israeli security firm Athena GS3. Shavit won't offer details on who's doing what. "You don't saw off the branch you're sitting on," he says.

Discretion is particularly prized when it comes to weapons sales. At the New Hampshire plant of Elbit Systems of America, a subsidiary of Elbit Systems, Israel's largest private defense contractor, there was a procedure when customers visited from Kuwait, Qatar, or Saudi Arabia, workers say. Managers purged the building of Elbit signs, Israeli maps, and Hebrew writing. Employee nameplates were removed temporarily, "if you had an obvious Jewish

name," says Richard Wolfe, who worked at the facility for 15 years, through 2013, designing lenses for the various optical systems the plant produces. Some components were also scrubbed of Israeli markings, another former worker says. Elbit Systems of America said in a statement that it isn't company policy to conceal the Elbit name or other associations with Israel.

Elbit's sales to Saudi Arabia attracted some attention two years ago when one of its New Hampshire technicians, an American named Chris Cramer, mysteriously died while servicing missile systems in the kingdom. According to a travelogue Cramer posted on Facebook, he was sent to help the Saudi army with a series of live-fire demonstrations of Elbit's newly upgraded targeting system for TOW missiles. Cramer had worked for Elbit for 12 years and helped build the system. He was found dead beneath his third-story hotel room in the military city of Tabuk one day before he was due to come home. Saudi police called the death a suicide, which Cramer's family rejected.

In a statement issued in Israel, Elbit did not specify what Cramer had been doing in Saudi Arabia. It said only that he was working on an "American product" with no Israeli technology. The statement e-mailed by the Saudi source said:

> "In regard to the death of the American citizen, that matter has criminal and judicial dimensions. The Saudi government does not

> interfere in these cases and assigns them to the criminal and judicial bodies to look into and decide in accordance with the laws governing these types of cases."

In speeches, Netanyahu likes to quip that the three reasons Arabs are interested in Israel these days are "technology, technology, and technology." That interest doesn't translate into open business relationships for one reason above all others: the Israeli-Palestinian problem. Cooperation in the Gulf cannot become truly lucrative until "the lightbulb goes off in Netanyahu's head" and he signs a peace treaty, says Riad al Khouri, a director at political risk adviser GeoEconomica, based in Amman, Jordan. "The Palestinians are still the gatekeepers." And the conflict could quickly get worse. Trump said during his campaign, and reiterated after his inauguration, that he intends to move the U.S. Embassy from Tel Aviv to Jerusalem. His nominee for ambassador to Israel, his bankruptcy lawyer, David Friedman, has said he intends to work from Jerusalem, calling it "Israel's eternal capital." The Palestinian Fatah party has stated such a move would "open the gates of hell." On Feb. 1, Netanyahu pledged to build the first new West Bank settlement in 25 years. Since Trump took office, Israel has announced plans to build an additional 5,500 housing units in the occupied territory. Trump has invited Netanyahu to visit the White House on Feb. 15.

The Saudis say they'll make peace with Israel after Israel

makes peace with the Palestinians. The offer was reiterated in 2016 by two retired senior Saudi officials in rare public appearances alongside Israeli counterparts in Washington and Jerusalem. Salman al-Ansari, a former banker and media executive who runs a new Saudi advocacy group in Washington, sent an even stronger signal in October. In an article for the *Hill*, he wrote that Saudi Arabia and Israel should form a "collaborative alliance," rooted in open business ties, to assert their rightful place as the "twin pillars of regional stability." Arab critics skewered al-Ansari for not mentioning the Palestinians in the article. He says the omission was intentional, reflecting his wish to change the old narrative of conditioning everything on Palestinian statehood. Even without formal diplomatic ties, he says, the Saudi-Israeli relationship can blossom under the "pragmatic and forward-thinking" Deputy Crown Prince Mohammed bin Salman.

That openness could change quickly if Trump and Netanyahu provoke another Palestinian intifada. Still, these feelers "show how Saudi Arabia is changing," says Dennis Ross, who conducted Arab-Israeli diplomacy for three U.S. presidents. "You'd never have seen something like that before. These are clearly straws in the wind."

On the ground, Netanyahu's frontman for regional cooperation is Ayoob Kara, a 61-year-old Arab-Israeli parliamentarian who recently became a full cabinet minister. A member of the Druze sect and a hard-liner on Palestinian peacemaking, Kara shares the Likud Party dream—or some might say fantasy—of normalizing

relations with Arab states while retaining large swaths of the West Bank.

Kara (in blue) at home with friends and relatives.

Photographer: Yaakov Israel for Bloomberg Businessweek

On a day last November, Kara stood on the veranda of a Jordanian mineral spa overlooking the Dead Sea and swept his left arm southward toward the Gulf of Aqaba, where Israel, Jordan, and Saudi Arabia converge. Israel and Jordan are developing plans for the desolate area where Moses led the Israelites while wandering the desert for 40 years, and Kara insists Saudi Arabia will eventually be involved. “They want our technology, they want our expertise, and they really want to get the Palestinian headache out of the way,” he says.

Plans start with the biggest public works collaboration ever proposed among Israel, Jordan, and the Palestinians. Dubbed the Red Sea-Dead Sea Conveyance Project, it's a $10 billion pipeline and desalination venture, backed in part by the World Bank, that will siphon water from the Red Sea to the Dead Sea, 1,400 feet below sea level. The project, whose construction is scheduled to start in 2018, will produce drinking water and electricity for Jordan, Israel, and the Palestinians. Waste brine will then flow into the Dead Sea, a vast mineral sink that's been shrinking for years. The project could ease water conflicts in the hydrological crossroads where Israel, Jordan, the West Bank, and parts of Saudi Arabia, Lebanon, and Syria all rely on the same handful of rivers and aquifers.

Kara has more immediate concerns, too, as he gazes across the water at the West Bank and Israel. Invited here to address the Swedish-funded EcoPeace Middle East conference on regional water sharing, Kara also arranged to meet a Jordanian counterpart to discuss a possible trade route from Europe and Turkey through the Israeli port city of Haifa, to Jordan, Saudi Arabia, and the Gulf. Since the outbreak of the Syrian civil war, Haifa has become a transshipment hub for Turkish goods that used to travel by road to the Gulf through eastern Turkey and Syria. Today about 20 Turkish trucks a week arrive by rusty freighter on the Haifa docks, where Israeli officials X-ray and process them in a drive-through warehouse and send them on their way across the Galilee to Jordan. For a time, customs agents at the Jordanian-Saudi border waved them through. But passage to Saudi Arabia ended abruptly two years ago,

when a competitor in Riyadh ratted out several truckloads of Turkish tomatoes that had arrived, via Haifa, in Saudi markets, according to a Haifa freight broker.

Kara is working with Gulf diplomats, through partners high up in Jordan's government, to attempt to reopen the Israeli-Saudi route to the wider Arabian Peninsula, a move that would quintuple Turkish truck traffic overnight, the freight broker says. "Very soon things will be out in the open, and you'll see Netanyahu landing in one of these countries," Kara says. His Jordanian go-between agrees: "Times have changed," he says. "They're all looking at ways to connect with Israel."

Netanyahu also uses other aides for high-level Arab contacts, including his personal attorney, Yitzhak Molcho, and former Ambassador to the United Nations Dore Gold. Off and on since the Oslo Accords in the early 1990s, Israel has operated trade offices in Qatar and Oman, and about a year ago it received approval to station a diplomat in the U.A.E.'s capital emirate, Abu Dhabi, as its representative to the International Renewable Energy Agency. The office has the capacity to function as an embassy for Israel's expanding ties in the Gulf.

"I connect with people in Arabic, but I don't give up

on Israel's needs"

Kara's role is unique. The only Arab in Netanyahu's cabinet, he meets regularly with Arab diplomats and businessmen in Cairo, Casablanca, Geneva, and New York. The Druze sect, which numbers about 140,000 in Israel and an additional 850,000 in Lebanon, Syria, and Jordan, formed a millennium ago. Druze have survived in tightknit farming clans in mountain villages by paying allegiance to whatever political authority is in control.

Two of Kara's uncles were killed by Arabs for cooperating with Jews before Israeli statehood. He was injured in an Israeli army tank while fighting in the 1982 Lebanon War and discharged as an officer after two of his brothers were killed. He practiced law in northern Israel for 15 years, won a Knesset seat in 1999, and broke into the Likud Party leadership in 2006. To celebrate Israel's 58th Independence Day that year, he threw a party for Netanyahu and hired kosher butchers to slaughter 58 sheep for the occasion. Netanyahu feasted with 7,000 Druze townspeople in front of the Kara home, in Daliyat al-Karmel.

