Notes on Individual HH Objects

HH 1/2 *(5 33, -06 48)*. Original papers: Herbig (1951), Haro (1952,1953). These are among the brightest HH objects in the sky, and form bow shocks in a highly collimated bipolar outflow with dimension 2.5 arcmin (0.34 pc projected). A small jet originates from the embedded central source. *Optical Spectroscopic Studies:* Herbig (1951), Böhm (1956), Osterbrock (1958), Haro & Minkowski (1960), Böhm, Perry, Schwartz (1973), Böhm, Siegmund, Schwartz (1976a), Dopita (1978a), Schwartz (1978), Böhm & Brugel (1979), Brugel, Böhm, Mannery (1981a), Schwartz (1981), Dopita, Binette, Schwartz (1982), Hartmann & Raymond (1984), Böhm & Solf (1985), Cantó & Rodríguez (1986), Solf, Böhm, Raga (1988), Noriega-Crespo, Böhm, Raga (1989), Solf & Böhm (1991), Solf et al. (1991), Böhm & Solf (1992), Beck-Winchatz & Böhm (1994), Beck-Winchatz, Böhm, Noriega-Crespo (1996). *Studies of Blue Continua:* Böhm, Schwartz, Siegmund (1974), Brugel, Böhm, Mannery (1981b), Dopita, Binette, Schwartz (1982), Solf, Böhm, Raga (1988). *Ultraviolet Spectroscopy:* Ortolani & D'Odorico (1980), Böhm, Böhm-Vitense, Brugel (1981), Brugel, Shull, Seab (1982), Böhm-Vitense et al. (1982), Brugel et al. (1985), Böhm et al. (1987), Lee et al. (1988), Böhm, Raga, Binette (1991), Böhm, Noriega-Crespo, Solf (1993), Moro-Martin et al. (1996), Raymond, Blair, Long (1997). *Structure and CCD Imaging:* Strom et al. (1985a, 1986), Mundt, Brugel, Bührke (1987), Raga & Mateo (1988a), Raga et al. (1988), Schwartz et al. (1993), Reipurth et al. (1993b), Eislöffel, Mundt, Böhm (1994), Ogura (1995), Ray et al. (1996), Hester, Stapelfeldt, Scowen (1998). *Variability of Knots:* Herbig (1969, 1973), Schwartz (1976), Herbig & Jones (1981), Brugel et al. (1985), Raga, Barnes, Mateo (1990). *Infrared observations:* Elias (1980), Harvey et al. (1986), Zinnecker et al. (1989), Zealey et al. (1992), Davis, Eislöffel, Ray (1994), Kelly, Rieke, Campbell (1994), Noriega-Crespo & Garnavich (1994a,b), Schwartz et al. (1995), Gredel (1996). *Radio continuum studies:* Pravdo et al. (1985), Curiel, Cantó, Rodríguez (1987), Rodríguez et al. (1990b). *Search for X-rays:* Pravdo & Marshall (1981), Strom et al. (1990), Pravdo & Angelini (1993). *Polarization studies*: Strom, Strom, Kinman (1974), Schmidt & Vrba (1975). *Energy Source:* Pravdo et al. (1985), Rodríguez, Roth, Tapia (1985), Strom et al. (1985a), Harvey et al. (1986), Pravdo & Chester (1987), Tapia et al. (1987), Reipurth (1989b), Rodríguez et al. (1990b), Reipurth et al. (1993a), Chini et al. (1997b), Zavagno et al. (1997), Dent, Matthew, Ward-Thompson (1998). *Studies of Jet:* Strom et al. (1985a), Bohigas et al. (1985), Cohen & Fuller (1985), Schwartz, Cohen, Williams (1987), Mundt, Brugel, Bührke (1987), Roth et al. (1989), Reipurth et al. (1993b). *Proper Motions:* Herbig & Jones (1981), Reipurth et al. (1993b), Eislöffel, Mundt, Böhm (1994), Noriega-Crespo et al. (1997). *Dust scattered emission:* Solf & Böhm (1991), Noriega-Crespo, Calvet, Böhm (1991), Henney, Raga, Axon (1994). *Mm Studies:* Loren, Evans, Knapp (1979), Edwards & Snell (1984), Torrelles et al. (1985b), Levreault (1988), Marcaide et al. (1988), Davis, Dent, Burnell (1990), Cernicharo (1990), Morgan et al. (1991), Torrelles et al. (1992b, 1993c, 1994), Chernin & Masson (1995), Choi & Zhou (1997), Correia, Griffin, Saraceno (1997), Choi & Lee (1998). *Various model calculations:* Hartmann & Raymond (1984), Choe, Böhm, Solf (1985), Hartigan, Raymond, Hartmann (1987), Raga et al. (1988), Hartigan (1989), Noriega-Crespo, Böhm, Raga (1989,1990), Indebetouw & Noriega-Crespo (1995). See also notes for HH 144 and HH 145, and for HH 401/402.

HH 3 *(5 33, -06 44)*. Original papers: Herbig (1951), Haro (1952,1953). Bright HH object with a jet-like protrusion (Ray 1987) and associated with a group of faint HH knots (Reipurth 1989b). Associated with faint near-infrared object (Roth et al. 1989). No molecular outflow detected by Edwards & Snell (1984). Optical spectroscopy: Dopita (1978a), Brugel, Böhm, Mannery (1981a).

HH 4 *(3 26, +31 09)*. Herbig (1974) notes that this is "a faint nebulosity 7-8 arcsec in diameter with a sharp condensation or faint star on the west edge". It is seen in the infrared images of Aspin, Sandell, Russell (1994), and the optical images of Bally, Devine, Reipurth (1996).

HH 5 *(3 26, +31 02).* Originally found by Herbig (1974). H_2 detection by Lane & Bally (1986). CCD image presented by Ray (1987). Astrometry and proper motion by Herbig & Jones (1983). Detailed optical/infrared imaging and spectroscopic study by Cohen, Jones, Hereld (1991). Low excitation object. It is seen in the infrared images of Aspin, Sandell, Russell (1994), and the optical images of Bally, Devine, Reipurth (1996). Schwartz et al. (1995) present near-infrared spectroscopy.

HH 6 *(3 26, +31 08).* Originally found by Herbig (1974). H_2 detection by Lane & Bally (1986), Lightfoot & Glencross (1986), and Schwartz, Cohen, Williams (1987). Detailed optical/infrared imaging and spectroscopic study by Cohen, Jones, Hereld (1991). CCD images are also presented by Bally, Devine, Reipurth (1996). This is a low excitation object. A weak VLA 6 cm continuum source is found nearby (Snell & Bally 1986) as well as an H_2O maser source (Henkel, Haschick, Güsten 1986). Energy source of 33 $L_\odot$ detected at 50 and 100 μm in IRAS CPC observations (Jennings et al. 1987). The HH object is seen in the infrared images of Aspin, Sandell, Russell (1994). Schwartz et al. (1995) present near-infrared spectroscopy. Liseau, Sandell, Knee (1988) found a very weak molecular outflow.

HH 7/8/9/10/11 *(3 26, +31 05).* This is a chain of bright HH knots about 1 arcmin long, first discussed by Herbig (1974) and Strom, Grasdalen, Strom (1974). *CCD Imaging:* Strom et al. (1986), Solf & Böhm (1987), Raga & Mateo (1988a), Hartigan, Curiel, Raymond (1989), Aspin, Sandell, Russell (1994), Davis et al. (1995), Bally, Devine, Reipurth (1996). *Optical Spectroscopy:* Strom, Grasdalen Strom (1974), Böhm, Brugel, Mannery (1980), Cohen & Schmidt (1981), Böhm, Brugel, Olmsted (1983), Goodrich (1986a), Solf & Böhm (1987), Böhm & Solf (1990), Beck-Winchatz & Böhm (1994), Beck-Winchatz, Böhm, Noriega-Crespo (1996). *Infrared Observations:* Simon & Joyce (1983), Zealey, Williams, Sandell (1984), Lightfoot & Glencross (1986), Cohen et al. (1988), Zinnecker et al. (1989), Burton et al. (1989), Hartigan, Curiel, Raymond (1989), Garden, Russell, Burton (1990), Stapelfeldt et al. (1991), Carr (1993), Aspin, Sandell, Russell (1994), Fernandes & Brand (1995), Gredel (1996), Lada, Alves, Lada (1996), Everett (1997). *Ultraviolet Observations:* Cameron & Liseau (1990). *Proper Motions:* Herbig & Jones (1983). *Radio Observations:* Lada et al. (1974), Ho & Barrett (1980), Snell & Edwards (1981), Liseau & Sandell (1986), Mirabel et al. (1987), Liseau et al. (1988), Rudolph & Welch (1988), Lizano et al. (1988), Koo (1990), Masson, Mundy, Keene (1990), Rodríguez et al. (1990a), Bachiller & Cernicharo (1990), Phillips & Mampaso (1991), Giovanardi et al. (1992), Dent et al. (1993), Mehringer (1996), Cernicharo, Bachiller, Gonzalez-Alfonso (1996), Warin et al. (1996), Lefloch et al. (1998a,b), Bachiller et al. (1998b), Codella, Bachiller, Reipurth (1999). *Source:* Strom, Vrba, Strom (1976a), Cohen & Schwartz (1983), Cohen et al. (1984a), Hodapp (1984), Snell & Bally (1986), Goodrich (1986), Cohen & Schwartz (1987), Grossman et al. (1987), Jennings et al. (1987), Sandell et al. (1990), Eislöffel et al. (1991), Carr & Tokunaga (1992), Liseau, Lorenzetti, Molinari (1992), Molinari, Liseau, Lorenzetti (1993), Reipurth et al. (1993a), Aspin & Sandell (1994), Chandler, Carlstrom, Scoville (1995), Najita, Carr, Tokunaga (1996), Rodriguez, Anglada, Curiel (1997), Chini et al. (1997b), Biscaya et al. (1997). *Magnetic Field Direction:* Heyer, Strom, Strom (1987). *H_2O Masers:* Dickinson, Kojoian, Strom (1974), Lo et al. (1976), Haschick et al. (1980), Haschick, Moran, Rodríguez (1980), Claussen et al. (1996), Lefloch et al. (1998a). *Distance:* Herbig & Jones (1983), Cěrnis (1990) and references therein; a distance of 220 pc is adopted here.

HH 12 *(3 25, +31 09).* Originally found by Herbig (1974). *CCD Imaging:* Strom, Strom, Stocke (1983), Strom et al. (1986), Stapelfeldt et al. (1991), Aspin, Sandell, Russell (1994), Bally, Devine, Reipurth (1996). *Spectroscopy:* Strom, Grasdalen, Strom (1974), Strom, Strom, Stocke (1983), Cohen & Jones (1987). *IR Observations:* Simon & Joyce (1983), Lane & Bally (1986), Schwartz, Cohen, Williams (1987), Garden, Russell, Burton (1990), Stapelfeldt et al. (1991), Aspin, Sandell, Russell (1994). *Proper motions:* Herbig & Jones (1983). *Mm Observations:* Ho & Barrett (1980), Edwards & Snell (1983), Liseau et al. (1988), Bachiller et al. (1998b). *Magnetic Field Direction:* Heyer, Strom, Strom (1987). *Source:* The source has not been unequivocally identified, but there are several candidates, star 107 proposed by Strom, Strom, Stocke (1983), and SVS 12 (Strom, Vrba, Strom 1976a, Cohen & Schwartz 1987, Jennings et al. (1987), Stapelfeldt et al. 1991, Molinari, Liseau, Lorenzetti 1993); Bachiller et al. (1998b) suggest that HH 12 is the working surface of a molecular jet driven by the submillimeter source SVS 13b.

HH 13 *(3 25, +30 56).* Original paper: Herbig (1974). CCD images by Bally, Devine, Reipurth (1996) show this to be an about 1 arcminute large cluster of mostly [SII] bright knots.

HH 14 *(3 25, +30 50).* Original paper: Herbig (1974), who notes that this is "a group of about 6 nebulous spots distributed over an area of about 20 × 60 arcsec." CCD images are presented by Bally, Devine, Reipurth (1996). Cohen & Schwartz (1987) draw attention to the nearby IRAS source 03254+3050 as a candidate energy source.

HH 15 *(3 25, +30 57).* Original paper: Herbig (1974). Cohen & Schwartz (1987) suggest IRAS 03256+3055 could be a possible energy source. Bally, Devine, Reipurth (1996) show a CCD image, and note that HH 15 lies on a line through IRAS 03255+3103 (IRAS 1) together with HH 338 and HH 339, which are on the opposite side of this IRAS source. The morphology of HH 15 is consistent with it being a bow shock originating in the IRAS 1 source. Phillips et al. (1988) detected a molecular outflow from IRAS 1 along the HH 15-341-338-339 axis.

HH 16 *(3 26, +30 58).* Herbig (1974) describes this as "a faint elongated smudge about 3 × 7 arcsec." Cohen & Schwartz (1987) suggest IRAS 03256+3055 could be a possible energy source. CCD images are shown by Bally, Devine, Reipurth (1996). Bachiller et al. (1998b) note that HH 16 is lying on the axis of a molecular jet from SVS 13b.

HH 17 *(3 26, +31 08).* Herbig (1974) writes that this is "a very faint nebulosity 5 to 10 arcsec across, with a sharp condensation or star at the northern edge". Bally, Devine, Reipurth (1996) show CCD images. Jennings et al. (1987) found an IRAS source (IRAS f) very close to HH 17. A near-infrared source (SVS 5 = ASR 112) was detected by Strom, Vrba, Strom (1976a) and Aspin, Sandell, Russell (1994).

HH 18 *(3 26, +30 57).* Herbig (1974) notes that this is "a group of at least 5 faint nebulous spots distributed over an area of about 20 × 35 arcsec." CCD images are shown by Bally, Devine, Reipurth (1996).

HH 19 *(5 43, −00 06).* Original paper: Herbig (1974). CCD images presented by Mundt et al. (1984), Strom et al. (1986) and Eislöffel & Mundt (1997). Spectroscopy by Jones et al. (1987) and Mundt, Brugel, Bührke (1987). Proper motions by Jones et al. (1987) suggest an origin near SSV 63 and HH 24. Specifically, Eislöffel & Mundt (1997) argue that HH 19 is a bow shock from the HH 24J jet, which has a counter-flow in the HH 24K jet and the HH 27 bow shock, with a total projected extent of 1.6 pc. Infrared H_2 spectroscopy by Zinnecker et al. (1989). Infrared imaging by Zealey et al. (1992).

HH 20/21 *(5 43, −00 05).* Original paper: Herbig (1974). These objects form a loose group of HH knots together with HH 70 (Reipurth & Graham 1988) and HH 37 of Strom et al. (1986); both papers present CCD images. Located near HH 19. The proper motion study by Jones et al. (1987) suggests HH 20 originates near SSV 63 and HH 24. Based on wide-field CCD images, Eislöffel & Mundt (1997) suggest that

HH 20/21, HH 37 and HH 70 may form a single giant bow shock from a flow originating in HH 24. HH 20 was observed spectroscopically by Jones et al. (1987).

HH 22 *(5 43, −00 06)*. Original paper: Herbig (1974). CCD images by Eislöffel & Mundt (1997) show that this is a 3 arcmin long finely collimated jet. No source has been identified.

HH 23 *(5 43, −00 04)*. Original paper: Herbig (1974). CCD images by Eislöffel & Mundt (1997) show that this is a collimated flow from the IRAS 05436−0007 source, which displays a faint reflection nebula. Jones et al. (1987) attempted to measure the proper motions of HH 23.

HH 24 *(5 43, −00 11)*. Originally discovered by Herbig & Kuhi (1963). This is a very complex region with at least three and perhaps more outflows. For an overview of the region, source locations and nomenclature of knots see Figs. 17 and 19 of Mundt, Ray, Raga (1991), and Fig. 8 of Eislöffel & Mundt (1997). *Structure and CCD Images:* Strom et al. (1986), Jones et al. (1987), Mundt, Ray, Raga (1991), Eislöffel & Mundt (1997). *Optical Spectroscopy:* Strom, Grasdalen, Strom (1974), Dopita (1978a), Schmidt & Miller (1979), Brugel, Böhm, Mannery (1981a,b), Solf (1987), Bacciotti & Eislöffel (1999). *Ultraviolet Spectroscopy:* Lee et al. (1988), Böhm et al. (1992), Moro-Martin et al. (1996). *Infrared Observations:* Zealey et al. (1992), Hodapp (1994), Moneti & Reipurth (1995), Davis et al. (1997a). *Proper Motions:* Jones et al. (1987). *Polarization Measurements:* Strom, Grasdalen, Strom (1974), Strom, Strom, Kinman (1974), Schmidt & Miller (1979), Scarrott, Gledhill, Warren-Smith (1987). *Source(s):* Strom, Grasdalen, Strom (1974), Strom, Strom, Vrba (1976a), Cohen & Schwartz (1983, 1987), Cohen et al. (1984a), Bieging, Cohen, Schwartz (1984), Cohen, Dopita, Schwartz (1986b), Lane (1989), Zealey et al. (1989, 1992), Reipurth et al. (1993a), Molinari, Liseau, Lorenzetti (1993), Chini et al. (1993), Krügel & Chini (1994), Ward-Thompson et al. (1995), Chandler et al. (1995), Bontemps, André, Ward-Thompson (1995), Bontemps, Ward-Thompson, André (1996), Greaves, Holland, Ward-Thompson (1997), Anglada et al (1998), Dent, Matthew, Ward-Thompson (1998), Gibb (1999). *Radio Observations:* Lada et al. (1974), Snell & Edwards (1982), Wootten et al. (1982), Matthews & Little (1983), Torrelles et al. (1983a), Edwards & Snell (1984), Little et al. (1985), Torrelles et al. (1989), Pastor et al. (1991), Lada et al. (1991), Gibb & Heaton (1993), Harju, Walmsley, Wouterloot (1993), Gibb et al. (1995), Gibb & Little (1998), Gibb (1999).

HH 25/26 *(5 43, −00 15)*. Original paper: Herbig (1974). The comment by Cohen & Schwartz (1987) that HH 25 is not an emission nebula is incorrect (e.g. Jones et al. 1987). Structure and CCD images discussed by Strom et al. (1986) and Jones et al. (1987). Optical spectroscopy presented by Jones et al. (1987). A 2.0 - 2.5 μm spectrum of HH 26 is given by Schwartz, Cohen, Williams (1987), and further near-infrared spectroscopy of both objects is presented by Schwartz et al. (1995). Infrared imaging is discussed by Schwartz, Burton, Herrmann (1997). An embedded near-infrared source, SSV 59 (= IRAS 05435–0015), is located between HH 25 and 26, and is a candidate energy source (Strom, Strom, Vrba 1976a, Cohen & Schwartz 1983, Cohen et al. 1984a). Another deeply embedded source, HH 25 IRS, is more recently discovered in the region (see e.g. Gibb & Davis 1998). Centimeter radio continuum observations are discussed by Bontemps, André, Ward-Thompson (1995), Anglada et al. (1998) and Gibb (1999). Hodapp (1994) presents a large-field K' band image and Davis et al. (1997a) discuss narrow-band infrared images. The region is very complex at mm wavelengths (see Gibb & Heaton 1993 for a summary, and references to radio observations under HH 24). Verdes-Montenegro & Ho (1996) have mapped the molecular core around the IR source in NH_3.

HH 27 *(5 43, −00 14)*. Original paper: Herbig (1974). Structure and CCD images are discussed by Strom et al. (1986), Jones et al. (1987) and Eislöffel & Mundt (1997). It is suggested by Eislöffel & Mundt (1997) that HH 27 is a bow shock from the HH 24K jet, which has a counterflow in the HH 24J jet and the HH 19 bow shock. Optical spectroscopy is presented by Jones et al. (1987). H_2 is detected by Schwartz, Cohen, Williams (1987). Mm observations are summarized by Gibb & Heaton (1993), see also notes under HH 24.

HH 28/29 *(4 28, +17 58)*. Original paper: Herbig (1974). These are two rather bright objects, which form bow shocks in the large outflow from L1551 IRS 5 starting in the HH 154 jet. CCD images are presented by Snell et al. (1985), Strom et al. (1986), Stocke et al. (1988), Graham & Heyer (1990), Garnavich, Noriega-Crespo, Green (1992), Fridlund, Liseau, Perryman (1993), Davis et al. (1995) and Devine, Reipurth, Bally (1999). Infrared images are presented by Davis et al. (1995). Optical spectroscopy is discussed by Strom, Grasdalen, Strom (1974) and Stocke et al. (1988). Detailed spectroscopy of HH 29 is analyzed by Fridlund, Liseau, Gullbring (1998). Ultraviolet spectroscopy of HH 29 is presented by Cameron & Liseau (1990) and Liseau et al. (1996a). The objects have large proper motions in a direction away from IRS 5 (Cudworth & Herbig 1979). More recent data suggest that HH 28/29 may instead originate in the neighboring source L1551NE (Devine, Reipurth, Bally 1998). The molecular outflow from IRS 5 has an abrupt velocity change at HH 29 (Fridlund et al. 1984). For references on the molecular outflow and the source, see notes on the HH 154 jet.

