

But biotech companies start with a clean piece of paper. There's more flexibility and more original thinking in putting deals together," says Wiltsey.

Covering up weak pipelines

Pharmaceutical companies will increasingly turn to biotech companies to cover pipeline deficiencies, according to David Hale, president and CEO of Gensia Pharmaceuticals (San Diego, CA). Most pharmaceutical-industry analysts expect pharmaceutical companies to achieve annual growth rates of 10 percent to 15 percent. This means a pharmaceutical company with annual sales of \$3 billion must generate \$450 million in new sales next year

and \$520 million in such sales the year after. "The only way to do this is by introducing new drugs—those drugs that biotechnology is developing," Hale says. While Glaxo (London), Pfizer (New York), and Merck (Rahway, NJ) have sufficiently strong pipelines, most pharmaceutical companies have "terrible pipelines that won't lead to significant products for some time," says Hale

Previously, pharmaceutical companies offset a lack of new products with price increases on old ones. But continuing federal-government pressure on pharmaceutical prices will limit future increases. So pharmaceutical companies will have little choice but to use their

"huge cash reserves as strategic assets. Biotech companies will thus have increasing opportunities to show pharmaceutical companies creative ways to use their assets to gain access to innovative drugs," Hale says.

Chiron's Penhoet sounded the panel's lone note of humility as the luncheon drew to a close. "We don't want to give the impression of discounting pharmaceutical companies—they're tough competition," Penhoet said. "Moving drugs through development, as well as marketing and distribution, are the pharmaceutical-company strengths." Conspicuously, Penhoet didn't list research as a pharmaceutical-company asset. —B.J. Spalding

LEADING RESEARCH PRODUCERS

ACADEMIC RESEARCH IS BETTER

NEW YORK—Counting published research papers is a rough gauge of a laboratory's output. The Institute for Scientific Information (ISI, Philadelphia, PA), however, not only counts published papers, it determines how many citations the papers received and the average number of citations per paper.

By these measures, 15 surveyed independent labs and university labs outperformed 10 surveyed biotechnology companies. Both the labs and biotech companies, moreover, far outperformed 10 surveyed pharmaceutical companies.

An ISI analyst puts these findings in perspective. "The attitude toward publishing is paramount. In academia, publishing is a necessity. Since biotechnology companies were started by academics, the culture has carried over. But pharmaceutical companies place less emphasis on publishing. Some of their best work isn't published," says David Pendlebury, editor of ISI's *Science Watch*.

The 15 independent labs and university labs clearly dominated, as their papers published between January of 1981 and June of 1992 earned an average of 31.3 citations each (Table 1). The Whitehead Institute (Cambridge, MA) led the way, with 51 citations per paper, on average. Massachusetts Institute of Technology's (Cambridge, MA) Department of Biology was runner up, with an average of 46.8 citations per paper.

The 10 biotech companies—with an average of 27.5 citations per paper—weren't far behind. Genentech (S. San Francisco, CA) was the front runner, with 39.6 citations per paper, on average, while Genetics Institute (Cambridge, MA) followed, with an average of 37.5 citations per paper. Genentech—which funded the ISI study—performed particularly well. Fully 1 percent of its papers were cited over 500 times, whereas, typically, only 0.03 percent of papers are

cited that often. "Genentech produces a lot of blockbuster papers," says Pendlebury.

The 10 pharmaceutical companies, for their part, brought up the rear, with an average of 10.8 citations per paper. John-

son & Johnson (New Brunswick, NJ) was the leader, as its papers earned 21 citations each. Merck (Rahway, NJ) placed second, with its papers capturing an average of 17 citations apiece.

—B.J. Spalding

TABLE 1. Leading research producers.

Independent and University Laboratories	Papers*	Citations*	Citations Per Paper
Whitehead Institute	1,035	52,820	51.03
Massachusetts Institute of Technology	3,139	146,770	46.76
Department of Biology			
Carnegie Institution	408	18,917	46.37
Department of Embryology			
Cold Spring Harbor	1,139	51,926	45.59
Salk Institute	3,612	144,739	40.07
University of California (San Francisco)	2,537	85,826	33.83
Department of Biochemistry & Biophysics			
La Jolla Cancer Research Center	1,037	28,424	27.41
Hutchinson Cancer Center	3,562	94,585	26.55
Stanford University	741	19,207	25.92
Department of Genetics			
University of California (Berkeley)	4,252	99,233	23.34
Division of Cell & Molecular Biology			
Wistar Institute	2,611	59,028	22.61
National Institutes of Health (NIH)	35,462	782,595	22.07
Princeton University	1,201	24,576	20.46
Department of Biology			
National Jewish Center for Immunology & Respiratory Medicine	2,636	49,560	18.80
Scripps	7,815	140,525	17.98
Average	4,746	119,915	31.25
Biotechnology Companies			
Genentech	2,181	86,258	39.55
Genetics Institute	553	20,759	37.54
Biogen	568	20,258	35.67
Chiron	1,691	55,493	32.82
Centocor	243	6,787	27.93
ImmuneX	541	14,858	27.46
Cambridge Biotech	140	3,660	26.14
Scios Nova	533	10,190	19.12
Amgen	570	9,983	17.51
Genzyme	77	831	10.79
Average	710	22,908	27.50
Pharmaceutical Companies			
Johnson & Johnson	452	9,480	20.97
Merck	3,690	62,893	17.04
Roche Group	3,764	62,047	16.48
Eli Lilly	2,061	22,452	10.89
Glaxo Holdings	1,232	11,338	9.20
Pfizer	826	7,291	8.83
Bristol-Myers Squibb	1,638	11,904	7.27
Abbott Labs	1,423	9,601	6.75
American Home	882	4,964	5.63
SmithKline Beecham	2,016	10,461	5.19
Average	1,798	21,243	10.8

*From January of 1981 to June of 1992.

Numbers for the pharmaceutical firms and NIH represent publications in journals of biological sciences, not all papers. Source: Institute for Scientific Information (Philadelphia, PA).