"I feel like a Jew, but I'm not a Jew," Kara says, sitting with his college-age daughter, Ameera, on the stone portico by his front door. "I connect with people in Arabic, but I don't give up on Israel's needs." He whips out a cell phone to show a photo of a guy lighting a fat Cuban cigar for him in

a New York hotel suite. The older bald man, who's wearing suspenders and holding the lighter, is a member of the royal family of Qatar, Kara says, and one of his go-to go-betweens.

He also says there's Gulf interest in a second Red Sea pipeline, an existing one built 50 years ago in partnership with the shah of Iran when the two countries maintained secret alliances. The state-owned Eilat-Ashkelon Pipeline Co. operates the 160-mile conduit to pump oil from tankers in the Red Sea port of Eilat to the Mediterranean city of Ashkelon. It bypasses the Suez Canal and can cut shipping costs to Europe and North America. When the shah was overthrown in 1979, Israel took sole ownership of the project. A Swiss appeals court last year awarded Iran $1.1 billion in lost revenue, a sum Israel refuses to pay its sworn enemy. Kara says the prospect of using the pipeline keeps coming up in his discussions with Saudis.

Kara's home at Daliyat al-Karmel.

Photographer: Yaakov Israel for Bloomberg Businessweek

For now, "everything has to be under the radar," says Shavit, the former Mossad chief. That's how Mati Kochavi blazed Israel's trail into the Gulf with a $6 billion security business in the United Arab Emirates. An Israeli serial entrepreneur who lives part time in the U.S., Kochavi, 54, founded several high-tech security companies after the Sept. 11 terrorist attacks. One, called 4D Security Solutions of South Plainfield, N.J., built the perimeter monitoring systems at New York's airports.

Kochavi shopped his companies' services to the leaders of the U.A.E. and Abu Dhabi. He didn't hide that he and most of his companies' technology and many of their employees came from Israel. Not a concern, he was assured, as long as the contractors weren't domiciled in Israel. In fact, Israel's security prowess was seen as an advantage in a country facing similar threats but lacking sophisticated defenses, former Kochavi employees say. "There weren't even fences when we started," says one former Israeli intelligence officer, describing the Emirates' 3 million-barrel-a-day oil infrastructure. "A camel could have walked up to the production facilities and drank the oil." Kochavi, through his spokesman, Moshe Debby, declined to comment.

Kochavi sold the U.A.E. on what became the most comprehensive integrated security system in the world at the time. From 2007 through 2015, a Kochavi company called AGT International, based in Zurich, installed thousands of cameras, sensors, and license-plate readers

along the U.A.E.'s 620-mile international border and throughout Abu Dhabi. AGT's artificial intelligence platform, code-named Wisdom, analyzed images and data from the devices. Nominally, Kochavi managed the operation out of the U.S. and Switzerland. The real brainpower, however, resided in Israel, at a separate Kochavi company called Logic Industries.

Twice a week at the height of the project, a chartered Boeing 737, painted all white, took off from Tel Aviv's Ben Gurion International Airport, touched down briefly in Cyprus or Jordan for political cover, and landed about three hours later in Abu Dhabi with dozens of Israeli engineers onboard, many of them out of the intelligence services. They lived and ate together—never in restaurants—carried location transmitters and panic buttons at all times, and disguised their nationality and Hebrew names as best they could. They called Israel "C country"; Kochavi was known as "MK."

Most Arabs who worked with AGT saw through the Swiss veneer, which caused occasional tension but didn't stop the formation of some close friendships. The charade got a bit absurd at times, such as when U.A.E. intelligence officials would wryly address the Israelis by pseudonyms from the TV series *Lost*, such as "Boone" and "Sawyer."

The Israeli technology demonstrated its value in December 2014, when a woman stabbed an American schoolteacher to death in the restroom of an Abu Dhabi mall. She then drove to the home of an Egyptian-American doctor and

planted a bomb, which was later defused. AGT's network, processing video and still images captured at the scenes, identified the suspect within a day. She was convicted and executed seven months later. Government spokesmen in Abu Dhabi didn't respond to e-mailed questions about AGT's work in the U.A.E. An embassy spokesman in Washington declined to comment.

"What always surprises me is how much money and technology and equipment flows between mortal enemies on the political stage"

In 2014, as the U.A.E. project was winding down, AGT and 4D teamed up on a crowd-management system with Mobily, a Saudi-based cellular provider, for a place so sacred that non-Muslims can't even set foot there: Mecca. With more than 3 million people flooding the city for the annual five-day hajj pilgrimage, Saudi Arabia's Ministry of

Hajj solicited bids for controlling access to the area. Although the Saudis ration hajj permits, they don't turn away pilgrims who make it into the holy city. So the flow of pilgrims has to be controlled long before their buses reach Western Saudi Arabia from throughout the Middle East and North Africa. But how?

4D engineers in New Jersey designed a system requiring every credentialed pilgrim to wear an electronic bracelet that would register his or her presence on hajj buses. The buses would use Mobily's cellular system to notify a central computer how many travelers were on each bus—both with bracelets and without. A red light could flash on the outside of buses carrying unpermitted passengers, alerting police to pull them over long before they reached Mecca. Or automated gates might turn them back at electronic checkpoints. Saudi officials could also deploy 4D's design like an air traffic control system, sequencing bus arrivals to minimize congestion.

The Kochavi companies and Mobily demonstrated a prototype of their system at the Hajj Ministry in Jeddah. The minister at the time, Bandar al-Hajjar, participated in the test with several aides, each donning 4D bracelets on a bus in the parking lot. At one point a computer screen showed there were more bracelets than passengers on the bus, a potentially embarrassing error. But al-Hajjar smiled and pulled a second wristband out of his pocket. "He was testing us," says a former Kochavi employee.

The AGT-4D system earned the ministry's top score of

three prototypes presented. Yet they didn't get the job. Several months later, some engineers at Saudi Arabia's King Fahd University of Petroleum and Minerals published an almost identical idea in an academic journal. At last year's hajj, the Saudis required pilgrims to wear bracelets for the first time. The police announced they turned back almost 200,000 people without permits. A Hajj Ministry spokesman didn't respond to e-mailed questions.

"Mobily has submitted a bid for the mentioned contract with an American company, but we did not win," wrote Mobily spokesman Mohammed Al Belwe, in response to e-mailed questions. "Claiming that this is a cooperation between Mobily and an Israeli company is totally misleading and incorrect. ... Our policy will not allow such teaming-up."

A former senior engineer in Kochavi's operation says he and his team believed their idea was stolen. Still, he marvels that the test happened at all. "What always surprises me is how much money and technology and equipment flows between mortal enemies on the political stage," he says. But Islam's holiest site appears to be, at least for now, a leap too far.

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Michael Jackson Is Worth More Than Ever, and the IRS Wants Its Cut

Jackson's star lawyer made a mint for his heirs, so now the government has to be startin' somethin'.

by **Devin Leonard**

February 1, 2017, 5:00 AM GMT-5

From **BloombergBusinessweek** | Subscribe | Reprints

Seven years after Michael Jackson's fatal overdose of propofol and lorazepam in 2009, the statute of limitations on gossiping about the deceased is, apparently, over. In one of her rare interviews in the midst of the presidential campaign, future First Lady Melania Trump told the luxury magazine *DuJour* how Jackson, a friend of Donald's and onetime Trump Tower resident, mischievously suggested they kiss to make her husband jealous. Then Madonna, on CBS's *Late Late Show*, revealed that she'd smooched amorously with him long ago. And the *New York Post*'s Page Six dropped a chunk from Tommy Hilfiger's memoir, *American Dreamer: My Life in Fashion and Business*, about the designer's visit in the 1990s at Neverland Ranch, the singer's compound in Santa Barbara County, Calif. After encountering a giraffe and a string of baby elephants outside, Hilfiger found Jackson in his office, with a bandage on his nose, wearing sunglasses and sitting on "an enormous gold-and-burgundy throne." His two oldest children, Prince and Paris, were there, dressed "like characters from a Broadway show or *The Sound of Music*—velveteen knickers, dirndl jumper, ruffled blouses, patent leather shoes, each in full makeup."