HH 30 *(4 28, +18 06)*. Original paper: Herbig (1974). *Structure and CCD Images:* Mundt & Fried (1983), Cohen & Jones (1987), Mundt, Ray, Bührke (1988), Mundt et al. (1990), Graham & Heyer (1990), Mundt, Ray, Raga (1991), López et al. (1995). *HST observations:* Burrows et al. (1996), Ray et al. (1996), Stapelfeldt et al. (1999a). *Optical Spectroscopy:* Brugel, Böhm, Mannery (1981a), Cohen & Schmidt (1981), Mundt, Brugel, Bührke (1987), Cohen & Jones (1987), Mundt et al. (1990), Raga et al. (1997). *Proper Motions:* Cudworth & Herbig (1979), Mundt et al. (1990), López et al. (1996), Burrows et al. (1996). *Source:* Cohen & Schwartz (1980), Vrba, Rydgren, Zak (1985), Cohen & Schwartz (1987). *Mm Data:* Calvet, Cantó, Rodríguez (1983).

HH 31 *(4 25, +26 11)*. Original paper: Herbig (1974). CCD images are discussed by Strom et al. (1986). A likely energy source, HH 31 IRS 2 (IRAS 04248+2612) was found by Cohen & Schwartz (1983), and further studied by Cohen et al. (1984a), Cohen, Harvey, Schwartz (1985) and Cohen & Schwartz (1987). A spectrum of a little nebula at the location of the source (identified as knot D by Herbig 1974) by Cohen & Fuller (1985) showed little emission, but Strom et al. (1986) found a southern emission line extension. Gómez, Whitney, Kenyon (1997) present deep [SII] images which reveal further faint HH knots in the flow. Lucas & Roche (1997) present near-infrared images of the source and associated nebula, and Padgett et al. (1999) used HST/NICMOS to image the nebula at high resolution and show that the source is a binary with a separation of 0.16 arcsec. Kenyon et al. (1998) suggest a spectral type of the source of M2. Whitney, Kenyon, Gómez (1997) present near-infrared polarimetry of the source. Moriarty-Schieven et al. (1994) measured the source at 1300 μm, and Dent, Matthews, Ward-Thompson (1998) at other sub-mm wavelengths . Limited ^{12}CO data of Edwards & Snell (1983) revealed no high-velocity gas.

HH 32 *(19 18, +10 56)*. Original paper: Herbig (1974). *CCD Images:* Mundt, Stocke, Stockman (1983), Hartigan, Mundt, Stocke (1986), Curiel et al. (1997). *Optical Spectroscopy:* Dopita (1978a), Brugel, Böhm, Mannery (1981a,b), Herbig & Jones (1983), Solf, Böhm, Raga (1986), Hartigan, Mundt, Stocke (1986). *UV Spectroscopy:* Böhm & Böhm-Vitense (1984), Lee et al. (1988), Moro-Martin et al. (1996). *IR Observations:* Zealey et al. (1986), Zinnecker et al. (1989), Hodapp (1994), Davis, Eislöffel, Smith (1996). *Radio Continuum Emission:* Anglada et al. (1992, 1998). *Proper Motions:* Herbig & Jones (1983). *Source:* AS353A (=V1352 Aql) was discovered by Merrill & Burwell (1950). The optical spectrum of the star has been extensively discussed by Cohen & Kuhi (1979), Herbig & Jones (1983), Mundt, Stocke, Stockman

(1983), Hartigan, Mundt, Stocke (1986), Böhm & Raga (1987) and Eislöffel, Solf, Böhm (1990). Near-infrared spectroscopy of AS 353A is discussed by Najita, Carr, Tokunaga (1996), and Biscaya et al. (1997). IR and sub-mm photometry is given by Cohen & Schwartz (1983, 1987), and Reipurth et al. (1993a). Edwards & Snell (1982) report high-velocity CO emission. *Various model calculations:* Raga, Böhm, Solf (1986), Hartigan, Raymond, Hartmann (1987). See also HH 332.

HH 33/40 *(5 32, −06 19).* HH 40 was discovered by Haro (1953), who also later found HH 33 (see Herbig 1974). HH 33 and 40 are physically connected with an emission-line filament. Mundt et al. (1984) suggest the HH objects form a jet, but Bally & Devine (1994) propose they are really a distant bow shock in the HH 34 flow. This is confirmed in a kinematic study based on radial velocities and proper motions by Devine et al. (1997). CCD images are presented by Mundt et al. (1984), Strom et al. (1986), Bally & Devine (1994), Eislöffel & Mundt (1997) and Devine et al. (1997). Optical spectroscopy is discussed by Dopita (1978a), Brugel, Böhm, Mannery (1981a), Goodrich (1986a), Mundt, Brugel, Bührke (1987) and Devine et al. (1997). Infrared H_2 observations are discussed by Elias (1980), Schwartz, Cohen, Williams (1987), Zinnecker et al. (1989), and Zealey et al. (1992). Heyer, Strom, Strom (1987) suggest an alignment with magnetic field lines. No convincing energy source has been found near HH 33/40 (Cohen & Schwartz 1983, 1987), in further support of the idea that the complex is driven by HH 34 IRS (Bally & Devine 1994). Edwards & Snell (1983) found no high-velocity gas in the region.

HH 34 *(5 33, −06 29).* Discovered by Haro, see Herbig (1974). HH 34, located in L1641 in Orion, is a large bright bow shock in the approaching lobe of a major bipolar HH complex which includes a very fine jet. This jet, the discovery of which was announced by Reipurth (1985b), was studied in detail by Reipurth et al. (1986), who present CCD images and low-dispersion spectrocopy. Further CCD images were made by Raga & Mateo (1988b), who resolved the width of the jet knots. Bührke, Mundt, Ray (1988) used CCD images and medium-dispersion spectroscopy for their study, in which they also pointed out a counter-bow shock, HH 34-North, placed symmetrically to HH 34 on the other side of the source. Very high resolution images were discussed by Raga, Mundt, Ray (1991). Further CCD images are discussed by Eislöffel & Mundt (1997) and Devine et al. (1997). Ray et al. (1996) discuss brief HST exposures. The existence of multiple bow shocks in the blue lobe of the HH 34 flow was discussed by Reipurth & Heathcote (1992), pointing to eruptive events in the driving source. Cohen & Jones (1987) drew attention to the extremely low Hα/[SII] ratio of the jet. High-resolution long-slit spectroscopy was presented of the entire approaching lobe of the HH 34 system by Heathcote & Reipurth (1992), and Fabry-Perot observations of the HH 34 bow shock and jet were analyzed by Morse et al. (1992, 1993b). Further long-slit spectroscopy of the HH 34 jet is analyzed by Bacciotti & Eislöffel (1999). Proper motion studies were discussed by Heathcote & Reipurth (1992), and Eislöffel & Mundt (1992). The optical polarization study of Scarrott (1988b) showed the reflection nebulae in the blue lobe to be illuminated by the source. Stapelfeldt et al. (1991) noted that neither the HH 34 bow shocks nor the HH 34 jet emit in the infrared molecular hydrogen lines, but the jet was mapped in the 1.644 μm line of [FeII]. With deeper H_2 images, Stanke, McCaughrean, Zinnecker (1998) detected a few knots in the jet plus a new infrared counter bow shock. Zealey, Suters, Randall (1993) and Moneti & Reipurth (1995) present broadband infrared images of the region. The driving source of the HH 34 complex was identified by Reipurth et al. (1986), who gave optical/infrared photometry and showed a red spectrum. Cohen et al. (1984) detected the source at 100 μm, Cohen & Schwartz (1987) derived a luminosity of 45 $L_\odot$ from IRAS data, and Reipurth et al. (1993a) detected the cold dust around the source at 1300 μm. Further sub-millimeter photometry is given by Dent, Matthew, Ward-Thompson (1998). The source was also detected with the VLA at 3.6 cm by Rodríguez & Reipurth (1996). Mm-observations of various molecular species are discussed by Reipurth et al. (1986), Anglada et al. (1989), Cernicharo (1990), Rudolph

& Welch (1992), Stapelfeldt & Scoville (1993) and Davis & Dent (1993). VLA observations of ammonia are discussed by Anglada et al. (1995). A weak molecular outflow is detected by Chernin & Masson (1995). The mass loss rate in the jet is estimated by Hartigan, Morse, Raymond (1994), and Bacciotti, Chiuderi, Oliva (1995) interpret available observations. Raga & Noriega-Crespo (1998) present a variable velocity jet model that is fitted to observations of the jet. From a large-field CCD imaging study, Bally & Devine (1994) have suggested that the HH 34 complex is much larger than previously thought, including HH 173 and HH 86/87/88 in the blue lobe, and HH 126, HH 85 and HH 33/40 in the red lobe. Devine et al. (1997) confirmed this with a detailed radial velocity and proper motion study. Also, Eislöffel & Mundt (1997) present CCD images that support the Bally & Devine (1994) scenario.

HH 35 *(5 33, −06 43).* Herbig (1974) found this small elongated object and suggested it originates in V380 Ori. CCD images are presented by Strom et al. (1986) and Corcoran & Ray (1995); the latter study also includes spectroscopy. The Herbig Ae/Be star V380 Ori is discussed in detail by Herbig (1960); see also Cohen & Kuhi (1979), Finkenzeller & Mundt (1984) and Shevchenko (1994). The star is surrounded by a large reflection nebula (e.g. Brück 1974). Edwards & Snell (1984), Levreault (1988) and Morgan et al. (1991) discuss high velocity gas around the star. A companion to V380 Ori was found with a separation of 0.17 arcsec by Leinert et al. (1994). The mass loss rate from infrared lines is derived by Nisini et al. (1995). For further references to V380 Ori see Herbig (1960) and Herbig & Bell (1988). See also notes on HH 130 and HH 148.

HH 36 *(5 34, −06 46).* Original paper: Herbig (1974). A small chain of HH knots south-east of the HH 1/2 and V380 region. Corcoran & Ray (1995) present CCD images, and suggest that V851 Ori may be the driving source.

HH 37 *(5 43, −00 06).* Original paper: Strom et al. (1986), who present CCD images. This is a single HH object in the little group of HH objects HH 20, 21 and 70 in the NGC 2068 region. It is no.37 of the list of Strom et al. (1986), their Table 18. The nature of the nearby objects 18-42 and 18-43 of Strom et al. (1986) is unclear. All objects are seen on the CCD images of Reipurth & Graham (1988). Based on wide-field CCD images, Eislöffel & Mundt (1997) suggest that HH 37 may be part of a giant bow shock (including HH 20/21 and HH 70) which originates in HH 24.

HH 38 *(5 35, −07 13).* Originally found by Haro (see Herbig 1974). Also see notes for HH 43, which together with HH 38 forms a large HH flow driven by HH 43 IRS1 = IRAS 05357−0710.

HH 39 *(6 36, +08 54).* Original papers: Herbig (1968,1974). This is a small cluster of knots forming a bow shock in a flow from R Mon. *Structure and CCD Imaging:* Jones & Herbig (1982), Brugel, Mundt, Bührke (1984), Walsh & Malin (1985), Mundt, Brugel, Bührke (1987), Schwartz & Schultz (1992). *Spectroscopy:* Brugel, Mundt, Bührke (1984), Walsh & Malin (1985). *Proper Motions:* Jones & Herbig (1982). *Source:* R Mon and its reflection nebula NGC 2261 has been extensively studied by many authors, and the following is only a partial list of the literature: Hubble (1916), Knox-Shaw (1916), Herbig (1960, 1968), Brück (1974), Stockton, Chesley, Chesley (1975), Böhm, Siegmund, Schwartz (1976b), Greenstein et al. (1976,1979), Harvey, Thronson, Gatley (1979), Bellingham & Rossano (1980), Gething et al. (1982), Cohen & Schwartz (1983), Persson et al. (1984), Aspin, McLean, Coyne (1985), Cohen, Harvey, Schwartz (1985), Edwards et al. (1987), Warren-Smith, Draper, Scarrott (1987), Menard, Bastien, Robert (1988), Lightfoot (1989), Scarrott, Draper, Warren-Smith (1989), Yamashita et al. (1989b), Hodapp (1990), Natta et al. (1993), Kelly, Rieke, Campbell (1994), Hodapp (1994), Mannings (1994), Hamann et al. (1994), Nisini et al. (1995), Close et al. (1997b), Corcoran & Ray (1997), Matsumura, Seki, Kawabata (1999). *Mm Data:* Cantó et al. (1981), Beckwith et al. (1984,1986), Sargent & Beckwith (1987).

HH 40 *(5 32, -06 20).* See notes for HH 33.

HH 41/42 *(5 33, −05 05).* Original paper: Haro (1953). The little-studied objects, HH 41 and 42, form, together with HH 128 and 129, a small cluster of HH objects in the NGC 1976/77 region. Photographic plates of the region are presented by Schwartz (1977a), Reipurth (1985a) and Ogura & Walsh (1991). Reipurth, Bally, Devine (1997) present CCD images. Optical spectroscopy of HH 42 is given by Schwartz et al. (1995). Infrared observations are discussed by Schwartz, Cohen, Williams (1987), Cohen et al. (1988), Schwartz et al. (1995) and Schwartz, Burton, Herrman (1997). It is suggested by Reipurth, Bally, Devine (1997) that HH 41/42 together with HH 128/129 forms the eastern lobe of a giant bipolar outflow driven by IRAS 05329–0505; this source drives the HH 294 jet, and the western lobe contains HH 295.

HH 43 *(5 35, −07 11).* Original paper: Haro (1953). *Structure and CCD Images:* Herbig (1974), Strom et al. (1986), Schwartz et al. (1988), Eislöffel & Mundt (1997). *Optical Spectra:* Herbig (1957), Strom, Grasdalen, Strom (1974), Dopita (1978a), Cohen & Schmidt (1981), Dopita, Binette, Schwartz (1982), Böhm, Brugel, Olmsted (1983), Schwartz, Dopita, Cohen (1985), Böhm & Solf (1990), Beck-Winchatz & Böhm (1994), Beck-Winchatz, Böhm, Noriega-Crespo (1996), Schwartz & Greene (1999). *Infrared Observations:* Schwartz, Cohen, Williams (1987), Schwartz et al. (1988), Cohen et al. (1988), Zinnecker et al. (1989), Gredel (1994), Schwartz et al. (1995), Schwartz & Greene (1999). *Ultraviolet Observations:* Schwartz (1983a), Schwartz, Dopita, Cohen (1985), Lee et al. (1988), Böhm, Scott, Solf (1991), Moro-Martin et al. (1996). *Polarization:* Cohen & Schmidt (1981). *Source:* Cohen & Schwartz (1980, 1983, 1987), Cohen et al. (1984a), Cohen, Harvey, Schwartz (1985), Schwartz et al. (1988), Strom et al. (1989), Reipurth et al. (1993a), Molinari, Liseau, Lorenzetti (1993), Dent, Matthew, Ward-Thompson (1998). The source is a binary star (Gredel 1994, Moneti & Reipurth 1995). *Model calculations:* Indebetouw & Noriega-Crespo (1995) calculate various shock parameters. *Mm Data:* Loren, Evans, Knapp (1979), and Anglada et al. (1989).

HH 44 *(5 32, −05 12).* Discovered by Schwartz (1977a). Located close to the OMC-2 region.

HH 45 *(5 33, −04 52).* Discovered by Schwartz (1977a). CCD images and spectroscopy by Reipurth (1989b). It has a strong morphological resemblance to a bow shock facing away from the OMC 3 region, where a number of class 0/I sources are located (Chini et al. 1997a).

HH 46/47 *(8 24, −50 50).* Discovered by Schwartz (1977a,b). This is a major bipolar highly collimated Herbig-Haro jet with several bow shocks and emanating from an infrared source embedded in the Bok globule ESO 210-6A (= Sa 111 = DC 267.4-7.5). The globule is part of the system of cometary globules in the Gum Nebula (Reipurth 1983). *Structure and CCD imaging:* Bok (1978), Dopita (1978b), Dopita, Schwartz, Evans (1982), Graham & Elias (1983), Raga & Mateo (1987, 1988a), Hartigan, Raymond, Meaburn (1990), Reipurth & Heathcote (1991), Hartigan et al. (1993), Eislöffel & Mundt (1994), Heathcote et al. (1996). *Optical spectroscopy:* Dopita (1978a,b), Dopita, Schwartz, Evans (1982), Dopita, Binette, Schwartz (1982), Graham & Elias (1983), Meaburn & Dyson (1987), Hartigan, Raymond, Meaburn (1990), Reipurth & Heathcote (1992), Hartigan et al. (1993), Bacciotti & Eislöffel (1999), Hartigan et al. (1999). *Ultraviolet spectroscopy:* Schwartz (1983), Lee et al. (1988), Böhm, Scott, Solf (1991), Moro-Martin et al. (1996), Hartigan et al. (1999). *Infrared observations:* Elias (1980), Graham & Elias (1983), Graham & Heyer (1989), Wilking et al. (1990), Zealey, Suters, Randall (1993), Eislöffel et al. (1994), Curiel et al. (1995), Micono et al. (1998). *Proper motions:* Schwartz, Jones, Sirk (1984), Eislöffel & Mundt (1994), Micono et al.

(1998). *Reflection nebula:* Graham (1987), Scarrott & Warren-Smith (1988). *Molecular outflow:* Chernin & Masson (1991), Olberg, Reipurth, Booth (1989, 1992), Codella, Bachiller, Reipurth (1999). *Source:* Elias et al. (1982), Graham & Elias (1983), Cohen et al. (1984b), Emerson et al. (1984), Cohen, Dopita, Schwartz (1986b), Graham & Heyer(1989), Sahu, Sahu, Pottasch (1989), Reipurth & Heathcote (1991), Reipurth et al. (1993a), Molinari, Liseau, Lorenzetti (1993), Dent, Matthew, Ward-Thompson (1998). *Globule:* Kuiper et al. (1987), Hodapp (1987), Sahu, Sahu, Pottasch (1989), Olberg, Reipurth, Booth (1992). *Shock structure and modelling:* Hartigan (1989), Raga et al. (1990), Hartigan, Raymond, Meaburn (1990), Morse et al. (1994), Raymond et al. (1994), Hartigan, Morse, Raymond (1994).

HH 48 *(11 03, −77 01).* Discovered by Schwartz (1977a). The object, which consists of two knots, coincides with an infrared source (Elias 1980) and a weak IRAS source 11030-7702 (Cohen & Schwartz 1987). The source may be a faint T Tauri star (Cohen, Dopita, Schwartz 1986b). No proper motion was found by Schwartz, Jones, Sirk (1984).

HH 49/50 *(11 04, −77 17).* Discovered by Schwartz (1977a). The two closely associated objects are located in a high extinction region of the Cha I clouds, and are illustrated by Schwartz, Jones, Sirk (1984), who find a very large and similar proper motion for the two objects. Schwartz & Dopita (1980) have obtained spectrophotometric data. Combining radial velocities and proper motions show a space motion close to the plane of the sky. Cohen & Schwartz (1987) suggest a low-luminosity far-infrared source IRAS 11054–7706C, on the axis of the proper motion vectors, as the energy source. Prusti et al. (1991) show this source to be multiple, and identifies one of them, Ced 110-IRS4, as the energy source. It was detected at 1300 μm by Reipurth et al. (1993a), and has a weak molecular outflow (Mattila, Liljeström, Toriseva 1989). A 1300 μm map by Reipurth, Nyman, Chini (1996) reveals a compact mm continuum source just south of the sources detected by IRAS, and this new object is a plausible driving source. Whittet et al. (1997) determine a distance for Cha I of 160 pc.

HH 51 *(11 08, -76 08).* Discovered by Schwartz (1977a). Very faint object north of the Cha I clouds. Schwartz, Jones, Sirk (1984) speculate that it is a counterflow to HH 49/50.

HH 52/53/54 *(12 52, −76 41).* Discovered by Schwartz (1977a). The objects may form a giant fractured bow shock driven by an embedded source IRAS 12496–7650 located fourteen arcmin to the south-west. The source has a faint optical counterpart with the small HH 274 object on the side towards the HH objects (Reipurth, unpublished). *Structure and CCD images:* Schwartz (1977a), Schwartz, Jones, Sirk (1984), Sandell et al. (1987), Graham and Heyer (1988). *Optical spectroscopy:* Schwartz & Dopita (1980), Graham & Hartigan (1988). *Infrared observations:* Elias (1980), Sandell et al. (1987), Zealey, Suters, Randall (1993), Gredel (1994). *ISO observations:* Liseau et al. (1996b), Nisini et al. (1996), Neufeld, Melnick, Harwit (1998). *Source:* Cohen & Schwartz (1987), Hughes et al. (1989, 1991), Reipurth et al. (1993a), Molinari, Liseau, Lorenzetti (1993), Henning et al. (1998). *Mm observations:* Knee (1992). Whittet et al. (1997) determine a distance for Cha II of 178 pc.