"It's like what they said about Elvis Presley when he died. Good career

move”

Paris, in response to such banter and because she’s now 18, just gave her first full-length interview in a *Rolling Stone* cover story, setting the record straight: She’d had a wonderful childhood until her father’s death at age 50. After, she struggled with drugs and attempted suicide several times, but she’s now happy, clean, and, the magazine reports, “heir to a mammoth fortune—the Michael Jackson Trust is likely worth more than $1 billion, with disbursements to the kids in stages.”

That number could change if the IRS has anything to do with it. The agency’s lawyers are taking the executors to trial, set to begin sometime this month in U.S. Tax Court in Los Angeles. The IRS intends to prove that $702 million of that inheritance is owed in penalties and back taxes. The crux of the case is the disputed value of Jackson’s name and likeness, which is to say the right to use his visage on everything from coffee cups to baseball caps. An estate tax filing is supposed to be a snapshot of the person’s assets on the day of his expiration, and under California law that includes the value of a star’s name and likeness. The IRS claims Jackson’s should have been valued at $434 million. The estate claims that it was worth a mere $2,105, implying that his image had been rendered all but worthless by stories about skin bleaching, his obsession with plastic surgery, prescription drug abuse, odd parenting choices—such as covering his children’s faces in black

veils or Spider-Man masks in public—and allegations that he molested young boys who visited Neverland.

This Is It, the 2009 documentary based on Jackson's last planned tour, made $290 million globally.

Celebrity estate lawyers are watching closely. It felt like a record year for the deaths of icons in 2016, with the passing of Prince, David Bowie, Leonard Cohen, Merle Haggard, Muhammad Ali, and Debbie Reynolds and her daughter Carrie Fisher. Fisher's December departure prompted reports that Walt Disney was rushing to make a deal to use her digital likeness in future *Star Wars* movies. (Disney denied this.) The Jackson case signals that tax examiners see enhanced value in a deceased star's face and name as technology and social media open up novel paths to profit, such as the ability to conjure up appearances using computer-generated imagery and voice software.

The man largely responsible for the estate's current fiscal health is not Michael Jackson, or not exactly. For the balance of the past 37 years, a 66-year-old Los Angeles entertainment attorney named John Branca, a partner at the firm Ziffren Brittenham, has handled the singer's record deals and tried to shield him from his own worst impulses. After Jackson's death, Branca and John McClain, a veteran music industry executive and former Jackson confidant who keeps a lower profile (and declined to be interviewed for this story), were appointed executors of the singer's estate, which gave them responsibility for generating income for the beneficiaries named in his will—his children Prince, Paris, and Blanket, and his mother, Katherine Jackson, whom he designated as their guardian.

"Michael used to say to me, 'You and I, Branca, we're going to be examples for the business, we're going to be the

kings,' " Branca says. It's early July, and he's reclining in the opulently furnished living room of his home in a gated community high in Beverly Hills. He looks like an aging rock star himself, intent on defying the calendar. He's slim, brown-haired, and dressed fashionably in a black polo shirt, black pants, and expensive-looking black leather sneakers. The twice-divorced Branca is engaged to Jenna Hurt, a 32-year-old model who makes a brief appearance and then withdraws to let her fiancé hold court. The walls are covered with signed portraits of clients extolling his expertise, including Berry Gordy, the former head of Motown Records, the Eagles' Don Henley, Brian Wilson of the Beach Boys, and, of course, Jackson, who can be seen posing happily with Lisa Marie Presley, his first wife. Branca casually notes that he introduced them.

It all might be too self-congratulatory if Branca himself weren't so convivial. He grew up in Mount Vernon, N.Y., the nephew of the late Ralph Branca, a three-time All-Star pitcher for the Brooklyn Dodgers. Branca liked sports—he became an avid baseball card collector—but he was more interested in music. His parents divorced, and he eventually moved to Los Angeles to live with his mother, a dancer. As a teenager, Branca was kicked out of the Chadwick School in Palos Verdes Peninsula, Calif., and played keyboards in a band that opened for the Doors on the Sunset Strip in the '60s.

Branca enrolled in Los Angeles City College to study music, where he got A's on his harmony papers but felt out of his league when it came to playing with some of his

fellow students, among them pianist Les McCann, a future soul-jazz great. “I just looked around and said, ‘This is ridiculous. I don’t belong here,’ ” Branca recalls. So he got a law degree at UCLA in 1975 and found a job working for the late entertainment lawyer David Braun. Braun, whose clients included Bob Dylan, Neil Diamond, and former Beatle George Harrison, was established enough not to bother keeping up. One day the Beach Boys came into the office. “David didn’t even know who they were and didn’t care,” Branca says. “So he sent me to the meeting. I was 27 years old at the time, and all of a sudden, I became the Beach Boys’ lawyer.”

“I’ve got fun pictures of Bubbles with my ex-wife and people at the wedding”

Fortuitously, the Beach Boys’ accountant also did Jackson’s taxes. In 1980 he introduced Braun and Branca to the ascendant pop star, who’d recently turned 21 and was in the process of distancing himself from his domineering father and primary manager, Joseph Jackson. Branca found Jackson pleasantly eccentric. “He

had sunglasses on, and he pulled them down and he goes, 'Do I know you?' " Branca recalls. "I go, 'I don't think we've met, but I look forward to getting to know you.' And he goes, 'Are you sure we don't know each other?' I said, 'Michael, I would remember if we had met.' " The next day, Branca got a call from the accountant. Jackson was hiring him to be his attorney.

One of the first things Branca did was renegotiate what he describes as Jackson's "absurd" contract with his label, Epic Records, winning him a royalty rate that only a few artists such as Dylan enjoyed at the time. When Jackson was ready to unveil *Thriller*, he wanted to spend $1.2 million on the video for the title track. Branca protested—this was a time when music videos typically cost $50,000—but Jackson curtly told him, "I don't care. Just figure it out." Branca persuaded Showtime and MTV to pay a total of $600,000 for a movie about the making of the *Thriller* video and got another company to spend $400,000 on the home video rights. The finished 13-minute film featured a troupe of corpses rising from a conveniently located graveyard to dance with a zombielike Jackson, their knees high and claws up. Jackson, then a Jehovah's Witness, decided it was blasphemous and should be destroyed. Branca came up with another crafty fix. He told his client that Bela Lugosi, the star of the classic 1931 *Dracula*, was also religious and had had the movie's producers include a disclaimer to the theatrical release saying it didn't represent his personal views. "It was a complete fabrication," Branca says, laughing. Jackson added the disclaimer, and the hugely popular

video helped propel the album's sales to 100 million copies worldwide. It's still the best-selling record ever.

In 1984, Branca learned that the Australian corporate raider Robert Holmes à Court was shopping a company called ATV Music, which held the rights to more than 200 Beatles songs, including *Yesterday*, *Revolution*, *The Long and Winding Road*, and *Hey Jude*. An excited Jackson told Branca to spend whatever it took to acquire ATV. "It's my catalogue!" he wrote in a note. But Jackson and Branca's $47.5 million offer was beaten by Marty Bandier and Charles Koppelman, two New Yorkers who promised $50 million.

Bandier remembers flying to London on the Concorde with Koppelman to meet with Holmes à Court. "We thought it was a closing," he says. He noticed Branca on the same plane but didn't think anything of it. When they arrived, Holmes à Court said he'd accepted Jackson's lower bid. Branca had offered to let the seller's daughter, named Penny, keep the rights to the Beatles classic *Penny Lane*. He'd also agreed to have Jackson appear for an hour at an event in Perth put on by Holmes à Court's favorite charity. "It was depressing," Bandier recalls. Branca sold off the rights to the catalog's cinematic background music for $6 million, which brought the effective price down to $41.5 million. In the end, Jackson, who borrowed $30 million to cover his costs, put only $11.5 million in cash on what would become his life raft when he was drowning. Jackson gave Branca a Rolls-Royce for his efforts.

Three years later, Branca helped Jackson buy Neverland, listed at $60 million, for $17.5 million. Jackson was so pleased that he rewarded his attorney with another Rolls-Royce. Around the same time, Jackson was best man at Branca's wedding to his first wife. He brought along his beloved chimp, Bubbles, in a matching tuxedo. "I've got fun pictures of Bubbles with my ex-wife and people at the wedding," Branca says nostalgically. Little Richard, it should be noted, performed the service.

Jackson was best man at Branca's first wedding.

Source: John Branca

As things got rocky for Jackson, so did his relationship with Branca. Various people competed for the performer's ear, and Branca was fired, then rehired in 1993 when the star was in the throes of the first molestation accusations, which were settled in a civil suit for what was widely

reported to have been $20 million. Branca, now back in charge, thwarted other advisers who were pushing for Jackson to sell half of ATV to Sony for $75 million to cover his costs. By 1995 he'd negotiated a deal for Jackson to merge ATV with Sony's music publishing company in exchange for $115 million and a yearly stipend that started at $10 million.