HH 55 *(15 53, −37 42).* Discovered by Schwartz (1977a). The object consists of a compact knot surrounded by a faint envelope (Heyer & Graham 1990) centered in a 90 arcsec long very faint bipolar jet (Graham & Chen 1994). Spectra are presented by Krautter, Reipurth, Eichendorf (1984), Cohen, Dopita, Schwartz (1986b), and Heyer & Graham (1990). The HH object is coincident with a faint IRAS source 15533–3742 (Cohen & Schwartz 1987), which appears to be a T Tauri star (Cohen, Dopita, Schwartz 1986b, Heyer &

Graham 1990).

HH 56 *(16 28, −44 48)*. Discovered by Schwartz (1977a). It is a bright bow shock in a bipolar collimated outflow (Reipurth et al. 1997a). Optical spectra are presented by Schwartz & Dopita (1980), Wilking et al. (1990) detected it in molecular hydrogen emission, and Gredel (1994) obtained infrared spectra. Schwartz, Jones, Sirk (1984) attempted a proper motion determination. A little reflection nebula, Re 13, is illuminated by the energy source (Reipurth 1981), which is detected in the infrared (Prusti et al. 1993) and at 1.3 mm (Reipurth et al. 1993a). Spectra of Re 13 show Hα emission (Alvarez et al. 1986), Cohen, Dopita, Schwartz 1986a). Mm observations are presented by Alvarez et al. (1986), and a molecular outflow has been mapped by Evans et al. (1994) and Reipurth et al. (1997a). SiO emission has been detected by Codella, Bachiller, Reipurth (1999).

HH 57 *(16 28, −44 49)*. Discovered by Schwartz (1977a). This is a small Herbig-Haro knot, studied spectroscopically by Schwartz & Dopita (1980). CCD images are shown by Graham & Frogel (1985), Reipurth (1985c), and Reipurth et al. (1997a). A proper motion determination was attempted by Schwartz, Jones, Sirk (1984). The energy source is a bright near- and far-infrared (IRAS 16289–4449) source (Elias 1980, Reipurth & Wamsteker 1983, Cohen et al. 1984b, 1985, Cohen & Schwartz 1987, Prusti et al. 1993). Near-infrared photometry is summarized by Molinari, Liseau, Lorenzetti (1993) and Reipurth et al. (1997a). Graham (1983) announced that a visible star had appeared at the source, which was identified as an FU Orionis object by Graham & Frogel (1985) and Reipurth (1985c). A weak stellar absorption spectrum was seen by Cohen, Dopita, Schwartz (1986a). The star is partly embedded and surrounded by a reflection nebula (Graham & Frogel 1985, Reipurth 1985c, Scarrott, Gledhill, Warren-Smith 1987). Circumstellar dust has been detected at sub-mm wavelengths by Weintraub, Sandell, Duncan (1991) and Reipurth et al. (1993a). The 3 μm water ice band was detected by Graham & Chen (1991), and further studied by Graham (1998). Mm observations are presented by Alvarez et al. (1986), and a molecular outflow has been mapped by Evans et al. (1994) and Reipurth et al. (1997a). SiO emission has been detected by Codella, Bachiller, Reipurth (1999).

HH 58 *(5 28, −04 11)*. Original paper: Reipurth & Graham (1988), where a CCD image is shown. The object consists of a northern and a southern group of knots. Cohen (1990) suggests that IRAS 05283–0412 could be a possible energy source.

HH 59 *(5 29, −06 31)*. Original paper: Reipurth & Graham (1988), where a CCD image is shown. The object is large and amorphous and located in the eastern outskirts of the L1641 complex.

HH 60 *(5 30, −06 28)*. Original paper: Reipurth & Graham (1988), where a CCD image is shown. The object is a curved diffuse emission nebula only 5 arcmin NE of HH 59, and they may be related.

HH 61/62 *(5 33, −07 10)*. Original paper: Reipurth & Graham (1988), where CCD images are presented. The two objects are situated on a north-south line with a separation of 4 arcmin, and are most likely related. HH 61 has a diffuse bow shape, while HH 62 consists of a little cluster of knots. Ogura & Walsh (1991) show a photographic plate of the region (note that their knot D is incorrectly identified), and present spectroscopy of HH 61. Cohen (1990) suggests that IRAS 05339–0708C could be a possible energy source for HH 61, but Reipurth, Devine, Bally (1998) believe the object is part of a giant HH flow from the L1641-N region.

HH 63 *(5 34, −04 27)*. Original paper: Reipurth & Graham (1988), where a CCD image is given. It is a small group of moderately bright HH knots embedded in a faint bow shaped nebula. Located next to the emission line binary star P2441.

HH 64 *(5 35, −07 07).* Original paper: Reipurth & Graham (1988), where a CCD image is shown. It consists of two faint closely attached knots, and is located in the same region of L1641 as HH 38 and HH 43. Cohen (1990) suggests that IRAS 05355–0709C could be a possible energy source. Anglada et al. (1989) has detected a dense ammonia condensation, which they suggest may contain an energy source.

HH 65 *(5 37, −07 26).* Original paper: Reipurth & Graham (1988), where a CCD image is shown. It is a small faint nebula, located in the red lobe of the molecular outflow driven by Re50 IRS = IRAS 05380–0728 (Reipurth & Bally 1986). The outflow was also found by Fukui et al. (1986) and further studied by Morgan et al. (1991). The source illuminates the large variable reflection nebula Re50 (Reipurth 1985a). An optical polarization study of the Re50 nebula has been done by Scarrott & Wolstencroft (1988), and infrared observations of the source and nebula are presented by Heyer et al. (1990), Casali (1991) and Hodapp (1994). Near-infrared polarimetry is discussed by Colomé, Di Francesco, Harvey (1996). Far-infrared maps are presented by Di Francesco et al. (1998). Strom & Strom (1993) suggest that Re50 IRS is an FU Orionis star. It was detected at 6 cm at the VLA (Morgan, Snell, Strom 1990), at 1300 μm by Reipurth et al. (1993a), and at several sub-mm wavelengths by Zavagno et al. (1997) and Dent, Matthew, Ward-Thompson (1998).

HH 66 *(5 37, −02 04).* Original paper: Reipurth & Graham (1988), where a CCD image is presented. The object consists of two knots, and is located in the HII region IC434 in the western low extinction region of the L1630 cloud.

HH 67 *(5 38, −01 48).* Original paper: Reipurth & Graham (1988), where a CCD image is presented. The object consists of a little chain of compact knots, located in a very opaque area of L1630 at the northwestern edge of NGC 2024. There are several nearby IRAS sources, including IRAS 05386–0149C (Cohen 1990).

HH 68/69 *(5 39, −06 29).* Original paper: Reipurth & Graham (1988), where CCD images are shown. This is a chain of three groups of knots, located with equidistant spacing on a well defined straight line. A faint red star is found underneath the HH 68b knot. HH 68c and HH 69 resemble small bow shocks. The energy source is most probably located on the flow axis somewhere to the NNW of HH 68c and HH 69. Cohen (1990) suggests separate driving sources for HH 68 and HH 69.

HH 70 *(5 43, −00 06).* Original paper: Reipurth & Graham (1988), who show Hα and [SII] CCD images. The object is a small knot among a group of other HH knots, including HH 20 and 21. The region is also discussed by Strom et al. (1986). Based on wide-field CCD images, Eislöffel & Mundt (1997) suggest that HH 70 is part of a giant bow shock, which includes HH 20/21 and HH 37, and originates in HH 24.

HH 71 *(5 44, +00 39).* Original paper: Reipurth & Graham (1988), who show a CCD image. It consists of two closely spaced knots and a faint diffuse tail, and is located in a region active in low-mass star formation. Cohen (1990) discusses several nearby young stars as potential driving sources. See also notes for HH 471-474.

HH 72 *(7 18, −23 56).* Original paper: Reipurth & Graham (1988), who present a large-field Schmidt plate, an Hα CCD image and a low-dispersion spectrum. This is a small chain of HH knots emanating from a bright-rimmed Bok globule, which is illuminated by the young OB cluster NGC 2362. The energy source is the nearby bright class I IRAS source 07180–2356 embedded in the globule. It was detected at 1300 μm by Reipurth et al. (1993a). Cohen (1990) estimates a luminosity of 280 $L_\odot$. The source drives a molecular outflow (Schwartz, Gee, Huang 1988). An H_2O maser was detected by Wouterloot, Brand, Fiegle (1993). Hodapp (1994) presents a wide field K' band image of the region. In a detailed H_2 imaging study, Davis et al. (1997a) found a long, winding and bipolar chain of H_2 knots centered on the IRAS source, of which the three easternmost knots correspond to the optically visible HH objects.

HH 73 *(9 00, −44 39).* Original paper: Reipurth & Graham (1988), who present CCD images. This is a 29 arcsec long, finely collimated HH flow located one arcmin south of a PMS binary illuminating the reflection nebula Re6. It probably belongs to the Vela star forming complex at a distance of about 700 pc (Liseau et al. 1992).

HH 74 *(9 00, −44 37).* Original paper: Reipurth & Graham (1988), who show CCD images. This is a single HH knot located about 20 arcsec north of a PMS binary illuminating the reflection nebula Re6, which could be the energy source.

HH 75 *(9 09, −45 30).* Original paper: Reipurth & Graham (1988), who present a CCD image and a low-dispersion spectrum. This is a large complex of many rather bright HH knots. It probably is part of the Vela star forming complex (Liseau et al. 1992). Cohen (1990) suggests that IRAS 09094–4522 could be the energy source.

HH 76 *(14 56, −62 52).* Original paper: Reipurth & Graham (1988), who show a CCD image. This object consists of two compact HH knots with sub-structure. They are lying on a line through the nearby IRAS source 14563–6250, which is most probably the energy source (Cohen 1990). It was detected in the 1300 μm survey of Reipurth et al. (1993a). The distance of 1 kpc is very uncertain. Bally et al. (1999) present a millimeter study of the Circinus cloud complex.

HH 77 *(14 56, −62 55).* Original paper: Reipurth & Graham (1988), who show CCD images. This is a small curved object located in a region of nebulous stars and several IRAS sources. Cohen (1990) suggests IRAS 14564–6253 as the energy source. Bally et al. (1999) present a millimeter study of the Circinus cloud complex.

HH 78 *(16 05, −38 57).* Original paper: Reipurth & Graham (1988), where a CCD image and a low-dispersion spectrum are presented. It is a faint knot with a diffuse tail, located in a region with many Hα emission stars in the Lupus 3 association. Graham & Heyer (1988) point out that HH 78 lies close to the axis of the HH 228 (= Th28) jet complex.

HH 79 *(16 23, −24 13).* Original paper: Reipurth & Graham (1988), who present a large-scale photographic plate. It is located in the dense region of the ρ Ophiuchi cloud core, which is very active in star formation. It is a small, highly structured object. Two embedded sources are found nearby, GSS 39 and Source 1. Wilking et al. (1997a) show it on a wide-field CCD image, and Gómez, Whitney, Wood (1998) find another HH knot, HH 79b, nearby.

HH 80/81 *(18 16, −20 53).* Original paper: Reipurth & Graham (1988), who present a CCD image and low-dispersion spectra. HH 80 has a bright core and is associated with a cluster of HH knots, whereas HH 81 is more isolated. Both HH 80 and 81 belong among the brightest HH objects in the sky, and at an assumed distance of 1700 pc they are the intrinsically most luminous HH objects known. Heathcote, Reipurth, Raga (1998) present detailed CCD images, both groundbased and from HST, high-resolution spectroscopy and a proper motion study. A line drawn through the objects intersects the 16000 $L_\odot$ embedded IRAS source 18162–2048, which is the driving source. Rodríguez et al. (1980) detected a compact HII region there, as well as OH and H_2O masers, and the source was detected at 1300 μm by Reipurth et al. (1993a). Rodríguez & Reipurth (1989) detected both HH objects in radio continuum and found the source to be elongated towards the HH objects. Higher resolution observations at 6 cm and 3.6 cm by Martí, Rodríguez, Reipurth (1993) revealed a highly collimated bipolar radio continuum jet emanating from the source. Large proper motions and ejection of new knots in the radio jet were reported by Martí, Rodríguez, Reipurth (1995, 1998). On the opposite side of the source with respect to HH 80/81 they found a resolved object, HH 80-North, with the same negative spectral index as HH 80 and 81. Ammonia was found downstream from HH 80-North by Girart et al. (1994), and this region was studied further in HCO^+ and ^{13}CO by Girart, Estalella, Ho (1998). Gómez, Rodríguez, Martí (1995) conclude that the thermal jet and the nearby H_2O maser are driven by different sources. Next to the source there is a small nebula, GGD 27 (Gyulbudaghian, Glushkov, Denisyuk 1978), which was shown to be a reflection nebula by Hartigan & Lada (1985). Yamashita et al. (1987a) found a large infrared reflection nebula, coincident with a large molecular outflow (Yamashita et al. 1989a). A dense CS disk was found around the HH driving source perpendicular to the outflow direction by Yamashita et al. (1990). Aperture synthesis observations by Yamashita et al. (1991) revealed three unresolved peaks. Aspin et al. (1991) performed near-infrared imaging and spectroscopy of the source region, and Aspin & Geballe (1992) did mid-infrared spectroscopy, finding evidence for a cluster of sources. Aspin (1994) found extended infrared CO emission around the source. Aspin et al. (1994) detected the source with 4.7 μm imaging. Stecklum et al. (1997) present high resolution imaging at several infrared wavelengths. McCutcheon et al. (1995) present maps at 450, 800 and 1100 μm, and Chini et al. (1997b) at 1300 μm. Greaves, Holland, Ward-Thompson (1997) present 800 μm polarimetry of the source.

HH 82 *(18 57, −37 01)*. Original papers: Strom et al. (1986) and Reipurth & Graham (1988), both of which present CCD images. Two groups of HH knots are found on a line straight east of S CrA. This star is a close visual binary (Joy & van Biesbrock 1944) and Strom et al. (1986) suspect that the fainter companion may be the driving source. S CrA has been studied spectroscopically in detail (e.g. Bertout et al. 1982, Appenzeller, Jankovics, Östreicher 1984, Appenzeller, Jankovics, Jetter 1986 and references therein). Najita, Carr, Tokunaga (1996) and Prato & Simon (1997) present a Brγ spectrum of S CrA. Photometric variability is discussed by Bellingham & Rossano (1980). The star is detected in X-rays by Carkner, Kozak, Feigelson (1998).

HH 83 *(5 31, −06 31)*. Original papers: Reipurth (1985a,1989b). This is a well collimated jet with a bow shock, a counterflow and a bright infrared source (IRAS 05311–0631), which is associated with a reflection nebula, where the jet breaks out of the cloud. Designations of knots are defined by Reipurth (1989b). Spectroscopic observations are presented by Reipurth (1989b) and Ogura & Walsh (1991). CCD images are discussed by Reipurth (1989b) and Mundt, Ray, Raga (1991). The source was observed in the near-infrared by Reipurth (1989b) and Moneti & Reipurth (1995), at 1300 μm by Reipurth et al. (1993a) and at other sub-millimeter wavelengths by Dent, Matthew, Ward-Thompson (1998), and was detected at 3.6 cm by Rodríguez & Reipurth (1998). A polarization study of the reflection nebula was done by Rolph, Scarrott, Wolstencroft (1990). Mm-observations are discussed by Bally, Castets, Duvert (1994), Nakano et al. (1994), Miesch & Bally (1994), and Anglada, Sepúlveda, Gómez (1997). See also notes for HH 84.

HH 84 *(5 31, −06 35)*. Original papers: Reipurth (1985a,1989b). This is a large chain of relatively bright HH knots in a small cloud at the edge of the L1641 complex. The CCD image of Reipurth (1989b) shows a multitude of knots on a fairly well defined line, suggesting it could be a jet, but no energy source has been found. Low-dispersion spectra are given by Reipurth (1989b). A search for ^{12}CO wings was done by Morgan et al. (1991). Anglada, Sepúlveda, Gómez (1997) detect a nearby ammonia core. Reipurth, Bally, Devine (1997) suggest that HH 84 forms a large distant bow shock in the HH 83 flow.

HH 85 *(5 32, −06 22).* Original papers: Reipurth (1985a,1989b). The CCD image of Reipurth (1989b) shows a long chain of knots, which resembles a finely collimated jet. Bally & Devine (1994), however, suggest it is part of a large bow shock in the red lobe of the HH 34 flow, and this has been confirmed in a kinematic study by Devine et al. (1997). Low dispersion spectra are presented by Reipurth (1989b). The positions listed by Reipurth (1989b) for HH 85 are in error, and are corrected in Bally & Devine (1994).

HH 86/87/88 *(5 33, −06 39).* Original papers: Reipurth (1985a,1989b). The CCD image of Reipurth (1989b) shows the three objects to be closely associated and have complex sub-structure. Bally & Devine (1994) suggest that they form a southern bow shock of the HH 34 complex, to which HH 33/40 is the equivalent northern counterpart in this major outflow region. This has been confirmed in a kinematic study by Devine et al. (1997). Low-dispersion spectra are given by Reipurth (1989b). Stanke, McCaughrean, Zinnecker (1998) detect the objects at 2.12 μm (SMZ 26A,B). Anglada, Sepúlveda, Gómez (1997) map a nearby ammonia core.

HH 89 *(5 35, −06 47).* Original paper: Reipurth (1985a). This object consists of two HH knots and a reflection nebula. Moneti & Reipurth (1995) found a near-infrared source next to the reflection nebula.

HH 90/91 *(5 39, −01 15).* Original paper: Reipurth (1985a). A detailed optical/infrared/mm study is presented by Gredel, Reipurth, Heathcote (1992). HH 90 is a large outlying bow shock, whereas HH 91 consists of several oppositely facing bow shocks moving away from a central emission region, which may contain a faint near-infrared source. The central part of HH 91 is very intense in near-infrared H_2 emission. A K-band image is shown by Moneti & Reipurth (1995), and H_2 images are presented by Davis, Mundt, Eislöffel (1994). Smith (1994) interprets the near-infrared spectra in terms of a J-shock.

HH 92 *(5 39, −01 19).* Original paper: Reipurth (1985a). CCD images show this to be a little chain of faint HH knots in the L1630 cloud (Reipurth, unpublished).

HH 93 *(5 40, −01 27).* Original paper: Reipurth (1985a). CCD images show this to be a little group of faint HH knots (Reipurth, unpublished).

HH 94/95 *(5 41, −02 37).* Original papers: Reipurth (1985a,1989b). CCD images and low-dispersion spectra are given by Reipurth (1989b), who suggested that HH 94 is a bent HH jet. This idea no longer appears tenable. Rather, HH 94 and HH 95 are probably bow shocks in a large bipolar outflow. Curiel et al. (1989a) found a radio continuum source located precisely mid-way between the two HH objects, which is a likely energy source.

HH 96/97/98 *(18 58, −37 04).* Original paper: Hartigan & Graham (1987), who show a large-scale photographic plate and obtained spectra. HH 96 and 97 are small HH knots on the line between HH 100 and HH 101 and they are, like these objects, blueshifted. HH 98 is on the same line, but on the opposite side of the source. See also notes for HH 100.

HH 99 *(18 58, −36 59).* Original paper: Cohen et al. (1984b). Two small knots in the HH 100 flow in the red north-eastern lobe. Proper motions by Schwartz, Jones, Sirk (1984) suggest an origin near HH 100 IRS. Spectroscopy by Hartigan & Graham (1987). Molecular hydrogen emission detected by Wilking et al.

(1990), and infrared spectra obtained by Gredel (1994). Infrared H_2 and [FeII] images are presented by Wilking et al. (1997b) who suggest that HH 99 may be driven by IRS 9. See also notes for HH 100.