That year, Jackson prepared the first of his wills, naming Branca and McClain as his executors. It was updated twice, as he had children, but the document essentially stayed the same.

It was getting harder for Branca to protect Jackson, though. He was abusing prescription drugs and acting strangely. He spent $30 million, a record sum, to record *Invincible*, his splendid final studio album, released in 2001. Jackson blamed Sony when it sold a mere 8 million copies, a hit for any other artist. In July 2002, Jackson, looking pale and Kabuki-like, held a series of press conferences in New York in which he described himself as a victim of a racist music industry with a history of ripping off black artists like himself. He made headlines that year when he dangled infant Blanket over the railing of a hotel room in Germany so his fans could get a look.

Immortal tour: Cirque du Soleil's roadshow (2011-14) is the eighth-top-grossing tour of all time, with $360 million in sales.

Jackson overrode Branca's attempts to control how British television producer Martin Bashir used interviews in the show *Living With Michael Jackson*, which aired in 2003. In it, Jackson admitted he sometimes shared his bedroom with the youngsters who visited Neverland, including a young cancer survivor who sat beside him on camera, and blithely insisted that it was nothing unusual. Soon after, the boy's family accused Jackson of molesting him, which led to a criminal trial. In 2005 he was acquitted by a jury in Santa Maria, Calif. By then, Branca had been fired again, though he continued to get calls for help from Jackson's

advisers. Finally, the Jackson maelstrom became too much, and Branca walked away from his former best man.

Without Branca, Jackson floundered. He was no longer releasing records or touring, so the only way he could afford his lifestyle was by basically borrowing against his half of Sony/ATV. By 2008 his debt secured by the publishing company had swelled to $300 million. Fortress Investment, a New York hedge fund, purchased his mortgage on Neverland and threatened to foreclose if Jackson didn't pay up.

Then Dr. Tohme R. Tohme appeared, a person often described as a mystery man because he declines to provide details about his history or the provenance of his degree. "I'm a self-employed guy," Tohme says. "I advise many people, many top people in the world, about investments."

Tohme first met Jackson, who was in a wheelchair wearing mismatched socks, in Las Vegas, through his brother Jermaine. Tohme connected Jackson with Colony Capital, a real estate buyout company founded by Jackson admirer (and now Trump confidant) Tom Barrack. Colony purchased the debt on Neverland to keep the property out of foreclosure. "It was 10 days from being sold in court," Tohme says. After that, he became Jackson's manager, persuading him to return to the stage so he could raise money to pay off his debts.

Jackson agreed in late 2008 to perform 50 concerts at the O2 arena in London the following summer. The concerts

quickly sold out; Jackson expected to make $50 million on ticket sales alone. Tohme insists the pop star wanted nothing to do with Branca and spoke ill of him in his final months. Eight days before his death, however, Jackson summoned Branca to a meeting at the Forum in Inglewood, Calif., where he was rehearsing. They embraced, and the attorney says Jackson told him, “Branca, you’re back.”

At this point in the interview, Branca disappears into a closet and returns with a framed letter bearing Jackson’s signature. “Here’s the letter he signed at that meeting confirming I was his lawyer again for all the family members that doubt it,” Branca says.

Spike Lee's documentary *Bad 25* aired on ABC in 2012; the anniversary edition box set flew into the top 50 on Amazon.com.

Jackson looked sleepy at their meeting, Branca says, but he assumed his client was trying to conserve energy for his

rehearsal. Eight days later, Jackson overdosed from the mix of sedatives administered by his personal doctor, Conrad Murray, who was later convicted of involuntary manslaughter. The outpouring of sympathy for Jackson was overwhelming. “His extraordinary talent and his music was matched with a big dose of tragedy and difficulty in his private life,” then-President Barack Obama told CNN. “I don’t think we can ignore that, but I think it’s important to affirm what was best about him.” Obama’s eventual successor provided a more self-referential tribute. “I knew Michael Jackson very well. He was a special guy. He was with me many times at Mar-a-Lago and Palm Beach.” (On the campaign trail last year, Trump offered some unexpected analysis about the nature of this tragedy at a GOP town hall: “He lost tremendous confidence because of, honestly, bad, bad, bad plastic surgery.” Jermaine Jackson, claiming it was external stress that broke his brother, tweeted back: “This fool Trump needs to sit down.”)

Shortly after Jackson’s death, Branca says, he read the singer’s final will, dated July 7, 2002, and signed in Los Angeles, to the family at Jermaine’s home. As he recalls, they applauded. But Joseph Jackson, the family patriarch, accused Branca and McClain of forging the document, insisting that Jackson had been in New York that day lambasting Sony. According to court documents, Joseph also revealed that his son had been paying him a monthly allowance of almost $60,000. He wasn’t likely to keep getting it if Los Angeles Superior Court Judge Mitchell Beckloff accepted the will, which he did. He also gave

Branca and McClain the power to manage the estate.

Now that Branca was in charge, he discovered that concert promoter AEG had footage of rehearsals for the O2 shows that had been filmed at Jackson's request. Several movie studios were eager to distribute a documentary stitched together from this material. Branca orchestrated a bidding war. Sony, the winner, agreed to pay the estate a $60 million guarantee and almost 90 percent of the profits. When it released *This Is It* in November 2009, the movie grossed $290 million globally, making it one of the most successful documentaries ever. With cash flowing in from the movie, the estate was able to refinance its debt. It pushed the rate on a $75 million loan secured by Jackson's compositions from an onerous 17 percent to 6 percent and lowered the rate on the $300 million loan backed by Jackson's share of Sony/ATV, from 5.8 percent to 2.9 percent, saving millions of dollars a month in payments.

This Is It addressed another one of Branca's chief concerns: He wanted to restore Jackson's tainted legacy. Jackson looks spectral in the film, but he banters about music with his band members and footwork with his choreographers. "I went to see it 11 or 12 times," says Susan Fast, a professor of cultural studies at McMaster University in Hamilton, Ont., who wrote a well-regarded book examining *Dangerous*, Jackson's eighth studio album. "They did an amazing job of humanizing him, showing him as being kind of vulnerable, and giving us a glimpse into his artistic process." She did also think it was "exploitative" to have released the imagery of Jackson when he looked like he

already had one foot in the grave.

The estate's income grew further in 2010 when Branca negotiated a $250 million deal with Sony to release 10 albums featuring old and new Jackson material. He also enlisted Spike Lee to direct documentaries to accompany rereleases of favorites like *Off the Wall* and *Bad*. Lee and Branca were in agreement on the direction: "I just wanted to focus on the music, his musicianship, the great artist that he was," Lee says. "All the other stuff? I wasn't down with it."

In the midst of this productive whirl, Branca got a call from Celine Dion's manager asking him if he was interested in meeting with the top executives of Cirque du Soleil, the Canadian theatrical company that had produced the successful Las Vegas show called *The Beatles LOVE*, featuring the band's music. He flew to Montreal to see Guy Laliberté, the company's founder, who'd just returned from a voyage in a space capsule during which he hadn't been allowed to enjoy a single cigarette. He was now chain-smoking to make up for it. "I said to Guy, 'We want a show in Vegas that's like *The Beatles LOVE* only better,' " Branca recalls. "He said, 'I want a show that's going to tour around the world.' So we said, 'OK. Why don't we do both?' "

Xscape, a 2014 album of previously unreleased recordings, sold 2.5 million copies.

The Cirque traveling show, called *Michael Jackson: The Immortal World Tour*, featured many of Jackson's band members, ran for three years, and, according to *Billboard*, became the eighth-top-grossing tour of all time, with $360 million in box-office revenue. Two years later, *Michael Jackson: One*, the company's Las Vegas show, complete with a hologram of its star, premiered at the Mandalay Bay Resort and Casino. "I think it will run forever, because Michael's music will be popular forever," says Daniel Lamarre, Cirque's chief executive officer. Branca also negotiated a video game deal; the rerelease of *Moonwalk*,

Jackson's 1988 memoir edited by the late Jacqueline Kennedy Onassis; and an agreement with Pepsi to put Jackson's face on a billion soda cans. By 2012 the estate had paid off Jackson's debt except for the Sony/ATV hunk. Jackson was proving to be more popular in death than he'd been when he had a pulse.

The following year, *60 Minutes*, in a highly flattering segment, called Branca and McClain's management of their ghostly client "the most remarkable financial and image resurrection in pop music." Correspondent Lara Logan asked Branca, "His image was so battered and tarnished by the time of his death. Have his fans just forgotten about all that?"

"We don't really pay attention to the tabloids," Branca replied. "We look at the Michael that we knew, the real Michael, the artistic genius, the visionary."

"The real Michael Jackson also told Ed Bradley on *60 Minutes* that he let young boys sleep in his bed," Logan persisted. "You can't run away from that, right?"

"Well, I don't recall that interview," Branca replied. "The Michael Jackson that I knew was somebody I considered a very honorable person."

The IRS took notice of the estate's prosperity, too. In 2013 the agency informed Branca and McClain that they'd insufficiently appraised the Jackson estate. The IRS said it was worth $1.1 billion. The estate, however, claimed he was

worth $7 million at the time of his death. To hear Branca and McClain tell it, Jackson was on the verge of bankruptcy in July 2009. The star owed $500 million. He hadn't filed personal income taxes in three years. He'd neglected to make the mortgage payments on his mother's home, which he owned, in Encino, Calif. IndyMac, the subprime mortgage lender, was preparing to foreclose. Meanwhile, more than 60 creditors claimed that Jackson owed them money. They included Ola Ray, the actress who played his easily frightened love interest in the *Thriller* video, and a woman who said she was the real Billie Jean.

A holographic image of Michael Jackson performs onstage during the Billboard Music Awards, at the MGM Grand Garden Arena, on May 18, 2014, in Las Vegas.

Photographer: Kevin Winter/Billboard Awards 2014/Getty Images for DCP

If it weren't for the executors' smart plays, Branca's position goes, everything might have been sold off in a fire sale and there'd have been little for the beneficiaries. Branca declines to discuss the IRS case, but in a 2015 deposition in a civil suit filed against the estate by another of Jackson's former managers, he said the molestation investigations "would have negatively affected his commercial value" and that Jackson had received "minimal income from pure name and likeness rights." This offers some explanation for why the estate valued his name and likeness at only $2,105. Still, it seems a puzzlingly low number. "Well, let me put it this way," says Jeffrey Eisen, an estate attorney in Los Angeles. "If somebody had come to you in July of 2009 and said, 'I will sell you all of the rights to Michael Jackson's name and likeness for $2,106,' one more dollar than the estate tax, would you have bought it? You bet! I would have. So the real number has to be higher."

The IRS is also skeptical. The agency has subpoenaed Tohme, who scoffs at the estate's valuing of Jackson's image. He argues that he resuscitated Jackson, rather than Branca, with the AEG deal—which, Tohme says, led to a flurry of endorsement offers from Louis Vuitton, Nike, and others. "Most of the money the estate has collected is because of me," Tohme says. "I did all the work." He and the estate are battling in court over his claim that he's

owed millions in unpaid fees; the estate argues that Tohme abused his position and sought to enrich himself by persuading Jackson to sign overly generous contracts.

The IRS also disputes the claim that Jackson's interest in Sony/ATV was worth nothing at the time of his death. But documents from the estate value Jackson's piece of the company at $242 million, less than the $300 million loan against it at the time. The estate didn't pay all the debt off until last year when Branca, in another negotiating coup, sold the singer's share to Sony for $750 million. Meanwhile, the dispute puts Jackson's personal effects in limbo, which, according to Paris Jackson's lawyer Craig Peters, is hard on the children. "The kids would like to have some of their dad's stuff that he wanted them to have," he says, describing clothes Jackson wore and pictures that hung around the house. "Mostly because of the IRS, it is still tied up in a warehouse. It's not the shimmering glove. It's personal stuff that means something to them."

The government's attorneys write repeatedly in their court filings that all of the estate's deals were "foreseeable." In other words, all he had to do was stop breathing, and the money would come flowing. "It's like what they said about Elvis Presley when he died," says Michael Morris, a former IRS trial lawyer now in private practice. "Good career move." But this suggests that anybody would have turned Jackson into a thriving multimillion-dollar business.

Brancalytes would disagree. "What John did for Michael

while he was living, he did probably 10 times more after he had died. He really protected a man who was no longer here," says Motown's Gordy, who once called Branca the "Smokey Robinson of dealmakers." Bee Gee Barry Gibb, another client, calls his lawyer's insight priceless: "I always listen. He's taught me a lot."

The estate's feud with the IRS isn't likely to tarnish Branca's image. Even if he has to give in, the Jackson estate, which has been paying income taxes all along, will survive and refill the children's coffers. Branca says he's been trying to slow down now that he's reaching retirement age, but his practice continues to grow in one area. Because of his success with the Jackson estate, he's attracted many clients who are no longer with us. He's been hired as a consultant by the estates of Kurt Cobain, Janis Joplin, Otis Redding, and Muddy Waters.

Much as he'd like to take them all, Branca has to set limits. "I got a call from Sammy Davis Jr.'s heirs," Branca says. "I always try to help them, because he and Michael were friends. I said, 'I can't represent you. You guys are all fighting.' The late Rat Packer's heirs worked out their differences and tried once again to hire him. "I told them, 'I can't,' " Branca recalls. " 'You guys don't have enough assets.' "

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Will a Test for Brain Trauma Protect NFL Players—or End the NFL?

Quanterix is one of several life sciences companies racing for a way to diagnose CTE in the living.

Photographer: Simone Lueck for Bloomberg Businessweek

by **Ira Boudway**

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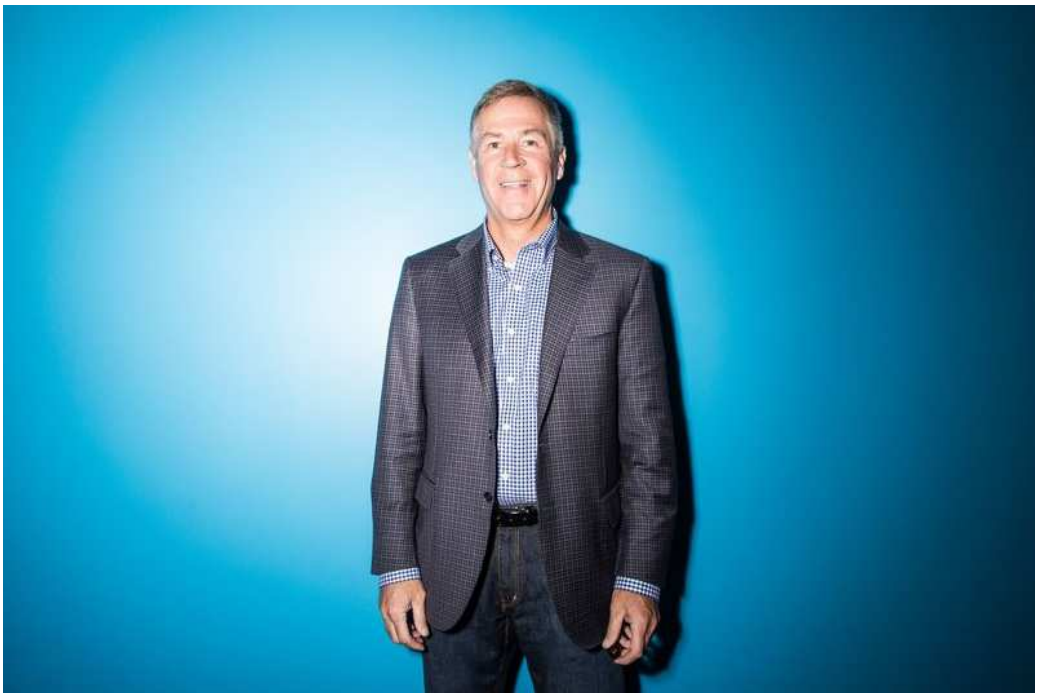
In November, Kevin Hrusovsky paid a visit to the NFL's headquarters on Park Avenue in New York. Hrusovsky (pronounced ruh-sov-skee) is chairman and chief executive officer of Quanterix, a life sciences startup that makes machines for measuring proteins and other biomarkers in the blood. He had the NFL's attention because researchers have been using his company's machines to hunt for markers of concussions and neurodegenerative disease. In an open letter NFL Commissioner Roger Goodell published in September about the league's commitment to player safety, he wrote that Quanterix was developing "a blood test to reveal a concussion diagnosis." It would be, Goodell said, "a major breakthrough." The league, through a partnership with General Electric, has awarded Quanterix $800,000 in grants in the past three years. Hrusovsky was hoping to persuade the NFL to invest directly.