HH 100 *(18 58, −37 02).* Original papers: Strom, Strom, Grasdalen (1974), Strom, Grasdalen, Strom (1974). This is an HH object surrounded by a large highly structured reflection nebula, seen in the plates and CCD images of Hartigan & Lada (1985), Strom et al. (1986), and Hartigan & Graham (1987). Polarization measurements of the reflection nebula have been done by Vrba, Strom, Strom (1975) and Scarrott et al. (1987), and Graham (1993) reports changes in its morphology. Spectroscopy is discussed by Strom, Grasdalen, Strom (1974). A large molecular outflow was mapped by Levreault (1988) and Anderson et al. (1997), and Loren (1979), Anglada et al. (1989) and Harju et al. (1993) mapped various molecular species in the region. The energy source, HH 100 IRS, was discovered by Strom, Strom, Grasdalen (1974) and Glass & Penston (1975); it is highly variable (Axon et al. 1982, Reipurth & Wamsteker 1983, (see Molinari, Liseau, Lorenzetti 1993 for a summary of infrared observations), and was detected in the far-infrared by Cohen et al. (1984b), in the radio continuum at 6 cm by Brown (1987), and at 1300 μm by Reipurth et al. (1993a). Spectroscopy of the reflection nebula shows the source to be an active T Tauri star (Cohen, Dopita, Schwartz 1986b). Near-infrared spectroscopy is given by Greene & Lada (1996b). Strong 3 μm water-ice absorption has been observed towards the source (Whittet & Blades 1980, Graham & Chen 1991, Chen & Graham 1993, Tanaka et al. 1994, Graham 1998). Other absorption features are discussed by Whittet et al. (1996) and Chiar et al. (1998). A dust model for HH 100 IRS is presented by Siebenmorgen & Gredel (1997).

HH 101 *(18 58, −37 07).* Discovered by Strom, Grasdalen, Strom (1974). This is a large bow shock in the blue lobe of the HH 100 flow. Structure and CCD images are discussed by Morgan et al. (1984), Hartigan & Lada (1985), Reipurth (1985c), Strom et al. (1986), Hartigan & Graham (1987). Proper motions are directed away from the driving source HH 100 IRS (Schwartz, Jones, Sirk 1984). Spectroscopy is analyzed by Strom, Grasdalen, Strom (1974), Dopita (1978a) and Schwartz (1981). H_2 emission was detected by Brown et al. (1983), and HH 101 was also detected in the radio continuum at 6 cm (Brown 1987). The bow shock nature of HH 101 is discussed by Hartigan (1989).

HH 102 *(4 28, +18 00).* Original paper: Strom, Grasdalen, Strom (1974). This is not an HH object, but a large amorphous reflection nebula illuminated by the L1551 IRS 5 source. It is further discussed by e.g. Cudworth & Herbig (1979), Draper, Warren-Smith, Scarrott (1985b) and Graham & Heyer (1990).

HH 103 *(21 41, +65 49).* Original paper: Strom, Grasdalen, Strom (1974). This is the brightest HH object in the very complex star forming region around NGC 7129, which is rich in HH objects. It is a large C-shaped object connected to HH 232 (formerly GGD 32) with faint knots and filamentary emission (Eiroa, Gómez de Castro, Miranda 1992). CCD images are shown by Hartigan & Lada (1985), Strom et al (1986), Eiroa, Gómez de Castro, Miranda (1992), and Goodrich (1993). Spectra are discussed by Strom, Grasdalen, Strom (1974), Cohen & Fuller (1985) and Magakyan et al. (1994). Proper motion is measured by Ray et al. (1990). King & Scarrott (1981) did not measure any polarization in the object. Wilking et al. (1990) detected H_2 in HH 103. Cohen & Schwartz (1983) did an infrared search for an energy source. Further references on the NGC 7129 region are given in the notes to the HH 167 jet.

HH 104 *(18 58, −37 01).* Original papers: Schwartz, Jones, Sirk (1984) and Graham (1993). This HH flow contains four HH knots located pair-wise and symmetrically on a straight line through R CrA. HH 104A,B form the eastern lobe (Schwartz, Jones, Sirk 1984, Strom et al. 1986, Hartigan & Graham 1987), and HH 104C,D form the western lobe (Graham 1993). The latter reference gives astrometry of all four objects.

HH 104A was detected in molecular hydrogen by Wilking et al. (1990), and Wilking et al. (1997b) present infrared H_2 and [FeII] images. A molecular outflow was mapped by Levreault (1988) and Anderson et al. (1997). R CrA is a Herbig Ae/Be star (e.g. Herbig 1960), and is surrounded by a large reflection nebula (e.g. Graham & Phillips 1987, Graham 1989) and is located in a large cloud core (e.g. Harju et al. 1993). Far-infrared photometry is reported by Cruz-Gonzalez, McBreen, Fazio (1984). Further references to observations of R CrA is given in Herbig & Bell (1988).

HH 105 *(21 42, +65 54).* Original paper: Hartigan & Lada (1985). This is a faint HH object in the NGC 7129 region. CCD images are presented by Hartigan & Lada (1985), Strom et al. (1986), Ray (1987), Eiroa, Gómez de Castro, Miranda (1992), and Goodrich (1993). Spectroscopy is discussed by Magakyan & Movsesyan (1997a). The object was detected in H_2 by Wilking et al. (1990). Cohen & Schwartz (1983) did an infrared search for an energy source.

HH 106/107 *(18 27, +01 18).* Original paper: Reipurth & Eiroa (1992), who present CCD images. HH 106 has a bow shock morphology. Gredel (1994) did infrared spectroscopy. HH 107 is larger and brighter and has a complex structure. In a dense cloud region in between the two objects one finds the faint Hα emission star ESO Hα 279 (= IRAS 18269+0116), which is the presumed energy source. It was detected at 1300 μm by Reipurth et al. (1993a), and has been studied in detail at optical and infrared wavelengths by Aspin, Reipurth, Lehmann (1994). Additional CCD images are presented by Davis et al. (1999) and Ziener & Eislöffel (1999). For references to star formation in Serpens see notes for HH 455.

HH 108/109 *(18 33, −00 37).* Original paper: Reipurth & Eiroa (1992), who present CCD images. The HH objects are only an arcminute apart and are lying on a line through the nearby IRAS source 18331–0035, which was detected at 1300 μm by Reipurth et al. (1993a). Chini et al. (1997b) mapped the region at 1300 μm, and detected the IRAS source plus a nearby sub-mm continuum source, either of which could be the driving source.

HH 110 *(5 48, +02 54).* Original reference: Reipurth & Olberg (1991). This is a major collimated HH flow, with a rich sub-structure of knots and a flow-pattern with graceful curves. CCD images, spectroscopy and mm-observations are discussed by Reipurth & Olberg (1991). Davis, Mundt, Eislöffel (1994) and Noriega-Crespo et al. (1996) present infrared H_2 images. Reipurth, Raga, Heathcote (1995) present deep large-field interference-filter CCD images which reveal the presence of another fainter HH flow, HH 270, pointing towards the apex of HH 110. It is argued that HH 110 is the result of a grazing collision of the HH 270 flow with a cloud core. Alternatively, Hurka, Schmid-Burgk, Hardee (1999) consider a deflection by an abient magnetic field. The source of HH 270/110 was detected at 3.6 cm by Rodríguez et al. (1998a). Less than an arcminute west of the apex of HH 110 there is an IRAS source 05487+0255 studied by, among others, Garnavich et al. (1997).

HH 111 *(5 49, +02 47).* Original reference: Reipurth (1989a). This is a major bipolar and highly collimated Herbig-Haro complex with a very fine jet and multiple bow shocks. Various parts of the HH flow have been imaged by Reipurth (1989a), Reipurth, Raga, Heathcote (1992), and Morse et al. (1993a). HST images are analyzed by Reipurth et al. (1997b). Spectra are discussed by Reipurth (1989a), Morse et al. (1993a,b), Noriega-Crespo, Garnavich, Raga (1993) and Reipurth et al. (1997b). High proper motions are found for all parts of the jet complex (Reipurth, Raga, Heathcote 1992), directed away from the energy source HH 111 VLA (= IRAS 05491+0247), which is also detected at 1300 μm (Reipurth et al. 1993a) and at other sub-millimeter wavelengths (Dent, Matthew, Ward-Thompson 1998), and as a 3.6 cm and 2 cm VLA source (Rodríguez & Reipurth 1994, Anglada et al. 1998). A small one-sided radio continuum jet emanates from the VLA source in the direction of the optical HH jet. A near-infrared reflection nebula is slightly displaced from the VLA source. A counter-jet has been found in the optical by Reipurth, Raga, Heathcote (1992) and in the infrared by Gredel & Reipurth (1994) and Davis, Mundt, Eislöffel (1994). Reipurth, Bally, Devine (1997) present wide-field CCD images, which in addition to finding further knots in the counterflow demonstrate that HH 113 and HH 311 are distant bow shocks with proper motions directed away from the HH 111 source; the HH 111 complex thus spans one degree on the sky, corresponding to a physical dimension of 7.7 pc. A major molecular outflow is found along the jet-axis (Reipurth & Olberg 1991). High spatial resolution CO observations by Cernicharo & Reipurth (1996) reveal a well collimated molecular jet in the blue lobe, and the presence of three more distant high-velocity bullets on the jet axis. Mm interferometer data resolve the blue lobe into a tubular cavity (Reipurth & Cernicharo 1995, Nagar et al. 1997, Cernicharo, Neri, Reipurth 1999) Near-infrared images and spectroscopy are discussed by Gredel & Reipurth (1993), who also find a second bipolar infrared jet, HH 121, emanating from the source, suggesting that it is a close binary. Proper motions of the H_2 knots are discussed by Coppin, Davis, Micono (1998). Stapelfeldt & Scoville (1993) find evidence of a circumstellar disk around the source based on ^{13}CO interferometer observations. Yang et al. (1997) detect a disk perpendicular to the jet axis in interferometer observations in CS, which suggest both rotation and infall. Hartigan, Morse, Raymond (1994) estimate the mass loss rate through the jet, and Bacciotti, Chiuderi, Oliva (1995) interpret available observations. Hodapp (1994) shows the whole region in a large-field K′ band image.

HH 112 *(5 49, +02 59)*. Original paper: Reipurth & Olberg (1991), who show a CCD image. It is a group of very faint HH knots.

HH 113 *(5 50, +02 42)*. Original paper: Reipurth & Olberg (1991). A large complex of HH knots, which forms a giant bow shock in the red lobe of the HH 111 flow. Reipurth, Bally, Devine (1997) present CCD images and a proper motion determination. See also notes for HH 111.

HH 114/115 *(5 16, +07 08)*. Original paper: Reipurth, Bally, Devine (1997). This is a very large bipolar HH complex, with a projected extent of 2.5 pc. It is probably driven by the IRAS source 05155+0707, located mid-way between the lobes of the HH flow and an associated molecular outflow, although another close-by class 0 source was detected at 1300 μm by Chini et al. (1997b), which could also be the driving source. Both sources were detected with the VLA at 3.6 cm (Rodríguez & Reipurth 1996). The IRAS source was observed at sub-millimeter wavelengths by Dent, Matthew, Ward-Thompson (1998). See also notes for HH 328 and HH 329.

HH 116 *(5 49, +08 24)*. Original paper: Reipurth, Bally, Heathcote (1999). This is a small HH object located at the edge of the L1598 cloud close to the class I IRAS source 05494+0820. Hodapp (1994) presents a K′ band image of this source. Fukui (1989) reports a molecular outflow in this region.

HH 117/118 *(5 49, +08 09)*. Original paper: Reipurth, Bally, Heathcote (1999). A bipolar HH complex centered on IRAS 05496+0812. Schwartz, Gee, Huang (1988) has reported a molecular outflow from the same source. The IRAS source has been imaged in the K′ band by Hodapp (1994), and was detected at 3.6 cm by Rodríguez & Reipurth (1998).

HH 119 *(19 34, +07 27)*. Original papers: Vrba et al. (1986), Reipurth, Heathcote, Vrba (1992). This is a chain of three little HH objects located on a line through the cold central source of the Bok globule B335, with HH 119A,B in the western red lobe of the associated molecular outflow and HH 119C in the eastern blue lobe, and proper motions in opposite directions away from the source (Reipurth, Heathcote, Vrba 1992). Deep near-infrared images are presented by Hodapp (1998). ISO-LWS spectra were obtained of the HH objects by Nisini et al. (1999). The molecular outflow has been studied by, among others, Frerking & Langer (1982), Goldsmith et al. (1984), Langer, Frerking, Wilson (1986), Davidson (1987), Cabrit, Goldsmith, Snell (1988), Moriarty-Schieven & Snell (1989), Hirano et al. (1988,1992) and Chandler & Sargent (1993). The source B335 IRS (= IRAS 19345+0727) was discovered by Keene et al. (1983), and has been observed at sub-mm wavelengths (e.g. Gee et al. 1985, Davidson 1987, Chandler et al. 1990), at centimeter wavelengths (Anglada et al. 1992,1998), and with far-infrared spectroscopy (Nisini et al. 1999). The globule has been extensively studied at mm-wavelengths by, among others, Menten et al. (1984), Walmsley & Menten (1987), Frerking, Langer, Wilson (1987), Menten et al. (1989), Zhou et al. (1990), Hasegawa, Rogers, Hayashi (1991), Velusamy, Kuiper, Langer (1995), and Murphy, Little, Kelly (1998). Line profiles are modeled as an inside-out collapse by Choi et al. (1995) and Zhou (1995). An H_2O maser has been studied by e.g. Claussen et al. (1996).

HH 120 *(8 07, −35 56).* Original papers: Westerlund (1963), Reipurth (1981). This is a bright low-excitation HH object emanating from one of the cometary globules, CG30, in the Gum Nebula. Pettersson (1984) has presented a detailed study with CCD images and spectroscopy, and he identified the driving source, CG30-IRS4, later detected in the far-infrared (Cohen et al. 1984b) and as an IRAS source (08076–3556, see Cohen & Schwartz 1987). Cohen (1990) presents an IRAS LRS spectrum of the source. It was detected at 1300 μm by Reipurth et al. (1993a) and Persi et al. (1994), and at other sub-millimeter wavelengths by Dent, Matthew, Ward-Thompson (1998). Near-infrared images are shown by Graham & Heyer (1989), Persi et al. (1994), Gredel (1994) and Hodapp & Ladd (1995). Molecular hydrogen emission was detected by Schwartz, Cohen, Williams (1987) and Wilking et al. (1990), and infrared spectra are discussed by Gredel (1994). An optical polarization study was made by Scarrott et al. (1990). Pettersson (1984) and Cohen, Dopita, Schwartz (1986b) studied the stellar continuum via the reflection nebula around the infrared source. Olberg, Reipurth, Booth (1989) mapped the globule in ^{12}CO. The globule is part of a larger complex of globules (Reipurth 1983), which is mapped in ^{12}CO and ^{13}CO by Nielsen et al. (1998), and other star formation has taken place in the vicinity (Pettersson 1987).

HH 121 *(5 49, +02 47).* Original paper: Gredel & Reipurth (1993). This is a small bipolar jet emanating from the HH 111 jet source, at almost right angles to the HH 111 jet, suggesting that the source is a binary. The jet is located in a high extinction region and is only detected in infrared emission lines. Proper motions are discussed by Coppin, Davis, Micono (1998).

HH 122 *(5 52, +01 43).* Original paper: Reipurth & Madsen (1989). This is a small HH flow located in a high extinction region of the L1622 cloud in Orion.

HH 123 *(4 32, −14 19).* Original paper: Reipurth & Heathcote (1990). This is a small amorphous HH object originating in the main component of the PMS binary L1642-2, located in the high galactic latitude cloud L1642. CCD images and spectra by Reipurth & Heathcote (1990). The source is IRAS 04325–1419 (Sandell, Reipurth, Gahm 1987), which was detected at 1300 μm (Reipurth et al. 1993a), and it drives a small molecular outflow (Liljeström, Mattila, Friberg 1989). The cloud has low extinction (Sandell et al. 1981), and its gas and dust has been studied by e.g. Magnani, Blitz, Mundy (1985), Laureijs, Mattila, Schnur (1987) and Liljeström & Mattila (1988).

HH 124 *(6 38, +10 17).* Original paper: Walsh, Ogura, Reipurth (1992). This is a long chain forming a bipolar HH flow in NGC 2264, driven by the IRAS source 06382+1017, which was detected at 1300 μm by Reipurth et al. (1993a). Distant bow shocks were discovered by Ogura (1995). Piché, Howard, Pipher

(1995) and Moneti & Reipurth (1995) found a nebulous source near the symmetry center of the outflow, close to the IRAS source. Rodríguez & Reipurth (1998) detected two VLA sources at 3.6 cm within the IRAS uncertainty ellipse. See also notes for HH 125.

HH 125 *(6 38, +09 50).* Original paper: Walsh, Ogura, Reipurth (1992), who present CCD images and spectroscopy. This is a group of giant interconnected filaments, presumably bow shocks. No energy source has been identified, but the HH objects appear to be closely associated with HH 225 and 226 (see notes for these objects), with which they form a line. The region of NGC 2264 is rich in young low mass stars (e.g. Herbig 1954a, Margulis, Lada, Young 1989), with large amounts of molecular material (e.g. Krügel et al. 1987), and much evidence for molecular outflows (e.g. Margulis & Lada 1986, Margulis, Lada, Snell 1988). CS in dense cores is studied by Wolf-Chase, Walker, Lada (1995).

HH 126 *(5 33, −06 24).* Original papers: Reipurth (1985a), Ogura & Walsh (1991). CCD images and spectroscopy by Ogura & Walsh (1991). This object is part of a large outflow from HH 34 (Bally & Devine 1994, Devine et al. 1997).

HH 127 *(5 33, −07 02).* Original papers: Reipurth (1985a), Ogura & Walsh (1991). Two small HH knots; a spectrum of the brighter one shows very low excitation (Ogura & Walsh 1991). Reipurth, Devine, Bally (1998) show a CCD image and suggest that the object comes from the L1641-N cluster and is the counterlobe to the giant flow HH 403/404.

HH 128/129 *(5 33, −05 06).* Original papers: Reipurth (1985a), Ogura & Walsh (1991). CCD images are shown by Reipurth, Bally, Devine (1997). Spectra show both objects to be of low excitation (Ogura & Walsh 1991). Together with HH 41 and 42 (Haro 1953), they form a small cluster of HH objects. Optical and infrared spectrophotometry of HH 128 is presented by Schwartz et al. (1995), and infrared images are discussed by Schwartz, Burton, Herrman (1997). See also notes for HH 294.

HH 130 *(5 34, −06 51).* Original papers: Reipurth (1985a), Ogura & Walsh (1991). Spectroscopy is presented by Ogura & Walsh (1991) and Corcoran & Ray (1995), and a CCD image by Corcoran & Ray (1995). This arcuate HH object appears to be a bow shock in a flow driven by V380 Ori. The opposite lobe of the flow contains HH 35, see further notes for this object.

HH 131 *(5 32, −08 30).* Original paper: Ogura (1991). This is a smattering of emission-line wisps and filaments stretching over almost half a degree south of and well outside the L1641 cloud. It does not appear to be associated with any young object.

HH 132 *(8 33, −40 28).* Original paper: Ogura (1990), who presents CCD images. These are very faint HH knots associated with a reflection nebula close to the IRAS source 08337–4028, which is embedded in the globule DC259.9-0.0. The object is very close to the bright nebula NGC 2626.

HH 133 *(9 09, −45 18).* Original paper: Ogura (1990), who presents CCD images. The object consists of a little cluster of faint HH knots.

HH 134 *(5 33, −06 32).* Original paper: Reipurth & Heathcote (1992). This is a small group of HH knots close to HH 34, but it is not clear if they are related to that flow or not.

HH 135/136 *(11 10, −58 30).* Discovered by Ogura & Walsh (1992), who present CCD images and long-slit spectroscopy. HH 135 is a single bright HH knot, and HH 136 forms a long chain of bright HH knots.

The objects are located in the dark cloud DC290.4+1.9 in Carina, at the considerable distance of 2.7 kpc, making the HH objects intrinsically very luminous. Ogura & Walsh (1992) suggest that the two objects are not part of the same flow, but that rather HH 135 is driven by IRAS 11101–5829, while HH 136 is driven by an unidentified source in the middle of the chain of knots. Tamura et al. (1997) provide infrared polarimetry, which suggests that only one source, IRAS 11101−5829, drives the two HH objects. The source has a very high luminosity of 10^4 $L_\odot$. Mm observations are presented by Ogura et al. (1998).

HH 137/138 *(11 12, −60 36)*. Discovered by Ogura (1993), who presents CCD images and long-slit spectroscopy. These two objects form a long well-collimated chain of numerous bright HH knots located in the small cloud DC291.4−0.2. Assuming an association with the nearby open cluster NGC 3590, this would place the HH objects at the considerable distance of 2.2 kpc.

HH 139 *(14 56, −63 04)*. Original paper: Reipurth (in preparation). This is a small chain of HH knots emanating from the cometary nebula vBH 65a (van den Bergh & Herbst 1975, Herbst 1975). The nebula is illuminated by an embedded infrared source (Scarrott, Stockdale, Draper 1994), and not as suggested by Perrin & Sivan (1993) by a nearby star. The energy source was detected at 1300 μm by Reipurth et al. (1993a). A molecular outflow was mapped by Bally et al. (1999).