A few minutes after his sitdown with the league, Hrusovsky preaches to me over coffee at a hotel restaurant in Midtown. "My goal is transforming health care," he says. At 55, with a broad mouth, smiling eyes, and graying hair, he resembles first-term George W. Bush. His homespun, slightly jumbled way of talking adds to the impression. Hrusovksy's pitch to me is roughly the same as the one he

just gave Jeff Miller, the NFL's senior vice president for health and safety—skittering from drones, to driverless cars, to Tesla, to heart attacks and diabetes. "I'm still addicted to pastries at night," Hrusovsky says before circling back to his thesis: Quanterix's machines are on the brink of delivering a revolution in medicine, as scientists use them to detect diseases earlier, target them more precisely, and create breakthrough treatments for cancer, heart disease, diabetes, and Alzheimer's, to name a few.

Researchers have also begun using Quanterix tests to search for signs of chronic traumatic encephalopathy, or CTE, the neurodegenerative disease that's been found in the brains of at least 90 dead former NFL players. Among them are Dave Duerson, the former Chicago Bears defensive back who fatally shot himself in the chest (preserving his brain) in 2011, and Junior Seau, who did the same in 2012, three years after finishing a 20-year career as a linebacker.



Hrusovsky

Photographer: Simone Lueck for Bloomberg Businessweek

The disease has changed the conversation about head trauma in football. While concussions are often visible—the hit, the woozy trip off the field, and, usually, the return—CTE is insidious—the slow, inevitable collapse of the brain from within. There's currently no way to test for CTE in the living. By the time there are noticeable symptoms—which include mood swings, depression, impulsiveness, and memory loss—the disease is far along. As a result, early detection of CTE has become a grail for scientists in the field. A diagnostic test would make it possible to distinguish the disease from Alzheimer's, to know how widespread it is, to begin to figure out why some people get it and others don't, and, potentially, to develop treatments or a cure. Quanterix is one of several life sciences companies in the race. Its approach, a simple blood test, is the most elegant and the most challenging.

While the NFL is backing Quanterix, a test for the living could present an existential crisis for the league. Discovering, for instance, that half its linemen show signs of CTE could starve the league of talent or force changes that make it unrecognizable to fans. And football isn't alone: CTE presents similarly dire questions for hockey, soccer, and ultimate fighting, among other contact sports.

"The NFL may not realize they have awakened an animal here," Hrusovsky says. "If they want it, they should invest like crazy in it. If they don't really want it, holy moly, what have they created? Because I am not going to go away."

A few weeks later, Hrusovsky and I meet again, at Quanterix's offices in Lexington, Mass., a suburb northwest of Boston where college professors live in well-kept colonials next to tech startups in single-story office parks. Hrusovsky keeps a bowl of buckeye nuts in his office to pass out as mementos; the buckeye is the state tree of his native Ohio and the mascot of his alma mater, Ohio State University. "The Indians named it a buckeye because it looks like a deer's eye," he says. "It's great for good luck."

After donning white coats and protective goggles, we enter the lab and watch technicians load a Quanterix Simoa HD-1 Analyzer. The machine, about the size of two refrigerators, is home to a microscopic technology called single-molecule array. Simoa uses millions of tiny beads, each about one-thirtieth the width of a human hair, trapped inside millions of tiny wells, to detect proteins in the blood.

The beads and wells were conceived in the lab of David Walt, a chemistry professor at Tufts University. Two decades ago, Walt and his team came up with a novel way to map the billions of DNA base pairs that make up a human genome. They took an existing process, which involved setting off chemical reactions that lit the pairs up in coded colors, and ran it on tiny silica beads sitting atop tiny wells, like scoops of ice cream nested on cones. The method dramatically sped up the work of gene researchers. Walt co-founded Illumina in 1998 to bring the technology to market; the company went public two years after. It later won a worldwide race to sequence a human genome for

less than $1,000, and now has annual sales of $2.4 billion.

In 2005, Walt and his lab began tinkering with another application for the beads and wells. Instead of using them as a kind of Lite-Brite for DNA, they tried putting lids across the wells, trapping tiny amounts of fluid in which they could hunt for molecules. The idea was to build a better test for blood and other bodily fluids.

For decades, the gold standard for blood tests has been the Elisa, or enzyme-linked immunosorbent assay. The process relies on antibodies that attach themselves, like puzzle pieces, to specific molecules. Enzyme reactions then make these matched pairs light up in fluorescent colors. It's an analog system: The final step is reading the intensity of color in a few drops of blood. For the signal to be bright enough to measure, you need at least 30 million target molecules per drop.

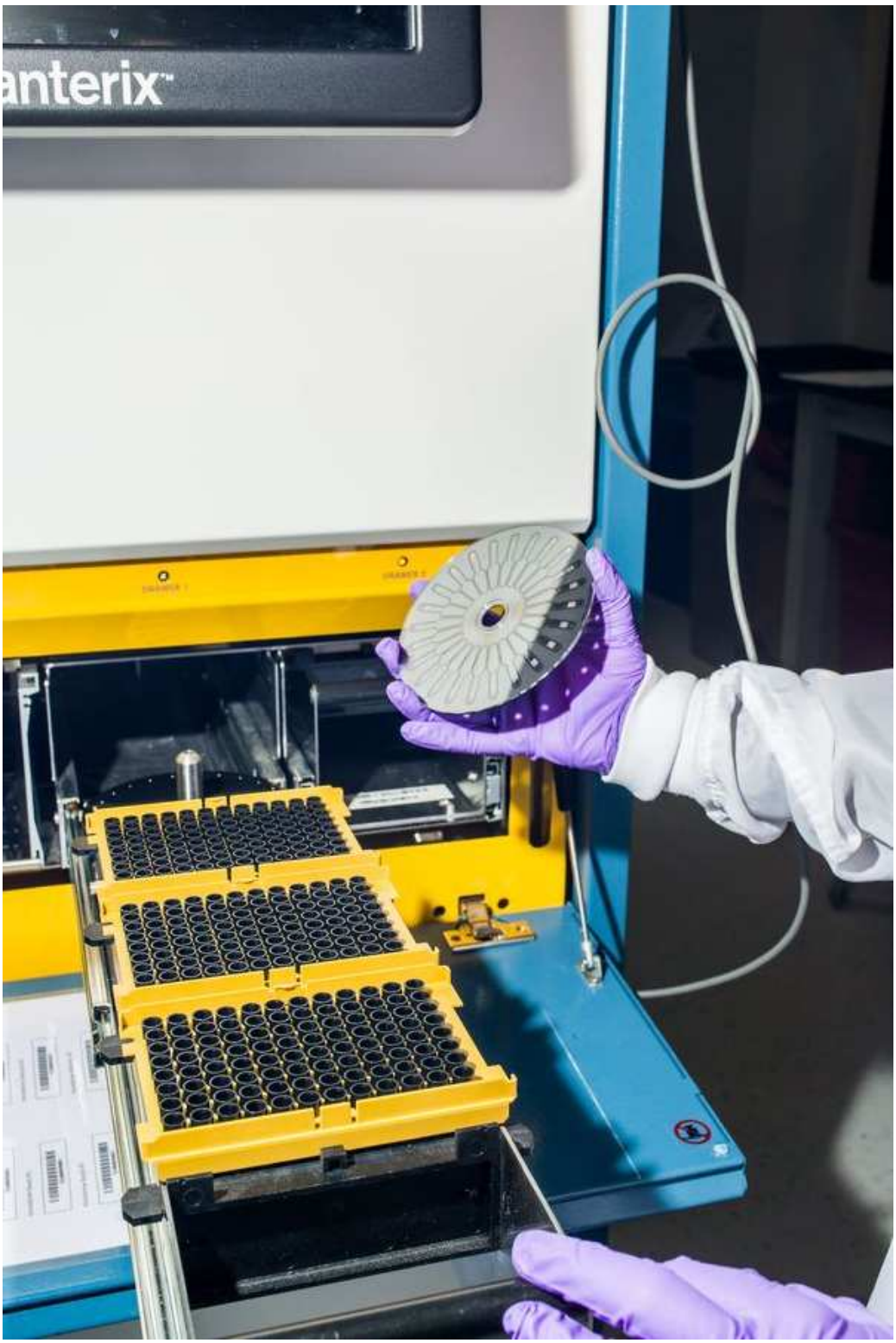
To assure the crowd he was no Elizabeth Holmes, Hrusovsky pulled on a white lab coat. He seemed

not to know that Holmes had done likewise for many photos

Walt's micro-wells made it possible to break the standard Elisa test into hundreds of thousands of mini tests. He co-founded Quanterix with then-CEO Nick Naclerio in 2007 to develop the method, which works like this: Beads are coated in hundreds of thousands of antibodies, like microscopic fur, and submerged in fluid samples, where the antibodies grab hold of any target molecule that comes into contact with them. The captured molecules, now attached to beads, are then tagged with an enzyme, as in a traditional Elisa, and the beads are rolled across a plate of wells, where they drop inside, one per well, and are sealed along with a trigger fluid. If the enzyme is present, the well lights up. If not, it doesn't. "You are basically breaking up the sample into 500,000 little samples," Hrusovsky says as we watch the machine work. "And you're checking each one of them to see if they have got a protein."