HH 140 *(14 59, -63 11)*. Original paper: Ray & Eislöffel (1994), who present a CCD image. This is a bipolar HH flow emanating from the young Herbig Ae/Be star vBH 65b (Sanduleak & Stephenson 1973, van den Bergh & Herbst 1975, Herbst 1975), located in the Circinus clouds. Spectroscopic observations of vBH 65b are reported by Allen (1978), Gahm & Malmort (1980), and Manchado et al. (1990). The star was detected in X-rays by Carkner, Kozak, Feigelson (1998). H_2O maser emission was detected by Scalise, Gahm, Sandell (1981). Bally et al. (1999) detect a molecular outflow here.

HH 141 *(14 59, −63 12)*. Original paper: Ray & Eislöffel (1994), who present a CCD image. This is a small chain of HH knots in the Circinus clouds. See notes for HH 140.

HH 142 *(14 59, −63 10)*. Original paper: Ray & Eislöffel (1994), who present a CCD image. This is a small cluster of HH knots in the Circinus clouds. See notes for HH 140.

HH 143 *(14 59, −63 11)*. Original paper: Ray & Eislöffel (1994), who present a CCD image. This is a single HH knot in the Circinus clouds. See notes for HH 140.

HH 144 *(5 33, −06 47)*. Original papers: Bohigas et al. (1985), Strom et al. (1985). Both of these papers comment on two faint knots just west of the HH 1 jet. Using deep CCD images, Reipurth et al. (1993b) found a number of additional faint HH knots, altogether forming an 83 arcsec long collimated jet, with proper motions pointing away from the HH 1/2 source region. Rodríguez et al. (1990b) found two VLA sources here, and the infrared K-band images of Reipurth et al. (1993b) show HH 1/2 VLA2 to be the driving source of HH 144. HH 1/2 VLA1/2 thus appears to be a pre-main sequence binary with each component driving an HH flow. Structure and proper motions are further discussed by Eislöffel, Mundt, Böhm (1994). For references to mm-studies see notes on HH 1/2.

HH 145 *(5 33, −06 48)*. Original paper: Reipurth et al. (1993b), who present CCD images. This is a cluster of faint HH knots west of HH 144, but it is not clear if HH 144 and 145 are related. Structure and proper motions are discussed by Eislöffel, Mundt, Böhm (1994).

HH 146 *(5 33, −06 50)*. Original paper: Reipurth et al. (1993b). An isolated faint HH knot south-west of

HH 2.

HH 147 *(5 33, −06 47)*. Original paper: Davis, Eislöffel, Ray (1994), who present CCD images and near-infrared H_2 images. It is an HH object associated with reflection nebulosity from an embedded infrared source (IRAS 05339−0646) about an arcminute east of HH 1. The star is number 50 in the list of Nakajima et al. (1986) and number 31 in the list of Strom et al. (1989); the latter reference gives optical/infrared/far-infrared photometry and a spectral classification. The source was detected at 1300 μm by Chini et al. (1997b). Structure and proper motions are discussed by Eislöffel, Mundt, Böhm (1994). Detailed CCD images and spectroscopy are given by Corcoran & Ray (1995).

HH 148 *(5 33, −06 44)*. Original paper: Strom et al. (1986), who show CCD images. This is a small chain of three HH knots emanating to the south-west from the Herbig Ae/Be star V380 Ori. It is orthogonal to the line defined by HH 35 and HH 130, which may suggest the presence of another source in the region. Leinert et al. (1994) found a companion to V380 Ori with a separation of 0.17 arcsec.

HH 149 *(22 34, +75 01)*. Original paper: Balázs et al. (1992), who present CCD images. This is a small group of HH knots clustered around the IRAS source 22343+7501 in the L1251 cloud. A molecular outflow around this source was discovered by Schwartz, Gee, Huang (1988) and further studied by Sato & Fukui (1989). Mm observations of L1251 are discussed by Sato et al. (1994). Ammonia maps are presented by Tóth & Walmsley (1996) and Anglada, Sepúlveda, Gómez (1997). Hodapp (1994) presents a wide field K′ band image. Detailed near-infrared images by Rosvick & Davidge (1995) reveal that the IRAS source is multiple; these authors also provide sub-mm photometry. Xiang & Turner (1995) and Claussen et al. (1996) detected an H_2O maser. Meehan et al. (1998) present high resolution radio and mm-wavelength maps. Kun & Prusti (1993) discuss the presence of young stars in L1251 and give further references to the region. See also notes for HH 189.

HH 150 *(4 28, +18 07)*. Original paper: Mundt, Ray, Bührke (1988). This is a fine bipolar jet emanating from HL Tau. It can be traced for 13 arcsec in the NE lobe before it becomes confused with the HH 151 jet, and longer in the SW lobe. HH 266 may be a distant bow shock. *Structure and CCD images:* Mundt, Ray, Bührke (1988), Mundt et al. (1990), Mundt, Ray, Raga (1991), López et al. (1995). *HST images:* Stapelfeldt et al. (1995), Ray et al. (1996). *Spectroscopy:* Mundt et al. (1990), Bacciotti & Eislöffel (1999). *Proper motions:* Mundt et al. (1990), López et al. (1996). *Polarization data:* Bastien (1982), Hodapp (1984), Gledhill & Scarrott (1989). *Molecular outflow:* Edwards & Snell (1982), Calvet, Cantó, Rodríguez (1983), Torrelles et al. (1987), Levreault (1988), Monin, Pudritz, Lazareff (1996). *Source:* There is a large body of literature on HL Tau and its circumstellar environment, the following are only some of many references: Cohen & Kuhi (1979), Cohen (1980b,1983), Grasdalen et al. (1984), Beckwith et al. (1984), Brown, Drake, Mundt (1985), Beckwith et al. (1986,1989), Edwards et al. (1987), Sargent & Beckwith (1987,1991), Monin et al. (1989), Grasdalen et al. (1989), Adams, Emerson, Fuller (1990), Carr (1990), Ohashi et al. (1991), Blake, van Dishoeck, Sargent (1992), Rodríguez et al. (1992), Schuster et al. (1993), Reipurth et al. (1993a), Molinari, Liseau, Lorenzetti (1993), Hayashi, Ohashi, Miyama (1993), Gómez et al. (1993), Rodríguez et al. (1994a), Lay et al. (1994), Hamann et al. (1994), Lin et al. (1994), Stapelfeldt et al. (1995), Beckwith & Birk (1995), Weintraub, Kastner, Whitney (1995), Mundy et al. (1996), Wilner, Ho, Rodríguez (1996), Liu et al. (1996), Greene & Lada (1996b), Close et al. (1997a), Lay, Carlstrom, Hills (1997), Lucas & Roche (1998a), Dent, Matthew, Ward-Thompson (1998).

HH 151 *(4 28, +18 07)*. Original paper: Mundt & Fried (1983). This is a fine bright bipolar jet apparently emanating from the VLA 1 source between HL and XZ Tau. *Structure and CCD images:* Mundt & Fried

(1983), Strom et al. (1986), Mundt, Ray, Bührke (1988), Mundt et al. (1990), Mundt, Ray, Raga (1991). *Spectroscopy:* Mundt, Brugel, Bührke (1987), Cohen & Jones (1987), Mundt et al. (1990). *Proper motions:* Mundt et al. (1990). *Source:* Brown, Drake, Mundt (1985). The reality of the VLA 1 source is controversial, and Rodríguez et al. (1994a) were not able to detect it in a deep high resolution VLA study.

HH 152 *(4 28, +18 07).* Original paper: Mundt, Ray, Bührke (1988). This is a short bipolar jet emanating from XZ Tau and stretching about 10 arcsec on either side of the star. *Structure and CCD images:* Strom et al. (1986), Mundt, Ray, Bührke (1988), Mundt et al. (1990), Krist et al. (1997). *Spectroscopy:* Mundt et al. (1990), Hirth, Mundt, Solf (1997). *Proper motions:* Mundt et al. (1990). *Polarization data:* Bastien (1982), Hodapp (1984), Gledhill & Scarrott (1989). *Source:* Cohen & Kuhi (1979), Brown, Drake, Mundt (1985), Carr (1990), Molinari, Liseau, Lorenzetti (1993). Haas, Leinert, Zinnecker (1990) and Leinert et al. (1993) resolved XZ Tau as a close binary star.

HH 153 *(4 28, +18 07).* Original paper: Mundt, Ray, Bührke (1988). A more detailed study (CCD images, spectroscopy, proper motions) was carried out by Mundt et al. (1990). As seen in Hα this is a short well-collimated jet, located about 30$''$ SSE of HL Tau. In [SII] the morphology changes dramatically, the jet being replaced by two bright knots, which may be part of the working surface where the jet flow terminates. No source has been identified yet. This jet is part of a small group of flows (HH 150-153) in the HL/XZ Tau region.

HH 154 *(4 28, +18 01).* Original paper: Mundt & Fried (1983), who show CCD images of a short (about 20 arcsec) jet emanating from the L1551 IRS 5 source. *CCD images* of the region are presented by Mundt & Fried (1983), Snell et al. (1985), Strom et al. (1986), Campbell et al. (1988), Graham & Heyer (1990), Davis et al. (1995) and, in most detail, by Mundt, Ray, Raga (1991) and Fridlund & Liseau (1994,1998). *Proper motion* of the knots in the jet are demonstrated by Neckel & Staude (1987b), Campbell et al. (1988) and Fridlund & Liseau (1994). *Optical spectra* are discussed by Cohen & Fuller (1985), Sarcander, Neckel, Elsässer (1985) and Stocke et al. (1988). *Molecular hydrogen emission* from the jet has been observed by Yamashita & Tamura (1992) and Davis et al. (1995), and [OI] 63μm emission was detected by Cohen et al. (1988). *Optical/infrared polarization* measurements of the reflection nebula around the source and the jet are discussed by Nagata, Sato, Kobayashi (1983), Hodapp (1984), Draper, Warren-Smith, Scarrott (1985b), Lenzen (1987), Scarrott (1988a), Campbell et al. (1988), Stocke et al. (1988) and Lucas & Roche (1997). A major *molecular outflow* is driven by L1551 IRS 5, it has been studied by, among others, Knapp et al. (1976), Snell, Loren, Plambeck (1980), Calvet, Cantó, Rodríguez (1983), Fridlund et al. (1984), Snell & Schloerb (1985), Mirabel et al. (1985, 1987), Moriarty-Schieven et al. (1987b), Rainey et al. (1987), Uchida et al. (1987), Moriarty-Schieven & Snell (1988), Lizano et al. (1988), Levreault (1988), Fridlund & White (1989), Rodríguez et al. (1989c), van der Werf et al. (1989), Liljeström (1989), Pound & Bally (1991), Moriarty-Schieven & Wannier (1991), Parker et al. (1991), Rudolph (1992), Giovanardi et al. (1992), Barsony, Scoville, Chandler (1993), Fridlund & Knee (1993), Bachiller, Tafalla, Cernicharo (1994), Chernin, Masson, Fuller (1994) and Plambeck & Snell (1995). *Extended far-infrared emission* from dust in the outflow cavity is discussed by Clark & Laureijs (1986), Edwards et al. (1986) and Clark et al. (1986). The *L1551 IRS 5 source* has been intensely studied and only a selection of references can be given here. It was discovered by Strom, Strom, Vrba (1976b), and near- and far-infrared and sub-millimeter photometric observations are given by Fridlund et al. (1980), Beichman & Harris (1981), Phillips et al. (1982), Davidson & Jaffe (1984), Cohen, Harvey, Schwartz (1985), Cohen & Schwartz (1987), Woody et al. (1989), Walker et al. (1990), Butner et al. (1991), Molinari, Liseau, Lorenzetti (1993), Liu et al. (1996), Harvey et al.(1998). *Optical/infrared spectroscopy* of L1551 IRS 5 and its reflection nebula shows that it is an FU Orionis object

(Mundt et al. 1985, Carr, Harvey, Lester 1987, Stocke et al. 1988, Sato et al. 1992). *Near-infrared imaging* of the source and its close environment is discussed by Strom et al. (1985b), Moneti et al. (1989), Hodapp et al. (1988), Hodapp & Ladd (1995) and Lucas & Roche (1996, 1997). *VLA radio continuum* observations are discussed by Cohen, Bieging, Schwartz (1982), Bieging, Cohen, Schwartz (1984), Snell et al. (1985), Bieging & Cohen (1985), Rodríguez et al. (1986), Snell & Bally (1986), Gómez et al. (1993), Rodríguez et al. (1998). Evidence for *extended structures or a disk* is discussed by, among others, Kaifu et al. (1984), Batrla & Menten (1985), Menten & Walmsley (1985), Moriarty-Schieven et al. (1987a), Duncan et al. (1987), Walmsley & Menten (1987), Sargent et al. (1988), Menten et al. (1989), Keene & Masson (1990), Walker, Adams, Lada (1990), Butner et al. (1991), Ohashi et al. (1991), Lay et al. (1994), Ladd et al. (1995), Fuller et al. (1995), Ohashi et al. (1996), Saito et al. (1996), Hogerheijde et al. (1998) and Momose et al. (1998). Evidence that IRS 5 is a *binary* is discussed by Bieging & Cohen (1985), Rodríguez et al. (1986), Looney, Mundy, Welch (1997), and Rodríguez et al. (1998). *A small high-density clump* has been observed at the head of HH 154 by Torrelles et al. (1985a). The presence of *magnetic fields* is discussed by Simonetti & Cordes (1986). *The L1551 molecular cloud* itself has been studied at mm-wavelengths by Snell (1981) and by Miesch & Bally (1994). See also notes for HH 28/29.

HH 155 *(4 19, +19 25).* Original paper: Schwartz (1975). This is a Herbig-Haro flow stretching from T Tauri to the west and including a knot located 32 arcsec west of T Tau (formerly HH 1555) and the spatiokinematic flow components A and B very close to T Tauri (Böhm and Solf 1994). All emission of HH 155 is blue-shifted; presumably the receding lobe is obscured by a circumstellar disk around T Tauri. The region of T Tauri contains another HH flow, HH 255, which lies in a north-south direction and includes Burnham's Nebula south of T Tauri and the two spatiokinematic flow components C and D of Böhm & Solf (1994) close to T Tauri; HH 255 appears to be driven by T Tau-S. Speckle interferometry of the Hα emission around T Tauri is presented by Devaney et al. (1995), and Robberto et al. (1995) discuss coronographic interference filter images. It is not clear if knot A found by Schwartz (1990) south-west of T Tauri belongs to HH 155 or HH 255. CCD images of HH 155 are shown by Bührke, Brugel, Mundt (1986), Schwartz (1990) and Eislöffel & Mundt (1998), and spectroscopy of HH 155 is discussed by Schwartz (1975) and Bührke, Brugel, Mundt (1986). [OI] 63 μm emission was detected by Cohen et al. (1988), and weak 3.6 cm emission extends about 1 arcsec west of T Tau (Skinner & Brown 1994). The molecular hydrogen emission detected towards T Tauri appears to come from Burnham's Nebula, see notes for HH 255. In addition to Burnham's Nebula south of T Tauri, which is shock-excited, there is a large reflection nebula, NGC 1555, west of the star that was discovered by Hind in 1852 (Astronomische Nachtrichten No.839) and described by Burnham (1890, 1894), Barnard (1895, 1899), Keeler (1900), Lampland (1936), Herbig (1953), and Lorre (1975). Spectra show the nebula to reflect light from T Tauri (Schwartz 1975). The reflection nebula close to the star is studied by Nakajima & Golimowski (1995), and with HST images by Stapelfeldt et al. (1998). T Tauri has been extensively studied, and only a few references are given here; see Herbig & Bell (1988) for further references. Its spectrum is described by Joy (1945), and high-resolution line profiles are discussed by e.g. Hartmann (1982), Mundt (1984), and Persson et al. (1984). Infrared spectroscopy is reported by Kelly, Rieke, Campbell (1994) and Greene & Lada (1996b). It is irregularly variable in addition to a regular variability with period 2.8 days (e.g. Herbst et al. 1986, Zaitseva 1989). T Tauri has a companion, T Tau-S, 0.6 arcsecond to the south which is a bright infrared and radio continuum source, as discussed by Dyck, Simon, Zuckerman (1982), Cohen, Bieging, Schwartz (1982), de Vegt (1982), Hanson, Jones, Lin (1983), Schwartz et al. (1984), Schwartz, Simon, Campbell (1986), Maihara & Kataza (1991), Ghez et al. (1991), Phillips, Lonsdale, Feigelson (1993), Skinner & Brown (1994), Ghez et al. (1995), Simon et al. (1996), Koresko, Herbst, Leinert (1997), and Ray et al. (1997). A third component, located 0.3 arcsec north of T Tau, was suggested to exist by Nisenson et al. (1985) and confirmed by Maihara & Kataza (1991), but not seen by Gorham et al. (1992) and its reality is questionable. Ray et al. (1997) found that the radio source known as T Tau N is identical to the optically visible star T Tau, and the radio source T Tau S is identical to the infrared companion. In between these two sources, Ray et al. (1997) found a third radio source, called T Tau R, which appears to be part of the system. X-ray emission was detected towards the T Tauri system by Carkner, Kozak, Feigelson (1998). H_2O maser emission has been detected near T Tauri (Knapp & Morris 1976, Thum, Bertout, Downes 1981, Claussen et al. 1996). High-velocity CO and possibly HI emanates from the T Tauri system (Edwards & Snell 1982, Ruiz, Alonso, Mirabel 1992). Evidence for circumstellar material or a disk is given by Weintraub, Masson, Zuckerman (1987), Weintraub et al. (1992), Schuster et al. (1993), van Langevelde, van Dishoeck, Blake (1994), Momose et al. (1996), Hogerheijde et al. (1997a,b,1998), Schuster, Harris, Russell (1997) and Akeson, Koerner, Jensen (1998). Using near-infrared spectropolarimetry, Kobayashi et al. (1997) found evidence for scattering in a compact nebulosity around T Tau-S. Ray et al. (1997) find evidence for a large-scale magnetic field in the outflow from T Tau S.

HH 156 *(4 15, +28 13).* Original paper: Strom et al. (1986). This is a small bipolar jet emanating from the star labelled Tau 1 by Cohen & Kuhi (1979) near CZ and DD Tau (and sometimes called CoKu-Tau 1). Cohen & Kuhi (1979), Strom & Strom (1994) and Kenyon et al. (1998) obtained spectra of the star, and Strom et al. (1986), Goodrich (1993) and Eislöffel & Mundt (1998) obtained CCD images. Proper motions of the jet is presented by Eislöffel & Mundt (1998). Movsesyan & Magakyan (1990) and Eislöffel & Mundt (1998) obtained long slit spectra of the jet. Infrared photometry of the star is reported by Strom & Strom (1994). Padgett et al. (1999) present HST/NICMOS images of the surrounding reflection nebula, and show that the source is a binary with 0.24 arcsec separation. The source is detected by IRAS at 12 μm (IRAS 04155+2812). Skinner, Brown, Stewart (1993) report a possible radio continuum detection.

HH 157 *(4 18, +26 50).* Original paper: Mundt et al. (1984). This is an HH jet powered by the T Tauri star Haro 6-5B (= FS Tau B), a companion about 20 arcsec west of Haro 6-5 (= FS Tau). CCD images are discussed by Mundt et al. (1984), Strom et al. (1986) and Eislöffel & Mundt (1998). Proper motions are determined by Eislöffel & Mundt (1998). Spectra of the jet are presented by Mundt, Brugel, Bührke (1987) and Eislöffel & Mundt (1998), and of the reflection nebula by Cohen & Fuller (1985). Polarization data are given by Gledhill, Warren-Smith, Scarrott (1986) and Gledhill & Scarrott (1989). Padgett et al. (1999) present HST/NICMOS images of the compact reflection nebula around the source. The source was observed with optical spectroscopy by Eislöffel & Mundt (1998), in the near-infrared by Vrba, Rydgren, Zak (1985), in H_2 by Carr (1990), in the far-infrared by Cohen & Scwartz (1987) and at 1300 μm by Reipurth et al. (1993a). HST images of FS Tau and Haro 6-5B are discussed by Krist et al. (1998).

HH 158 *(4 24, +25 59).* Original paper: Mundt & Fried (1983). This is a short jet emanating from the T Tauri star DG Tau. CCD images are discussed by Mundt & Fried (1983), Strom et al. (1986), Mundt, Brugel, Bührke (1987), Eislöffel & Mundt (1998), and HST images are presented by Kepner et al. (1993). Proper motions are determined by Eislöffel & Mundt (1998). Spectroscopic observations are analyzed by Mundt & Fried (1983), Cohen & Fuller (1985), Mundt, Brugel, Bührke (1987) and Solf & Böhm (1993). A detailed 3D spectro-imaging study in the [OI] 6300 line is presented by Lavalley et al. (1997). Optical spectra of DG Tau are given by e.g. Cohen & Kuhi (1979), Levreault (1988), and Hessman & Guenther (1997) who derive a spectral type of K6V, and an infrared spectrum is shown by Greene & Lada (1996b). DG Tau is detected in the radio continuum (Bertout & Thum 1982, Cohen, Bieging, Schwartz 1982), and Bieging, Cohen, Schwartz (1984) find it is extended in the same direction as the jet. A reflection nebula is imaged by Nakajima & Golimowski (1995). Polarization measurements are given by Bastien (1982), Moneti et al. (1984), and Hodapp (1984). Infrared lunar occultation observations are analyzed by Leinert et al.