Sample vials of blood and other fluids go in a tray on the left, where the machine mixes in the antibody beads and the enzymes. On the right, it traps the beads in micro-wells sandwiched inside a compact disc, the same size as those that play music. The wells are arranged into 24 plots, each

about the size of a baby's fingernail, that are arrayed around the perimeter of the disc. Each plot holds 212,000 wells, meaning a single disc can yield more than 5 million results. The machine racks the loaded discs and turns them slowly, like an underpowered jukebox, to photograph the plots.



A technician loads the Simoa HD-1 Analyzer.

Photographer: Simone Lueck for Bloomberg Businessweek

The method is a thousand times more sensitive than the Elisa, capable of detecting molecules in concentrations as

low as 30,000 per drop—the equivalent, Hrusovsky says, of finding a grain of sand in 2,000 swimming pools. Simoa also offers digital results, with each well sending out a "yes" or "no" signal in microscopic plots of light and dark, which can then be charted to come up with molecule counts.

In 2013, Quanterix began selling its Simoa analyzer to drug companies for about $165,000 each. It sold some 65 in 2016, to customers including Eli Lilly, Merck, Novartis, and Pfizer. Quanterix also sells antibody kits, and it charges smaller researchers to run experiments in its lab—sales were almost $20 million last year. In March the company raised $46 million from investors, who pegged its value at about $150 million. Hrusovsky is using the money to expand the menu of antibody kits and build a cheaper, tabletop version of the company's machines. He hopes to begin selling them—and to take the company public—before the end of the year.

For a while now, Hrusovsky has been rhapsodizing about the future of medicine to anyone who will listen. In September he organized a conference called the Powering Precision Health Summit at the Marriott in Cambridge, Mass., drawing a crowd of about 300 cardiologists, neurologists, oncologists, and pharmaceutical executives. He delivered his opening remarks wearing a black turtleneck and blue jeans—a not-so-subtle homage. "It was 19 years ago when Steve Jobs took the stage at Macworld right here in Boston," he told the audience. Jobs, he reminded them, had just come back to Apple from Pixar,

and he used the stage that day to prod his company to try new things. Hrusovsky ticked through the list of products that followed in the next 15 years: the iPod, iPhone, iPad, and more. It was, he said, probably "the most unprecedented level of innovation that you can ever imagine."

Quanterix, he suggested, was at the center of something similarly grand: a burgeoning $30 billion market for blood screens that would upend notions of health and sickness. "It's a huge opportunity to do a big transformation," he said, "almost an Apple level of transformation, right here in health care."

Hrusovsky was aware of what everyone was thinking: He wasn't the first executive to don Jobs's mantle and promise a revolution in health care through high-tech blood tests. On screen, he displayed the cover of a year-old issue of *Inc.* magazine with Elizabeth Holmes, the CEO of Theranos, in a black turtleneck under the headline "The Next Steve Jobs." Theranos, once valued at $9 billion, had crashed to earth in the months after the *Inc.* cover, following a series of articles in the *Wall Street Journal* showing that its technology didn't work as promised and that it was relying on other companies' machines. In July federal regulators banned Holmes from operating a medical lab for two years (pending an appeal by the company). "You may be wondering why I am wearing black, given what's going on in the industry right now," Hrusovsky said. Then, to assure the crowd that he was no Holmes, he pulled on a white lab coat. He seemed not to know that Holmes had done

likewise for many photos—including for *Inc.*

Hrusovsky's backstory contrasts with Holmes's too-perfect tale of dropping out of college and finding a calling to disrupt medicine. He got a degree in mechanical engineering and an MBA, and spent 30 years at a handful of unsexy companies: DuPont, FMC, Zymark, Caliper, PerkinElmer. He worked in plastics, agricultural chemicals, pharmaceuticals, and lab robotics. He'd planned to spend his late career advising life sciences companies from the boardroom, but in 2014 a few Quanterix investors persuaded him to come aboard. The company had churned through four CEOs since its founding, and its backers were growing impatient. The vision of marketing diagnostic tools for a variety of diseases required not only the creation of "bleed-to-read" tests but also getting them approved by the Food and Drug Administration and persuading health insurers to help pay for the tests. "It was taking a long time and a lot of money, and it was getting frustrating," Hrusovsky says.

As CEO, he shifted the focus to selling analyzers to drug companies, who would use them for research that might one day lead to diagnostic tests. Unlike at Theranos, Quanterix's technology isn't a trade secret: Dozens of scientists have detailed their work using the company's machines in more than 80 peer-reviewed papers. They've used it to detect markers of cancer, Parkinson's, Alzheimer's, heart disease—and head trauma.

In 2013, Henrik Zetterberg, a professor at the University of

Gothenburg's Institute of Neuroscience and Physiology in Sweden, published a study in the journal *Brain Injury*, based on Quanterix tests, that showed increased levels of a protein called tau in the plasma of Olympic boxers after their bouts.

As proteins go, tau is famous. It helps hold together the intricate railway that carries signals between tens of billions of brain cells. When a brain slams against the inside of the skull, some tau dislodges and crosses the blood-brain barrier—the wall that prevents infection but also makes it hard for doctors to know what's happening inside the organ. If a brain is jostled too often, even with subconcussive blows, tau proteins can begin to deteriorate, becoming "misfolded" and falling off the railway. This deformed tau, known as P-Tau, is the primary marker of CTE. In stained slices of autopsied brains, P-Tau shows up as brown splotches.

The first known case of CTE in a former NFL player was found in the brain of Mike Webster, a Hall of Fame center for the Pittsburgh Steelers who died in 2002 after a long decline into mental illness. Bennet Omalu, the doctor who autopsied Webster, concluded that football had, in essence, caused his brain to collapse from within. (Omalu is the protagonist of the film *Concussion*, starring Will Smith.) Since then, the brains of 90 deceased former NFL players have been diagnosed with the disease.

The amount of tau that gets into the bloodstream following a concussion is minuscule, not enough to detect with any

established test. Doctors and trainers rely instead on checklists of symptoms and patient reports. When a football player gets knocked down and doesn't know what day it is, the diagnosis is clear enough. But not every blow is spectacular, and players, eager to stay in the game, don't always report symptoms. It's especially hard to know when a player has recovered. "We desperately need a blood test," says Robert Cantu, an investigator at Boston University's CTE Center and a consultant to the NFL's head, neck, and spine committee.

A year after Zetterberg's boxing study, he and his team looked at players in the Swedish Hockey League, again using Quanterix tests, and found that tau levels spiked in the first hour after a head injury, then dipped over the next 12 hours before rising again over the following two days. For a study published in January 2017 in *Neurology*, Jessica Gill, a head trauma researcher at the National Institute of Nursing Research in Bethesda, Md., tested the blood of 46 concussed college athletes from the University of Rochester and found that those with the highest levels of tau six hours after the injury were the least likely to be able to play again within 10 days.

Hrusovsky sees this research as prelude to a concussion blood test. "A finger prick could tell you the answer within 20 minutes," he said in an appearance on *Good Morning America* in December 2015. At the time, Quanterix said it might have a test ready within a year. By September, at his conference in Boston, Hrusovsky was speaking of the company's "ability to see concussions in blood."