(1991) and Bogdanov & Cherepashchuk (1993). Near-infrared observations of DG Tau are discussed by Carr (1990), Chandler et al. (1993), Molinari, Liseau, Lorenzetti (1993), Hamann et al. (1994), Chandler, Carlstrom, Scoville (1995), Najita, Carr, Tokunaga (1996), Biscaya et al. (1997) and Muzerolle, Hartmann, Calvet (1998), and far-infrared observations by Cohen, Harvey, Schwartz (1985) and Cohen & Schwartz (1987), and sub-mm photometry by Moriarty-Schieven et al. (1994). Levreault (1988) did not detect clear evidence for a molecular outflow. Circumstellar gas or dust has been detected by Ohashi et al. (1991), Chen et al. (1992), Schuster et al. (1993), Mannings & Emerson (1994), and Kitamura, Kawabe, Saito (1996a,b).

HH 159 *(4 23, +25 59)*. Original paper: Mundt & Fried (1983). This is a more than one arcmin long highly collimated jet emanating from the low-luminosity star DG Tau B, located approximately 50 arcsec southwest of DG Tau. CCD images are presented by Mundt & Fried (1983), Mundt, Brugel, Bührke (1987), Mundt, Ray, Raga (1991) and Eislöffel & Mundt (1998). Proper motions are determined by Eislöffel & Mundt (1998). Spectroscopy is discussed by Jones & Cohen (1986), Mundt, Brugel, Bührke (1987) and Eislöffel & Mundt (1998). Padgett et al. (1999) present HST/NICMOS images of the compact reflection nebula around the source. The source was observed in the near-infrared by Vrba, Rydgren, Zak (1985), in the far-infrared by Cohen, Harvey, Schwartz (1985) and Cohen & Schwartz (1987), and in the radio continuum by Rodríguez, Anglada, Raga (1995). Schwartz et al. (1995) present near-infrared spectroscopy. A well-collimated redshifted molecular outflow was found along the jet-axis by Mitchell et al. (1994), and further studied by Mitchell, Sargent, Mannings (1997).

HH 160 *(7 01, −11 28)*. Original paper: Poetzel, Mundt, Ray (1989), who present CCD images and long-slit spectroscopy. This is a finely collimated bipolar jet emanating from Z CMa with the very large extent of 3.6 pc. Parts of the flow have very high radial velocities, and the jet near the source shows complex velocity-structure. Z CMa itself has been very extensively studied, see Herbig (1960,1991) for references. It is an FU Orionis object (Hartmann et al. 1989, Hessman et al. 1991, Welty et al. 1992, Sato et al. 1992, Liljeström & Olofsson 1997, Reipurth & Aspin 1997) and it has an infrared companion (e.g. Koresko et al. 1991, Haas et al. 1993, Whitney et al. 1993, Barth, Weigelt, Zinnecker 1994, Thiébaut et al. 1995). Polarimetry of both components are presented by Fischer, Stecklum, Leinert (1998). The photometric behaviour of Z CMa is discussed by e.g. Covino et al. (1984), Hessman et al. (1991) and Teodorani et al. (1997). Rapid spectroscopic variability of Z CMa is discussed by Chochol et al. (1998). The mass loss rate based on [SII] emission is determined by Corcoran & Ray (1997). Submillimeter observations are presented by Weintraub, Sandell, Duncan (1991), Henning et al. (1998) and Dent, Matthew, Ward-Thompson (1998), and radio continuum observations by Bieging, Cohen, Schwartz (1984) and Skinner, Brown, Stewart (1993). Evidence for a disk is presented by Malbet et al. (1993). The inner reflection nebula is imaged by Nakajima & Golimowski (1995). Optical photometry is summarized by Kolotilov (1991). X-ray observations are reported by Zinnecker & Preibisch (1994). A molecular outflow was detected by Evans et al. (1994). Mm observations of the surrounding cloud core are discussed by Liljeström & Olofsson (1997) and Fuente et al. (1998). Lamzin et al. (1998) argue that the primary component of the binary is the main source of activity rather than the infrared companion.

HH 161 *(0 08, +58 33)*. Original paper: Strom et al. (1986), who present CCD images. This is a single bright HH knot next to the luminous Herbig Ae/Be star LkHα 198 (= V633 Cas). A deeply embedded companion to LkHα 198 has been detected by infrared imaging (Lagage et al. 1993) and optically (Corcoran, Ray, Bastien 1995); the latter paper presents CCD images which show that the object has a tail pointing back towards the companion LkHα 198B. This orientation coincides with the axis of a molecular outflow (Cantó et al. 1984, Levreault 1988, Nakano et al. 1990). The LkHα 198 region has been extensively studied, see the following papers and references therein: Herbig (1960), Schwartz & Buhl (1975), Loren (1977), Harvey, Thronson, Gatley (1979), Chavarria (1985), Leinert, Haas, Lenzen (1991), Hodapp (1994), Sandell & Weintraub (1994), Mannings (1994), Butner & Natta (1995), Nisini et al. (1995), Asselin et al. (1996), Corcoran & Ray (1997), Koresko et al. (1997), Fuente et al. (1998), Henning et al. (1998).

HH 162 *(0 08, +58 33)*. Original paper: Corcoran, Ray, Bastien (1995). This is a group of HH objects east of the Herbig Ae/Be star V376 Cas. This star is about 35 arcsec north of LkHα 198. See also notes for HH 161.

HH 163 *(2 57, +60 17)*. Original paper: Ray et al. (1990), who present CCD images and long-slit spectroscopy. This is a short jet in the region of the luminous star AFGL 4029 (IRAS 02575+6017). The CCD images of Ray et al. (1990) show that AFGL 4029 consists of two components, A and B, of which B may be the more likely driving source. Snell et al. (1988) found a molecular outflow from AFGL 4029. Cohen & Lewis (1978) discuss a low-dispersion spectrum of the star. An H_2O maser was detected by Churchwell, Walmsley, Cesaroni (1990).

HH 164 *(0 08, +58 33)*. Original paper: Corcoran, Ray, Bastien (1995). This is a jet of several HH knots emanating from LkHα 198. The embedded companion to this star also drives an HH flow, HH 161, see notes for this object. The object HH 461 is found to the SE along the HH 164 flow axis, and is probably a bow shock in this flow (Aspin & Reipurth 1999).

HH 165 *(19 40, +23 17)*. Original paper: Mundt et al. (1984), who present CCD images. This is a fine jet about 45 arcsec long emanating from the cometary nebula 1548C27, first noted by Craine, Boeshaar, Byard (1981). Spectra of the jet and nebula are discussed by Mundt, Brugel, Bührke (1987), Magakyan et al. (1989) and Vilchez et al. (1989). Optical polarization maps are presented by Scarrott, Rolph, Tadhunter (1991), and Dent & Aspin (1992) find a molecular outflow and present near-infrared imaging and polarimetry. These latter authors argue for a kinematical distance of 2.4 kpc. Phillips & Mampaso (1996) discuss CO data around the cometary nebula. Najita et al. (1996) and Biscaya et al. (1997) analyze near-infrared CO overtone spectra. Chini et al. (1997b) found extended 1300 μm emission around the source. The jet points to HH 365, which appears to be a bow shock in the flow, see notes for that object.

HH 166 *(20 27, +40 01)*. Original paper: Poetzel, Mundt, Ray (1992), who present CCD images, infrared images and long-slit spectroscopy. This is a chain of three HH knots located next to and approximately on a line through the AFGL 2591 infrared source. Additional knots are seen in the near-infrared, and the source is surrounded by optical/infrared reflection nebulae. Very high velocities are measured in the HH flow. The AFGL 2591 region is well studied, and only some references are given here. Bally & Lada (1983) and Torrelles et al. (1983b) found a molecular outflow, which was studied in more detail by Lada et al. (1984), who also give near- and far-infrared photometry. Higher-resolution CO and HCO^+ maps are presented by Hasegawa & Mitchell (1995). Near-infrared images are discussed by Forrest & Shure (1986), Lenzen (1987), Yamashita et al (1987b) and Burns et al. (1989); polarimetric data are also presented by the three latter papers. Mitchell, Maillard, Hasegawa (1991) have obtained infrared spectroscopy, and Tamura & Yamashita (1992) mapped H_2 and Brγ emission. Gürtler et al. (1991) discuss mm continuum data, Torrelles et al. (1989a) NH_3 observations, and Yamashita et al. (1987b) CS observations. Campbell (1984) identifies several VLA sources, and Wynn-Williams et al. (1977) and Tofani et al. (1995) discuss the position of an H_2O maser.

HH 167 *(21 41, +65 53)*. Original paper: Ray et al. (1990), who present CCD images and long-slit spectroscopy. This is a well collimated jet 40 arcsec in length consisting of numerous knots and emanating from the near vicinity of the luminous Herbig Be star LkHα 234. Radial velocity and density decreases outwards from the source. LkHα 234 and the surrounding NGC 7129 region is well studied, see the following selected papers and references therein. The star has been studied by Herbig (1960), Strom et al. (1972), Bechis et al. (1978), and Weintraub, Kastner, Mahesh (1994) have found a deeply embedded companion. Weintraub et al. (1996) argue that the deeply embedded star is the source of the jet. Cabrit et al. (1997) present a high-resolution H_2 image of the jet, plus 10 μm and 17 μm images of the infrared companion. Far-infrared maps are presented by Di Francesco et al. (1998). There is complex CO outflow activity in the region (Edwards & Snell 1983, Bertout 1987), and Mitchell & Matthews (1994) show that the redshifted CO outflow is collimated with an axis approximately opposite the HH 167 jet axis. Fuente et al. (1998) and Henning et al. (1998) present ^{13}CO, CS and 1.3 mm continuum maps. Hodapp (1994) presents a wide field K$'$ band image. Nisini et al. (1995) derive a mass loss rate from near-infrared HI lines. Sandell & Olofsson (1981) summarize available data on several H_2O masers. Eiroa, Palacios, Casali (1998) present HIRAS maps of the whole NGC 7129 region. There are numerous HH objects in the NGC 7129 region, see notes on HH 103, 105, 232, 234, 235, 236, 237, 238, 239 and 242. Overviews of this complex region are given by Hartigan & Lada (1985, fig.30) and Ray et al. (1990, fig.6).

HH 168 *(22 54, +61 45).* Original paper: Gyulbudaghian, Glushkov, Denisyuk (1978). This is a large cluster of interconnected HH knots mixed with reflection nebulosity (formerly GGD 37). Positions and knot designations are given by Hartigan & Lada (1985). The Cep A region is very complex with much star formation activity; the most likely energy source is the high-luminosity radio continuum source HW 2. *Structure and CCD Images:* Hartigan & Lada (1985), Hartigan et al. (1986), and Lenzen (1988). *Spectroscopy:* Lenzen, Hodapp, Solf (1984), Hartigan et al. (1986). *Molecular hydrogen emission and ir images:* Bally & Lane (1982), Simon & Joyce (1983), Doyon & Nadeau (1988), Lane (1989), Hodapp (1994), Wright et al. (1996), Hartigan et al. (1996), Goetz et al. (1998). *Proper Motions:* Lenzen (1988). *Optical/infrared polarization:* Lenzen, Hodapp, Solf (1984), Joyce & Simon (1986), Eaton & Scarrott (1989), Hodapp (1990), Colomé & Harvey (1995), Casement & McLean (1996). *Molecular outflow:* Ho, Moran, Rodríguez (1982), Richardson et al. (1987), Hayashi, Hasegawa, Kaifu (1988), Levreault (1988), Phillips & Mampaso (1991), Choi, Evans, Jaffe (1993), Torrelles et al. (1993b), Narayanan & Walker (1996). *Other mm-observations:* Güsten, Chini, Neckel (1984), Weliachew et al. (1985), Torrelles et al. (1986), Moriarty-Schieven, Snell, Hughes (1991), Torrelles et al. (1993a), Codella, Bachiller, Reipurth (1999). *Radio continuum observations:* Beichman, Becklin, Wynn-Williams (1979), Hughes & Wouterloot (1982, 1984), Hughes (1985, 1988, 1989, 1997), Hughes & Moriarty-Schieven (1990), Hughes (1991, 1993), Rodríguez et al. (1994b), Hoare & Garrington (1995), Hughes, Cohen, Garrington (1995), Torrelles et al. (1996), Garay et al. (1996), Torrelles et al. (1998). *H_2O and OH masers:* Wouterloot, Habing, Herman (1980), Lada et al. (1981), Cohen, Rowland, Blair (1984), Cohen & Brebner (1985), Mattila et al. (1985, 1988), Cohen, Brebner, Potter (1990), Migenes, Cohen, Brebner (1992), Torrelles et al. (1996), Mehringer, Zhou, Dickel (1997), Torrelles et al. (1998). *Far-infrared and sub-mm observations:* Ellis et al. (1990), Gordon (1990), Colomé & Harvey (1995). *Magnetic fields:* Simonetti & Cordes (1986).

HH 169 *(22 54, +61 46).* Original papers: Lenzen (1988), Corcoran, Ray, Mundt (1993), who present CCD images. This appears to be the counter-flow to the HH 168 (formerly GGD 37) flow in Cepheus A. The two main condensations, HH 169-NE and HH 169-NE2, have bow shock morphologies, facing away from the luminous embedded star HW 2, which is the likely driving source. The objects are part of a larger ellipse of emission (Corcoran, Ray, Mundt 1993). Spectra of HH 169-NE are discussed by Lenzen (1988), who also present proper motions. For references to the molecular outflow and other aspects of this complex region, see notes for HH 168.

HH 170 *(23 15, +60 34)*. Original paper: Poetzel, Mundt, Ray (1992), who present CCD images and long-dispersion spectroscopy. This is a somewhat poorly collimated bipolar jet flowing from the high luminosity young Herbig Ae/Be star MWC 1080. A molecular outflow is reported by Cantó et al. (1984) and Levreault (1988). Optical spectroscopy of the star is discussed by Herbig (1960), Garrison & Anderson (1977), Cohen & Kuhi (1979), Finkenzeller & Mundt (1984) and Poetzel, Mundt, Ray (1992). Near-ir spectroscopy is discussed by Nisini et al. (1995). ISO-SWS spectra are presented by Benedettini et al. (1998). Far-infrared maps are discussed by Di Francesco et al. (1998). Polarization data are given by Garrison & Anderson (1978) and Vrba, Schmidt, Hintzen (1979). Radio continuum observations are discussed by Curiel et al. (1989b), Skinner, Brown, Linsky (1990) and Skinner, Brown, Stewart (1993). A companion 0.75 arcsec east of MWC 1080 was found by Leinert et al. (1994). Sub-mm photometry of the combined system is given by Mannings (1994). Fuente et al. (1998) and Henning et al. (1998) present ^{13}CO, CS and 1.3 mm continuum maps. MWC 1080 was detected in X-rays by Carkner, Kozak, Feigelson (1998).

HH 171 *(9 46, −54 43)*. Original paper: Ogura & Noumaru (1994), who present CCD images and spectroscopy. This is a faint HH object in the small dark cloud D278.6−0.9 in Vela. It has an unusually high excitation. The distance to the region is unknown.

HH 172 *(18 51, +00 28)*. Original paper: Cappellaro et al. (1994), who present CCD images and spectroscopy. This is a large structured object located next to the dense dark cloud containing the reflection nebula GGD 30, studied by Gómez de Castro & Eiroa (1991) and Foley et al. (1993). Infrared sources in the region are discussed by Gómez de Castro & Eiroa (1991) and Cappellaro et al. (1994). Mm observations are discussed by Rodríguez et al. (1980).

HH 173 *(5 33, −06 34)*. Original paper: Bally & Devine (1994). This is a faint HH object between HH 34 and HH 86/87/88, which was shown by Devine et al. (1997) in a kinematic study to be part of the HH 34 outflow.

HH 174 *(22 54, +61 46)*. Original paper: Bally et al. (1999). This is a Herbig-Haro object in the Ceph A region located to the east of HH 168 and 169, see notes for these objects.

HH 175 *(05 42, +09 09)*. Original paper: Reipurth, Bally, Heathcote (1999), who present CCD images. This is a bow shock located 4 1/2 arcmin ENE of and facing away from the source IRAS 05417+0907, which is embedded in the B35 cloud. B35 is a cometary shaped cloud facing λ Ori (Lada & Black 1976), and is best known for harboring FU Orionis. The IRAS source is located near the peak of a dense NH_3 core (Benson & Myers 1989), and is driving a *molecular outflow* (Myers et al. 1988). Terebey, Vogel, Myers (1992) detected the source at 6 cm, as well as two *H_2O masers*, which are further observed by Claussen et al. (1996).

HH 176 *(5 28, +12 08)*. Original paper: Goodrich (1993), who presents CCD images and a spectrum, and suggests it is a bow shock facing away from the Herbig Ae/Be star HK Ori. This is confirmed by higher resolution CCD images by Reipurth, Bally, Heathcote (1999). HK Ori is further discussed by Herbig (1960), Strom et al. (1972), Finkenzeller & Mundt (1984), and Hillenbrand et al. (1992) summarize optical/ir/mm photometry. The cloud in which HK Ori is located has been studied by Zhou, Butner, Evans (1988). A close companion to HK Ori with a separation of 0.33 arcsec was found by Leinert et al. (1994).

HH 179 *(05 29, +12 33)*. Original paper: Reipurth, Bally, Devine (1997), who present a wide-field CCD image. This is a large diffuse cluster of HH knots, which is a distant bow shock in the red lobe from the outflow centered on IRAS 05295+1247 which drives also HH 243, 244 and 245. The HH flow coincides with a major molecular outflow (Bence, Richer, Padman 1996). See also notes for HH 243.

HH 180 *(18 14, −19 52).* Original paper: Reipurth (in prep.), who present CCD images. This is a faint HH knot associated with a small reflection nebula in the L291 cloud in Sagittarius.

HH 183 *(5 35, −07 04).* Original paper: Strom et al. (1986), who present CCD images. This is a single low-excitation HH object, next to the bright reflection nebula IC430, illuminated by the luminous partly embedded young star V883 Ori (= IRAS 05358–0704) in L1641. Haro (1953) commented on IC430 (his Haro 13a). Allen et al. (1975) provide optical/ir photometry and a spectrum of V883 Ori, Nakajima et al. (1986) discuss ir variability, Strom et al. (1989) give IRAS fluxes, and Reipurth et al. (1993a) found it to be bright at 1300 μm. Further sub-millimeter photometry is presented by Dent, Matthew, Ward-Thompson (1998). Strom & Strom (1993) obtained spectra of the reflection nebula and conclude that V883 Ori is a likely FU Orionis object.

HH 184 *(4 26, +24 26).* Original paper: Elias (1978), who presents a spectrum and find the HH object to be coincident with an infrared source (Haro 6-10 = GV Tau = Elias 7 = IRAS 04263+2426). This is a compact HH knot overlying a young partly embedded star and with faint outlying emission (Strom et al. 1986, Gómez, Whitney, Kenyon 1997). Devine et al. (1999a) present wide field CCD images and show that HH 184 is part of a giant HH flow (HH 410/411) stretching over 38 arcmin. Cohen & Fuller (1985) also present a spectrum. Hirth, Mundt, Solf (1997) present detailed long-slit spectra. A high-resolution K-band image is discussed by Lucas & Roche (1997). Elias (1978) and Cohen & Schwartz (1983) noted a continuous decline in infrared brightness of the source. Bieging, Cohen, Schwartz (1984) detected Haro 6-10 at 6 cm, Reipurth et al. (1993a) measured it at 1300 μm and Dent, Matthew, Ward-Thompson (1998) at other sub-mm wavelengths, Carr (1990) and Herbst, Koresko, Leinert (1995) detected H_2 towards the object, and Whittet et al. (1988) obtained near- and mid-infrared spectra. Leinert & Haas (1989) discovered a close infrared companion, which was further observed by Ménard et al. (1993) and Koresko, Herbst, Leinert (1997). No molecular outflow has been found (Edwards & Snell 1984, Levreault 1988). Emission from high-density ammonia gas was detected by Anglada et al. (1989). HCO^+ and 2.7 mm continuum observations are presented by Hogerheijde et al. (1997a,1998). A 790 μm dust map and a ^{12}CO J=2-1 map is discussed by Chandler, Barsony, Moore (1998). See also notes for HH 410/411.

HH 185 *(15 39, −33 59).* Original paper: Heyer & Graham (1989), who present CCD images and spectra. This is a faint low-excitation HH object located next to the IRAS source 15398–3359, detected as a faint near-infrared source by Heyer & Graham (1989). The object is located in the B228 cloud in the Lupus 1 complex. The source was detected at 1300 μm by Reipurth et al. (1993a).

HH 186 *(15 42, −34 08).* Original paper: Heyer & Graham (1989), who present CCD images and spectra. This is a highly collimated [SII]-strong jet extending 34 arcsec from the T Tauri star Sz 68 (= CoD - 33°10685 = IRAS 15420–3408). Sz 68 was observed spectroscopically by Appenzeller, Jankovics, Krautter (1982), Finkenzeller & Basri (1987) and Johns-Krull & Hatzes (1997). A faint companion was found by Reipurth & Zinnecker (1993). The binary was detected at 1300 μm by Reipurth et al. (1993a).

HH 187 *(15 42, −34 08).* Original paper: Heyer & Graham (1989), who present CCD images and spectroscopy. This is a faint high excitation HH object consisting of two knots located 72 arcsec due east of

Sz 68, see notes for HH 186.

HH 188 *(8 19, −49 25)*. Original paper: Graham (1986), who presents CCD images and spectroscopy. Reipurth (1981) drew attention to a little nebula in a globule in the Gum Nebula, and Graham (1986) showed that the northern part of the nebula is a low-excitation HH object, HH 188 (formerly Re 4 head); the main southern part of Re 4 is a reflection nebula. The energy source is the embedded star IRAS 08914–4925 (Cohen & Schwartz 1987), detected in the near-infrared by Graham & Heyer (1989), and at 1300 μm by Reipurth et al. (1993a). Further sub-millimeter photometry is presented by Dent, Matthew, Ward-Thompson (1998). CO observations are reported by de Vries et al. (1984).

HH 189 *(22 37, +74 55)*. Original paper: Eiroa et al. (1994b), who present CCD images. This is a chain of three HH knots in L1251 pointing towards the embedded IRAS source 22376+7455, which seems a likely driving source. The source is detected in the centimeter radio continuum by Anglada et al. (1998). Sato & Fukui (1989) found a molecular outflow from this source, and this outflow and the surrounding cloud structure is discussed by Sato et al. (1994). Ammonia maps are presented by Tóth & Walmsley (1996) and Anglada, Sepúlveda, Gómez (1997). Hodapp (1994) presents a wide field K′ band image. Alten et al. (1997) show a large-field CCD image of the region, which includes two further HH knots, HH 189 D and E, apparently belonging to the same flow, plus three other groups of HH objects, HH 364, 373 and 374. For further details on L1251 see the notes for HH 149.

HH 190 *(5 27, +33 45)*. Original paper: Eiroa et al. (1994b), who present CCD images. This is a single HH object embedded in the large reflection nebula around the AFGL 5142 source. Snell et al. (1988) found a molecular outflow from this source. Mm data and an H_2O maser are discussed by Verdes-Montenegro et al. (1989), Pastor et al. (1991), Torrelles et al. (1992c), Wouterloot, Brand, Fiegle (1993), Estalella et al. (1993), Xiang & Turner (1995), Tofani et al. (1995), and Hunter et al. (1995).

HH 191 *(6 11, +13 50)*. Original paper: Eiroa et al. (1994c), who present CCD images and longslit spectroscopy. The HH object has blueshifted radial velocities up to 400 km/sec. It is associated with a luminous young source, IRS 2, which is double in near-infrared images. The western component may be associated with the IRAS source 06117+1350 and H_2O and OH masers in the region and probably powers the HH object. For further references see Eiroa et al. (1994c).

HH 192 *(4 36, +25 57)*. Original paper: Eiroa et al. (1994a), who present CCD images and a spectrum. This is a small HH object, it is enveloped in a reflection nebulosity that was discussed by Tamura et al. (1991), and observed spectroscopically by Kenyon et al. (1998). L1527 is a small cloud core studied by Benson & Myers (1989) and Ohashi et al. (1991). High velocity CO wings are reported by Heyer et al. (1987) and Terebey et al. (1989) around the cold source IRAS 04368+2557, which has been studied by Ladd et al. (1991a,b). Strong near-infrared polarization was measured by Whitney, Kenyon, Gómez (1997). The source was also detected at 3.6 cm by Rodríguez & Reipurth (1998). Fuller, Ladd, Hodapp (1996) found a companion at sub-mm wavelengths. High resolution mm line and continuum maps of the environment of IRAS 04368+2557 are discussed by Myers et al. (1995), Zhou, Evans, Wang (1996), Tamura et al. (1996), Ohashi et al. (1997a), Matsumoto, Hanawa, Nakamura (1997), and Hogerheijde et al. (1997a,1998).

HH 193 *(3 21, +30 44)*. Original paper: Bally et al. (1997), who present CCD images and spectra. This is a little chain of three HH knots in the L1448 cloud (see also notes for HH 197).

HH 194 *(3 21, +30 37)*. Original paper: Bally et al. (1997), who present CCD images and spectra. These are two HH knots in the L1448 cloud (see also notes for HH 197).

HH 195 *(3 22, +30 36)*. Original paper: Bally et al. (1997), who present CCD images and spectra. This is a chain of faint HH knots just north-east of the reflection nebula RNO 13 in the L1448 cloud (Cohen 1980a). See also notes for HH 197.

HH 196 *(3 22, +30 38)*. Original paper: Bally et al. (1997), who present CCD images and spectra. This is a cluster of HH knots in the L1448 cloud (see also notes for HH 197).

HH 197 *(3 22, +30 34)*. Original paper: Eiroa et al. (1994a), who present CCD images; see also Bally et al. (1997). This is a single HH object located just south of a compact reflection nebula apparently associated with the brightest IRAS source, 03225+3034, in the L1448 cloud. This source is associated with bright H_2 emission clumps (Bally, Lada, Lane 1993, Davis et al. 1994), a strong H_2O maser (Anglada et al. 1989, Wouterloot, Brand, Fiegle 1993, Chernin 1995, Claussen et al. 1996), an ammonia core (Anglada et al. 1989), and the core has been mapped in HCO^+ and CS by Davis et al. (1994) and in ^{13}CO by Bally & Devine (1995). A molecular outflow was detected by Bachiller et al. (1990), who also mapped the core in ^{13}CO and CS. IRS 3 was detected in the radio continuum as a double radio source with about 8 arcsec separation (Curiel et al. 1990). Polarized 800 μm emission was detected towards IRS 3 by Greaves, Holland, Ward-Thompson (1997). The L1448 cloud is a dense core about one degree south-west of NGC 1333 in the Perseus dark clouds (Bachiller & Cernicharo 1986a,b). About 80 arcsec south of IRS 3 is a deeply embedded source detected at centimeter and sub-mm wavelengths (Curiel et al. 1990, Bachiller, André, Cabrit 1991), which drives a major bipolar molecular hydrogen complex (Bally, Lada, Lane 1993, Davis et al. 1994, Davis & Smith 1995, 1996) and a fast collimated molecular outflow (Bachiller et al. 1990, Bachiller, Martin-Pintado, Fuente 1991, 1993, Guilloteau et al. 1992, Bachiller et al. 1995b, Dutrey, Guilloteau, Bachiller 1997). Ceccarelli et al. (1997) measured OI 63 μm emission towards both L1448-mm and L1448-IRS3. Barsony et al. (1998) present far-infrared, submillimeter and millimeter images of all the known protostars in L1448.

HH 198 *(21 00, +78 11*. Original paper: Brugel & Fesen (1990). This object (formerly RNO 129 in Cohen 1980) has been studied with CCD imaging and spectroscopy by Bally et al. (1995). It consists of two bright Hα-strong knots surrounded by a complicated compact nebulosity. The eastern knot contains a star at its southern end.

HH 199 *(20 55, +77 20)*. Original paper: Bally et al. (1995), who present CCD images, spectroscopy, near-infrared images and mm-data. This is an about 2 pc long bipolar HH flow consisting of many knots emanating from the low luminosity source IRAS 20582+7724, embedded in a cloud core in the L1228 cloud. The source was detected at 3.6 cm with the VLA by Rodríguez & Reipurth (1996). It is associated with a large molecular outflow (Bally et al. 1995, Tafalla & Myers 1997). ^{13}CO observations of L1228 are discussed by Miesch & Bally (1994). An ammonia core was mapped by Anglada, Sepúlveda, Gómez (1997). See also notes for HH 200.

HH 200 *(20 56, +77 19)*. Original paper: Bally et al. (1995), who present CCD images, spectroscopy and mm-data. This is an about 1.8 pc long bipolar HH flow emanating from a star embedded in a cloud core in the L1228 cloud. The flow contains a bright and prominent bow shock. There is a weak molecular outflow coincident with the HH flow. The L1228 cloud has been studied in ^{12}CO and ^{13}CO and at 100 μm by Haikala & Laureijs (1989), and in ^{13}CO by Miesch & Bally (1994). An ammonia core was mapped by Anglada, Sepúlveda, Gómez (1997). Many Hα emission stars have been found around the cloud by Ogura

& Sato (1990).

HH 201 *(5 32, −05 23)*. Original paper: Münch & Taylor (1974), Gull et al. (1973). The latter reference gives no position nor a finding chart, but their object appears to be the same found in the former reference. This is an isolated HH object (formerly M42-HH1) near the Trapezium and is resolved into a multitude of sub-knots in HST images (Hester et al. 1991, O'Dell et al. 1997a). Spectra of the object are discussed by Münch & Taylor (1974), Münch (1977), Axon & Taylor (1984) and Hu (1996). Taylor et al. (1986) and O'Dell et al. (1997b) present Fabry-Perot observations. The proper motion studies of Jones & Walker (1985) and Hu (1996) show motion away from the BN region. Infrared images of Allen & Burton (1993) show the object to be weak in H_2 but strong in [FeII].

HH 202 *(5 32, −05 24)*. Original paper: Cantó et al. (1980), who present photographic plates and spectroscopy. This is a rather large object (formerly M42-HH2) with a bow shock morphology located close to the Trapezium, seen well in the HST images of Hester et al. (1991), O'Dell & Wong (1996) and O'Dell et al. (1997a). Spectra are discussed in detail by Meaburn (1986), by O'Dell, Wen, Hester (1991), and by Clayton & Meaburn (1994). Fabry-Perot observations by O'Dell et al. (1997b) reveal a long curved jet-like feature of high velocity gas which extends to the south-east from HH 202. Detailed HST NICMOS images are presented by Schultz et al. (1999).

HH 203 *(5 32, −05 26)*. Original paper: Taylor & Münch (1978). This is a very fine bow shock (formerly cloudlet A or M42-HH3) located just outside the Orion Bar, and with an apparent origin in the direction of the Trapezium or BN region. Part of the object appears in the HST images of O'Dell, Wen, Hu (1993) and it is fully depicted in the HST images of O'Dell & Wen (1994), O'Dell & Wong (1996) and O'Dell et al. (1997a). Spectra are discussed by Taylor & Münch (1978), Cantó et al. (1980), Walsh (1982), and Hu (1996). O'Dell et al. (1997b) present Fabry-Perot observations. The infrared images of Allen & Burton (1993) show the object to be very weak in H_2 and strong in [FeII]. Yusef-Zadeh (1990) detected the object in the radio continuum at 20 cm.

HH 204 *(5 32, −05 27)*. Original paper: Taylor & Münch (1978). This is a bright somewhat amorphous HH object (formerly cloudlet B or M42-HH4) close to HH 203 just outside the Orion Bar. It is partly seen in the HST images of O'Dell & Wen (1994), and in great detail in HST images through several interference filters by O'Dell & Wong (1996) and O'Dell et al. (1997a). Spectra are discussed by Taylor & Münch (1978), Cantó et al. (1980), Walsh (1982) and Hu (1996), and O'Dell et al. (1997b) present Fabry-Perot observations. Proper motions are determined by Cudworth & Stone (1977) and Hu (1996). In the infrared images of Allen & Burton (1993) it is barely seen in H_2 but is very strong in [FeII]. The object is detected in the radio continuum at 20 cm by Yusef-Zadeh (1990).

HH 205/206/207 *(5 32, −05 22)*. Original paper: Axon & Taylor (1984), who present electronographic plates and spectra. This is a chain of HH knots (formerly M42-HH5,6,7) which break into numerous condensations in the HST images of Hester et al. (1991) and O'Dell et al. (1997a). A proper motion determination of HH 205 by Jones & Walker (1985) suggests an origin near BN or IRc2. The infrared images of Allen & Burton (1993) show that the three HH objects form part of the brightest of the "fingers" streaming out from the BN/IRc2 region, reminiscent of explosively ejected matter. Possible formation mechanisms are discussed by Stone, Xu, Mundy (1995) and Gvaramadze (1997). The HH objects are visible in H_2 as well as [FeII]. Hu (1996) present a proper motion and radial velocity study of HH 205 and 206. O'Dell et al. (1997b) analyze Fabry-Perot observations. A vast literature exists on the BN/IRc2 region, a recent study with references to the main literature is given by Gezari, Backman, Werner (1998).

HH 208 *(5 32, -05 24).* Original paper: Axon & Taylor (1984), who present electronographic plates and spectra. This is a single little-studied HH object (formerly M42-HH8), seen in the HST images of Hester et al. (1991), and O'Dell et al. (1997a). Fabry-Perot observations are discussed by O'Dell et al. (1997b). Detailed HST NICMOS images are presented by Schultz et al. (1999).

HH 209 *(5 32, −05 23).* Original paper: Axon & Taylor (1984), who present electronographic plates and spectra. This object (formerly M42-HH9) is resolved into two close knots and a filament in the HST images of Hester et al. (1991) and O'Dell et al. (1997a). It is detected in the H_2 and [FeII] images of Allen & Burton (1993). Fabry-Perot observations are discussed by O'Dell et al. (1997b).

HH 210 *(5 32, −05 22).* Original paper: Axon & Taylor (1984), who present electronographic plates and spectra. This object (formerly M42-HH10) shows a wealth of detail in the HST images of Hester et al. (1991) and O'Dell et al. (1997a). A proper motion study of Jones & Walker (1985) suggests an origin in the BN region. Fabry-Perot observations are discussed by O'Dell et al. (1997b). The infrared images of Allen & Burton (1993) do not detect it in H_2, but it is prominent in [FeII]. Hu (1996) presents a high-resolution spectrum.

HH 211 *(3 40, +31 51).* Original paper: McCaughrean, Rayner, Zinnecker (1994). This is a fine highly collimated bipolar jet located in the IC 348 region. The jet has so far only been detected in molecular hydrogen through near-infrared imaging. The jet is 0.15 pc long and the lobes emanate from a dense NH_3 core (Bachiller, Guilloteau, Kahane 1987). The jet coincides with a molecular outflow, and both are driven by a cold sub-mm source (McCaughrean, Rayner, Zinnecker 1994). Sub-millimeter photometry of the source is given by Dent, Matthews, Ward-Thompson (1998). The region is close to IC 348, a cluster of young stars (Strom, Strom, Carrasco 1974), and harbours a number of Hα emission stars (Herbig 1954b). Infrared images of the cluster are discussed by Lada & Lada (1995), and X-ray observations by Preibisch, Zinnecker, Herbig (1997). A detailed optical/infrared study of the stellar population within the core of IC 348 was performed by Luhman et al. (1998).

HH 212 *(05 41, −01 04).* Original paper: Zinnecker, McCaughrean, Rayner (1998), who present infrared imaging and spectroscopy. This is a spectacular molecular hydrogen jet, which is only seen in the infrared except for the most distant bow shock which also shows up in [SII] emission CCD images. The jet is highly symmetric, and centered on the cold IRAS source 05413–0104, observed at 1300 μm by Zinnecker et al. (1992) and at other sub-millimeter wavelengths by Dent, Matthew, Ward-Thompson (1998). Claussen et al. (1998) have detected a bipolar distribution of masers around the source along the jet axis, and their VLBI measurements combining radial velocities and proper motions suggest a flow inclination of only 4 degrees to the plane of the sky, and an origin of the outflow as close as 40 AU from the source.

HH 213 *(17 59, −24 17).* Original paper: Reipurth (1981). This is a little HH flow consisting of two knots, one with the appearance of a small bow shock as seen in CCD images (Reipurth, in preparation). They are located in the active star formation region M8.

HH 214 *(20 18, +37 00).* Original paper: Neckel & Staude (1987a), who present CCD images, long-slit spectroscopy and polarimetry. This is a single HH knot located in the brighter lobe of a bipolar reflection nebula around the bright IRAS source 20183+3700, located in small dense cloudlet in Cygnus. It was found independently through spectroscopy by Magakyan (1988). The HH object was studied spectroscopically by

Magakian & Movsessian (1995). Scarrott, Rolph, Tadhunter (1991b) also did surface polarimetry of the reflection nebula.

HH 215 *(20 45, +67 46).* Original paper: Neckel et al. (1987), who present CCD images and long-slit spectroscopy. These are two Herbig-Haro objects lying on a line through the young star PV Cephei and partly within its principal reflection lobe. The reflection nebula is highly variable (Cohen, Kuhi, Harlan 1977, Cohen et al. 1981, Neckel & Staude 1984), and is bipolar (Levreault & Opal 1987). Spectroscopy of the nebula is reported by Cohen, Kuhi, Harlan (1977), Cohen et al. (1981), Neckel et al. (1987). Carr (1990) detected Brγ and H_2 emission towards the source. Levreault (1984) mapped a molecular outflow. Anglada et al. (1992) detected PV Cep in the radio continuum. Fuente et al. (1998) present ^{13}CO, CS and 1.3 mm continuum maps. HH 215 forms the innermost part of a much larger bipolar HH flow, HH 315, from PV Cep. See also notes for HH 415.

HH 216 *(18 16, −13 53).* Original paper: Meaburn & White (1982). This is a large elongated HH object (formerly M16-HH1) situated in prominent elephant-trunks in the HII region NGC 6611. Extensive optical and ultraviolet spectroscopy of the line and continuum emission from this object are reported by Meaburn & White (1982), Meaburn (1982), Meaburn & Walsh (1984), Krautter, Reipurth, Eichendorf (1984), and Meaburn & Whitehead (1990); the latter also present various interference filter CCD images. No energy source has been identified so far (e.g. Walsh & White 1982).

HH 217 *(8 15, −35 43).* Original paper: Neckel & Staude (1995), who present CCD images, infrared images and long-slit spectroscopy. This is a bipolar Herbig-Haro flow, which is part of the larger nebulosity GM 1-27 = GN 08.15.9, surrounding the luminous embedded class I IRAS source 08159–3543. Centimeter radio emission from an ionized wind is reported by Felli et al. (1998).

HH 218 *(21 38, +50 00).* Original paper: Goodrich (1986b), who presents CCD images and spectroscopy of an HH object associated with V645 Cygni. This is a high-luminosity star with L = $6\times10^4 L_\odot$ at a distance of 3.5 kpc, corresponding to a massive newborn star. It is extensively studied, and principal references are given here. The star is associated with a small structured reflection nebula; images are shown by Cohen (1977), Goodrich (1986b), and Lenzen (1987). Optical spectra of star and nebulae are discussed by Cohen (1977), Humphreys, Merrill, Black (1980), Goodrich (1986b), Hamann & Persson (1989) and Corcoran & Ray (1997). Infrared spectroscopy is discussed by Harvey & Lada (1980), Geballe & Persson (1987), Kelly, Rieke, Campbell (1994), and Carr (1990) detected Brγ emission. Radio continuum observations are reported by Curiel et al. (1989b) and Skinner, Brown, Stewart (1993). Ammonia emission was mapped by Torrelles et al. (1989b). A molecular outflow has been observed by Rodríguez, Torrelles, Moran (1981), Torrelles et al. (1987), Schulz et al. (1989) and Verdes-Montenegro et al. (1991). H_2O and OH masers are reported by Lada et al. (1981) and Morris & Kazès (1982). A disk/envelope model has been fitted to the energy distribution by Natta et al. (1993).

HH 219 *(8 21, −41 59).* Original paper: Graham (1991), who presents a photograph and spectroscopy. This is a relatively compact and knotty object with a low-excitation spectrum. It is close to a small nebula reflecting light from the embedded luminous IRAS source 08211–4158, which has also been observed by Persson & Campbell (1988). Scarrott et al. (1992) present surface polarimetry of the reflection nebula.