The league, he says, has yet to "fully embrace the notion that hitting the head against another head is not good for people and that the brain is not designed to take those forces without damaging it"

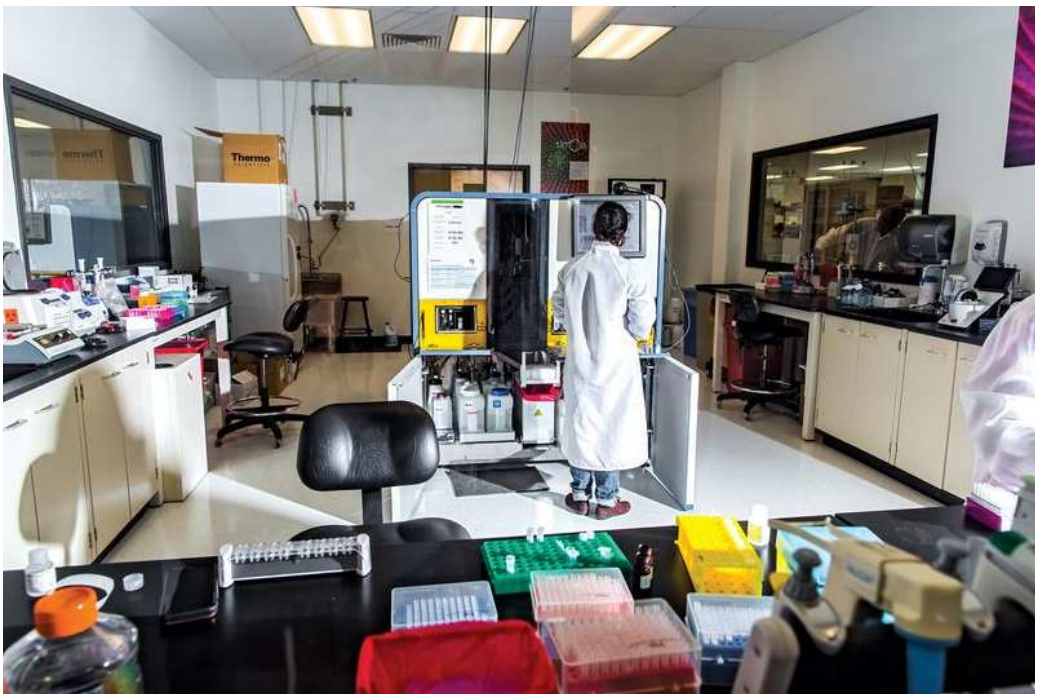
It's a long way, however, from a handful of studies showing correlations to a reliable biomarker test. To get there, Quanterix will need to establish tau baselines across populations and locate thresholds for injury, then test its method against results from clinicians trained to spot concussions. "When he talks in front of audiences, he kind

of often comes off like it's done," Cantu says, "but it's not done." During my visit in November, Hrusovsky said a test was four to five years away.

A blood test for CTE is further off. Quanterix hasn't yet identified an antibody that latches on only to the P-Tau proteins that mark the disease. And even if its researchers find one, there might not be much P-Tau to detect. With concussions, the impact sends tau proteins across the blood-brain barrier; with CTE, they may stay contained. "I don't think there is liberation in the bloodstream constantly of any proteins," says Julian Bailes, chairman of the department of neurosurgery at NorthShore Neurological Institute in Illinois. "I think there are damaged areas that are fixed."

Bailes was one of the first doctors to recognize the significance of Omalu's early findings. He believes positron emission tomography, or PET, scans, which rely on dyes with radioactive tracers, offer a better chance than blood tests of diagnosing CTE in the living. Jorge Barrio and Gary Small, scientists at the UCLA Brain Research Institute, have been scanning retired NFL players in search of the disease. Barrio and Small use a tracer called FDDNP that binds to tau and other proteins associated with neurodegenerative disease. For a study in the journal *PNAS* in 2015, they injected 14 former players with the experimental drug and found protein deposit patterns consistent with those identified in autopsies of players diagnosed with CTE.

A company called TauMark holds the license for FDDNP and is working to be able to market brain scans to athletes, military veterans, and others who've suffered head trauma. Small and Barrio own TauMark, along with Omalu, longtime NFL agent James "Bus" Cook, and Bob Fitzsimmons, the West Virginia plaintiffs' attorney who represented Webster in his disability case against the NFL. Fitzsimmons says the company is looking for funding for a long-term study, which could lead to an FDA-approved test. For the study, TauMark plans to scan dozens of terminally ill patients suspected of suffering from CTE, then compare the results with autopsies after they die. Omalu has done this with former Minnesota Vikings linebacker Fred McNeill, who died of Lou Gehrig's disease in 2015 after suffering years of dementia; McNeill's family told CNN that the PET scan and autopsy showed matching patterns indicating CTE.



In a lab at Quanterix's offices in Lexington, Mass.

Photographer: Simone Lueck for Bloomberg Businessweek

Aethlon Medical, a San Diego immunotherapy company, is coming at CTE from yet another angle, using exosomes, bits of cells that break off and show up in all types of bodily fluids, as biomarkers. Last year researchers found elevated levels of a tau-related exosome in former NFL players, compared with a control group. In January, Aethlon announced that it was looking to begin a study of 200 former NFL players.

Robert Stern, director of clinical research at BU's CTE Center, oversees the university's seven-year, $16 million effort to find a diagnosis for living patients. Over the years, he's used blood tests, PET scans, exosomes, and more to test former NFL players. Speaking at the Boston conference about his results with Quanterix, he said, "We found a pretty robust relationship between the cumulative head impact exposure and total tau through this simple blood test." Still, he doesn't believe a standalone blood test for CTE is coming. Instead, he says, blood work will likely serve as a screen to find patients who need PET scans and other tests. "It will always require these extra steps. It won't be the kind of thing that will be immediately able to be done in, let's say, a Simoa." (Stern declined to comment for this story.)

"I would say that the jury is still out on how far we're going to be able to get," Hrusovsky says of a standalone blood test.

During this year's playoffs, the NFL has been airing TV commercials with the tag line "The Future of Football."

One of them shows a white-coated technician loading blood samples into a Quanterix machine. “We’re trying to develop the best tools, ones that will allow us to diagnose concussions in real time,” says the narrator, Teena Shetty, a neurologist who consults with the New York Giants. Quanterix’s concussion research fits into the NFL’s vision of a future in which head trauma is neatly contained. A pinprick sideline test would make everyone rest easy when a player who just took a head shot returns to the field.

The CTE research is less comfortable for the league. For several years after Webster died, the NFL downplayed the problem of head trauma. In 2009, after being called to testify before Congress, Goodell ducked questions about the link between football and neurological disease. “Medical experts would know better than I do,” he said.

Nobody knows how common CTE is among current and former NFL players. “Some people have said up to 90 percent,” Bailes says. “I think it’s much less than that.” Not everybody who suffers repetitive head trauma winds up with the disease. And nobody knows why some get it and others don’t. It could have to do with the intervals between hits, with genetics, with nutrition. A test for the living would make it possible to begin sorting this out, to devise prevention programs, and maybe even find drugs that can reverse the damage. This is the hope, both for CTE sufferers and for the NFL.

For now, the league has the problem contained, at least from a legal standpoint. In 2013 it settled a lawsuit brought

by more than 5,000 retired players who claimed the league had failed to share what it knew about the long-term effects of head trauma. The NFL promised to pay at least $675 million to former players whose symptoms make them eligible and to set aside $90 million for medical monitoring and research. In March of last year, Miller, the NFL health and safety executive, openly acknowledged the link between football and CTE. And in September, in his open letter, Goodell committed an additional $100 million to fund further research in helmet engineering and neuroscience. All of this was on top of a 2012 grant of $30 million to the National Institutes of Health for research on brain injuries.

With CTE on many fans' minds, the NFL has little choice but to present itself as eager to learn more about it, though not everyone is convinced the league is prepared to acknowledge the full scope of the problem. "The NFL, in my opinion, still has weasel words," says Fitzsimmons, the West Virginia attorney who represented Webster. The league, he says, has yet to "fully embrace the notion that hitting the head against another head is not good for people and that the brain is not designed to take those forces without damaging it."

"We understand that there are many, many unanswered questions," says Joe Lockhart, a spokesman for the NFL. "Our ultimate goal is to do our part to contribute to finding the answers. We are prepared to follow the science to wherever it leads." That didn't include buying a stake in Quanterix. The league sticks to grants, Lockhart says, so

that there's no question its goal is to advance the science rather than to direct it or profit from it.

Hrusovsky left the November meeting feeling less than loved—a league representative, he says, chided him for failing to mention its funding during his appearance on *Good Morning America*—but the NFL has gone out of its way since then to show its support. The commercial featuring the Quanterix machine was one example. "I think they're just trying to get their hands around what all this can mean," he says.

His message to the NFL was not to fear what's coming. "The objective test might wind up being your best friend," he says. "Maybe it's a big risk, or maybe it's salvation."

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