HH 220 *(4 11, +28 03).* Original paper: Gómez de Castro (1993), who presents high-resolution CCD images. This is a short bipolar jet system stretching 4-6 arcsec on either side of the young star CW Tau (= HBC 25). Hirth, Mundt, Solf (1994a) discuss long-slit spectroscopy of the HH complex. CW Tau is a

T Tauri star observed spectroscopically by Rydgren, Strom, Strom (1976), Cohen & Kuhi (1979), Sun et al. (1985), Edwards et al. (1987), and Walker (1987), and with near-infrared spectroscopy by Greene & Lada (1996b). Sub-mm observations are given by Beckwith et al. (1990) and Beckwith & Sargent (1991).

HH 221 *(19 26, +09 32).* Original paper: Staude & Neckel (1992), who present CCD images and long-slit spectroscopy. This is a short Herbig-Haro flow oriented along the axis of the cometary reflection nebula Parsamian 21 (Parsamian 1965). The nebula was studied by Petrosian (1984), who derived a spectral type of F2-F5V. Further spectroscopic observations are discussed by Parsamian, Gasparian, Ohanian (1996). Near-infrared spectroscopy is presented by Greene & Lada (1996b). Cohen (1974a) presented infrared photometry and Eiroa & Hodapp (1990) infrared images. A polarization study was done by Draper, Warren-Smith, Scarrott (1985a). Hillenbrand et al. (1992) summarize optical/infrared photometric observations. Henning et al. (1998) present a 1300 μm map. No molecular outflow has been found (Bally & Lada 1983).

HH 222 *(5 33, −06 24).* Original paper: Cohen & Schwartz (1983). This is a peculiar Herbig-Haro object consisting of a number of large arcs or streamers, one of them 5 arcmin long, emanating from a common point 15 arcsec SE of the T Tauri star V571 Orionis in a region of L1641 rich in star formation. Reipurth & Sandell (1985) present CCD images, optical spectroscopy and mm observations and in the absence of other sources suggested that a wind from V571 Ori could interact with a cloud ridge producing the shock. This interpretation became obsolete with the discovery of a significantly polarized non-thermal VLA source at the core of the streamers, and with a faint near-infrared counterpart (Yusef-Zadeh et al. 1990). The VLA source was also observed by Morgan, Snell, Strom (1990).

HH 223 *(19 15, +19 06).* Original paper: Vrba et al. (1986), who present CCD images and polarization data. Long slit spectroscopy is presented by Movsesyan (1989). This is a Herbig-Haro object, possibly part of a small group, near the young IRAS source 19156+1906, studied by Davidson (1987) and located in the molecular cloud L723. Infrared images are presented by Hodapp (1994) and Palacios & Eiroa (1999). The source is at the center of a four-lobe molecular outflow (Goldsmith et al. 1984, Mirabel et al. 1987, Moriarty-Schieven & Snell 1989, Avery, Hayashi, White 1990, Hayashi, Hasegawa, Kaifu 1991, Girart et al. 1997). VLA observations of Anglada et al. (1991) show a double source, suggesting that each drives a molecular outflow. Anglada, Rodríguez, Torrelles (1996) found a thermal radio jet in the region. Only one source is detected at 1300 μm, corresponding to the north-eastern (VLA 2) of the VLA sources (Cabrit & André 1991, Reipurth et al. 1993a). Interferometric CO and single dish CS observations support that VLA 2 is powering the outflow activity (Hirano et al. 1998).

HH 224 *(16 24, −24 40).* Original paper: Wilking, Schwartz, Blackwell (1987), who noted this object in an objective prism survey of the Ophiuchus clouds. CCD images by Wilking et al. (1997a) and Gómez, Whitney, Wood (1998) show this to be a group of faint HH knots stretching towards the north-west. Reipurth et al. (1993a) suggested that they emanate from the southern component of the young binary SR 24. The binary was found by Struve & Rudkjøbing (1949), is identical to IRAS 16239–2438, and was detected at 1300 μm by Reipurth et al. (1993a). However, Wilking et al. (1997a) point out that other possible sources exist, and with the recent discovery of faint extensions to the north-west, the whole complex looks like a giant bow shock, which may well be driven by a more distant source.

HH 225 *(6 38, +09 47).* Original paper: Adams, Strom, Strom (1979), who present photographic plates and spectra. This is a group of HH knots located in the star formation region NGC 2264. A search for an energy source is discussed by Cohen & Schwartz (1983), and Cohen, Harvey, Schwartz (1985). HH 225 and

226 may be related to HH 125 (Walsh, Ogura, Reipurth 1992), see notes for this object.

HH 226 *(6 38, +09 42)*. Original paper: Adams, Strom, Strom (1979), who present photographic plates and spectra. This is a group of HH knots located in the star formation region NGC 2264. A search for an energy source is discussed by Cohen & Schwartz (1983), and Cohen, Harvey, Schwartz (1985). HH 226 and 225 may be related to HH 125 (Walsh, Ogura, Reipurth 1992), see notes for this object.

HH 227 *(6 57, −04 41)*. Original paper: Neckel & Staude (1992), who present CCD images and long-slit spectroscopy. This is a single HH object located in the S287 molecular cloud next to the 440 $L_\odot$ embedded IRAS source 06571–0441. The source drives a molecular outflow (Fukui 1989).

HH 228 *(16 05, −38 55)*. Original paper: Krautter (1986), who presents CCD images, long-slit spectroscopy, proper motions, and infrared photometry of the source. This is a bipolar jet complex emanating from the young star Th 28, which is located in the Lupus 3 cloud (Thé 1962), and is studied spectroscopically by Appenzeller, Jankovics, Krautter (1983), Appenzeller, Jankovics, Östreicher (1984), Krautter, Reipurth, Eichendorf (1984) and Graham & Heyer (1988). Far-infrared fluxes of Th 28 are given by Cohen & Schwartz (1987). Graham & Heyer (1988) discuss further long-slit spectroscopy of star and HH flow, and note an additional eastern bow shock, and point out a possible link to the nearby HH 78. Bacciotti & Eislöffel (1999) discuss long-slit spectroscopy of the jet.

HH 229 *(5 04, +30 20)*. Original paper: Hirth, Mundt, Solf (1994b). This is a bipolar HH flow from the T Tauri star RW Aur, with a total extent of at least 145″ (Mundt & Eislöffel 1998). The two sides are asymmetric in velocity and excitation. The physical properties of the jet is discussed by Bacciotti, Hirth, Natta (1996). Further long-slit spectra are analyzed by Hirth, Mundt, Solf (1997). A high-resolution spectrum of the star is presented by Hamann (1994). RW Aur is a close visual binary (Joy & van Biesbrock 1944), and the companion itself is also a very close binary (separation 0.12″) found by Ghez, Neugebauer, Matthews (1993). The star is extensively studied, see Herbig & Bell (1988) for references.

HH 230 *(4 35, +26 04)*. Original paper: Hirth, Mundt, Solf (1994b). This is a bipolar HH flow stretching 2 - 4 arcsec on either side of the T Tauri star DO Tau. A large velocity difference is seen between the two lobes. Long-slit spectra are analyzed by Hirth, Mundt, Solf (1997). Tessier, Bouvier, Lacombe (1994) suggest that DO Tau may be a binary with 0.2 arcsec separation. Optical spectroscopy of the star is discussed by Edwards et al. (1987) and infrared spectroscopy by Muzerolle, Hartmann, Calvet (1998). Sub-mm photometry is given by Manning & Emerson (1994). Koerner, Chandler, Sargent (1995) discuss 7 mm continuum VLA observations, and Koerner & Sargent (1995) present aperture synthesis imaging of CO (2-1) emission. See Herbig & Bell (1988) for further references.

HH 231 *(4 39, +25 10)*. Original paper: Hirth, Mundt, Solf (1994b). This is an asymmetric bipolar HH flow from the T Tauri star DP Tau. Long-slit spectra are analyzed by Hirth, Mundt, Solf (1997), and CCD images are presented by Mundt & Eislöffel (1998). For further references on the star, see Herbig & Bell (1988).

HH 232 *(21 41, +65 50)*. Original papers: Gyulbudaghian & Magakyan (1977a), Gyulbudaghian, Glushkov, Denisyuk (1978). This is a fairly bright HH object (formerly GGD 32) in the NGC 7129 region; it is connected with HH 103, and both objects are part of a large complex of fainter HH emission (Eiroa, Gómez de Castro, Miranda 1992, Magakyan et al. 1994). CCD images are presented by Hartigan & Lada (1985), Strom et al. (1986), Eiroa, Gómez de Castro, Miranda (1992), and Goodrich (1993). Spectra are discussed by Magakyan (1983), Cohen & Fuller (1985) and Magakyan et al. (1994). Ray et al. (1990) measured the proper motion of the object. It was detected in H_2 by Wilking et al. (1990). Cohen & Schwartz (1983) searched for an infrared energy source.

HH 233 *(04 35, +26 04).* Original paper: Magazzù & Martín (1994), who present spectra showing strong forbidden line emission close to HV Tauri, a weak-lined T Tauri star in the L1527 cloud. Woitas & Leinert (1998) suggest that the object seen by Magazzù & Martín (1994) is not an HH object, but rather an obscured companion star HV Tauri C, which itself has strong emission lines. CCD images show a tiny Hα strong knot about 18 arcsec NNW of HV Tau, suggesting that the outflow is rather extended (Reipurth, Bally, Devine, unpublished). Simon et al. (1992) found HV Tau to be a triple system.

HH 234 *(21 42, +65 54).* Original papers: Gyulbudaghian & Magakyan (1977a), Gyulbudaghian, Glushkov, Denisyuk (1978). This is a chain of three HH knots located in the NGC 7129 region. The HH nature of HH 234 (formerly GGD 34) was recognized spectroscopically by Magakyan (1984). Based on CCD images, Ray (1987) suggested HH 234 is a jet. A detailed imaging and spectroscopic study is presented by Gómez de Castro, Miranda, Eiroa (1993). Other CCD images are discussed by Hartigan & Lada (1985), Strom et al. (1986), and Eiroa, Gómez de Castro, Miranda (1992). Early spectra are presented by Magakyan (1984) and Goodrich (1986). The radial velocity field was measured by Magakyan & Movsesyan (1997a). Proper motion was measured by Ray et al. (1990). No source has been found so far (Cohen & Schwartz 1983), but the presence of a reflection nebula at the western edge of the jet suggests the source is located there (Ray 1987, Gómez de Castro, Miranda, Eiroa 1993).

HH 235 *(21 42, +65 54).* Original papers: Gyulbudaghian & Magakyan (1977a), Gyulbudaghian, Glushkov, Denisyuk (1978). This is an amorphous HH object (formerly GGD 35) close to HH 234 and HH 105 in the NGC 7129 region. CCD images are presented by Hartigan & Lada (1985), Strom et al. (1986) and Eiroa, Gómez de Castro, Miranda (1992). Spectra are discussed by Magakyan (1983), Cohen & Fuller (1985), Goodrich (1986), Magakyan et al. (1994), and Magakyan & Movsesyan (1997a). Proper motion has been measured by Ray et al. (1990).

HH 236/237/238/239 *(21 41, +65 52).* Original paper: Miranda, Eiroa, Gómez de Castro (1993). These are four faint HH objects located to the west of LkHα 234 in the NGC 7129 region; they do not appear to be physically related. Spectra are shown of HH 238 and 239 (formerly N7129-HH 3 and 4).

HH 240 *(5 17, −05 54).* Original paper: Cohen (1980a), who listed this object as RNO 40 in his survey of red and nebulous objects. It is located in the small highly opaque cloud L1634. CCD images show this to be a chain of HH knots with a bright central core (Bohigas, Persi, Tapia 1993). Spectra are discussed by Jones et al. (1984) and Goodrich (1986), and the object was detected in H_2 by Schwartz, Cohen, Williams (1987). Bohigas, Persi, Tapia (1993) present near-infrared images which show that a star is at the center of RNO 40, and they suggest this is the driving source. This is not supported by the large-field K' band image of Hodapp (1994). Previously, Cohen, Harvey, Schwartz (1985) found a far-infrared source to the E-S-E of HH 240. This is IRAS05173–0555 (Cohen & Schwartz 1987), detected at 1300 μm by Reipurth et al. (1993a) and at other sub-millimeter wavelengths by Dent, Matthew, Ward-Thompson (1998). Jones et al. (1984) measured a large proper motion of HH 240 with a direction that, within the errors, points away from the far-infrared source, and moreover found a faint HH object, now HH 241, on the opposite side of the source (see notes on HH 241), which suggests that HH 240 and 241 form a bipolar HH complex driven by IRAS05173–0555. This is confirmed by the infrared H_2 images of Hodapp & Ladd (1995) and Davis et al. (1997a), who find that HH 240/241 in H_2 form a highly symmetric bipolar outflow along a well defined axis centered on the IRAS 05173–0555 source. Limited CO data by Davis et al. (1997a) show the presence of a CO outflow, where the eastern part is redshifted and the western blueshifted.

HH 241 *(5 17, −05 55).* Original paper: Jones et al. (1984), who comment on a faint nebula east of HH 240. Cohen, Harvey, Schwartz (1985) note that this is an HH object. CCD images by Reipurth (unpublished) show HH 241 to be a group of faint HH objects appearing like bow shocks facing towards the east, away from the IRAS source 05173–0555, located between HH 240 and 241. Jones et al. (1984) show that HH 241 has proper motions directed away from the IRAS source. See also notes for HH 240.

HH 242 *(21 41, +65 52).* Original paper: Miranda, Eiroa, Gómez de Castro (1993), who present CCD images and long-slit spectroscopy. This is a bow-shaped HH object located close to a star, HL14, in the NGC 7129 region. The authors find HL14 to be an emission line star and suggest the HH object could be a bent jet from HL14. However, a chance superposition cannot be excluded.

HH 243 *(5 29, +12 51).* Original paper: Cohen (1980a), who listed this as RNO 43 in his survey of red and nebulous objects. This is a large HH flow terminating in a bright bow shock. It is bipolar, with the counterlobe ending in HH 244. CCD images are presented by Ray (1987), Mundt, Brugel, Bührke (1987), Reipurth (1991), Eislöffel & Mundt (1997), and Reipurth, Bally, Devine (1997). Spectroscopy is given by Jones et al. (1984) and Magakyan & Movsesyan (1994). Jones et al. (1984) also show proper motion vectors pointing away from a far-infrared source found by Cohen, Harvey, Schwartz (1985). This is an IRAS source 05295+1247 (Cohen & Schwartz 1987), with a large error in its position. Accurate positions derived from sub-mm data are given by Zinnecker et al. (1992) and Reipurth et al. (1993a), and from a radio continuum counterpart detected by Anglada et al. (1992,1998). Sub-millimeter photometry is presented by Dent, Matthew, Ward-Thompson (1998). A large molecular outflow has been mapped by Edwards & Snell (1984), Cabrit, Goldsmith, Snell (1988) and Bence, Richer, Padman (1996). Emission from high-density ammonia gas has been detected by Anglada et al. (1989) and Anglada, Sepúlveda, Gómez (1997). See also notes for HH 244, 245 and 179.

HH 244 *(5 29, +12 43).* Original paper: Reipurth (1991). This is a large bow shock in the receding lobe of a major outflow, which between the tips of HH 243 and HH 244 spans more than 8 arcminutes (>1pc). CCD images are presented by Reipurth (1991), Eislöffel & Mundt (1997) and Reipurth, Bally, Devine (1997). See notes for HH 243.

HH 245 *(5 29, +12 56).* Original paper: Jones et al. (1984), who provide proper motion estimates. Ray (1987) shows CCD images that reveal HH 245 to be a long well collimated chain of HH knots terminating in a bright bow shock (formerly RNO 43 North). He suggests a physical relation to HH 243, while Mundt, Brugel, Bührke (1987) argue for two separate flows. Bence, Richer, Padman (1996) demonstrate that the molecular outflow at HH 245 is part of a single huge outflow driven by HH 243 IRS (= IRAS 05295+1247). Further CCD images are presented by Eislöffel & Mundt (1997) and Reipurth, Bally, Devine (1997). Magakyan & Movsesyan (1993) present spectra, radial velocities and electron densities. The molecular flows are complex in this region (Edwards & Snell 1984, Cabrit, Goldsmith, Snell 1988). Anglada et al. (1992) draw attention to a radio continuum source near the base of the HH 245 flow. See notes for HH 243.

HH 246 *(8 19, −49 29).* Original paper: Graham (1986), who presents photographic plates and spectroscopy. This is a small, about 10 arcsec long jet emanating from a faint M-type star.

HH 247 *(5 39, −02 18).* Original paper: Malin, Ogura, Walsh (1987), who present photographic plates, low- and high-dispersion spectra and proper motion measurements. This is a chain of HH knots (formerly N2023-HH1,4,5) located at the edge of the large reflection nebula NGC 2023 around the B-star HD 37903. The region is seen well in the photographs of Witt & Malin (1989). Fuente, Martín-Pintado, Gaume (1995) report on high-density filaments in NGC 2023, and give further references to studies of the region. An H_2O maser was reported by Xiang & Turner (1995). The HH knots are lying on a line, and the proper motion vectors suggest an origin to the north-east, inside NGC 2023. An Hα emission star (HH 247 star C) is located on the flow axis and is a likely energy source for the entire flow. The following nomenclature is proposed: HH247 A,B,C = N2023 HH1A,B,C, HH247 D = N2023 HH5, HH247 E = N2023 HH4.

HH 248/249 *(5 39, −02 25).* Original paper: Malin, Ogura, Walsh (1987), who present photographic plates, spectroscopy and proper motion measurements. These are two groups of HH knots located south-east of the bright T Tauri star V615 Ori at the base of the Horsehead. HH 248 have proper motion vectors pointing towards V615 Ori, so this star is unlikely to be the energy source. It seems probable that the source is located between HH 248 and 249.

HH 250 *(19 18, +10 46).* Original paper: Devine, Reipurth, Bally (1997), who present an Hα CCD image. This is a relatively bright, fine bow shock emanating from the IRAS source 19190+1048.

HH 251/252/253/254 *(22 18, +63 17).* Original paper: Eiroa et al. (1993), who present CCD images. This is a chain of four Herbig-Haro objects, located in the S140N region, and situated on a straight line, suggesting that they represent different episodes of activity in a common driving source. HH 251 is a large and complex HH object with much substructure and a component of reflection nebulosity next to two infrared sources. Eiroa et al. (1993) consider one of these stars a likely energy source. HH 252, 253 and 254 are smaller HH objects with a simple structure. Near-infrared H_2 images and low resolution CO data are presented by Davis et al. (1998). The L1204 molecular cloud region is well known for several infrared/radio sources around an HII region (Evans et al. 1989 and references therein). Several radio continuum jets and bullets are found in the region (Schwartz 1989). The northern part of the cloud, which contains the HH objects, is less studied, but contains an IRAS source 22178+6317 with a molecular outflow (Fukui et al. 1986).

HH 255 *(4 19, +19 24).* Original papers: Burnham (1894), Böhm & Solf (1994). The mass flows around the binary star T Tauri are highly complex, and appear to be the result of two separate Herbig-Haro flows. HH 255 comprises a north-south bipolar flow, close to the plane of the sky, that apparently arises in T Tau-S and includes Burnham's Nebula to the south of T Tauri and the two spatiokinematic flow components C and D of Böhm & Solf (1994) close to T Tau; further spectroscopy of HH 255 is analyzed by Böhm & Solf (1997). HH 155 is, as described in the notes for that object, a flow from T Tauri that stretches to the west in an approaching lobe closer to the line-of-sight, including a bright HH knot and the spatiokinematic flow components A and B of Böhm & Solf (1994) close to T Tau. Burnham's Nebula was discovered by Burnham (1894) as a small nebula some arcseconds to the south of T Tauri. The extent of shock-excited [SII] emission around T Tau is shown by Bührke, Brugel, Mundt (1986, their fig.7). Almost all is south of T Tauri, but a small region is west and north of T Tau, and may be part of HH 155. Following Böhm & Solf (1994), it is recommended to define Burnham's Nebula as the large southern emission region forming part of the north-south oriented HH 255 flow. Optical spectroscopy of Burnham's Nebula shows that it has a Herbig-Haro spectrum (Herbig 1950, Osterbrock 1958, Schwartz 1974, 1975, Bührke, Brugel, Mundt 1986, Solf, Böhm, Raga 1988). An anomalous Fe/S ratio was determined by Beck-Winchatz & Böhm (1994), see also Beck-Winchatz, Böhm, Noriega-Crespo (1996). The reddening of Burnham's nebula is discussed by Cardelli & Brugel (1988). Ultraviolet spectroscopy is reported by Brown et al. (1981). Molecular hydrogen emission has been detected towards T Tauri by Beckwith et al. (1978), Schwartz et al. (1987), van Langevelde et al. (1994), Herbst et al. (1996), Quirrenbach & Zinnecker (1997), and Herbst, Robberto, Beckwith (1997). The nature of T Tau-S, the suspected driving source of HH 255, was discussed by Bertout (1983). For further references to the T Tau region, see the notes for HH 155.

HH 256 *(4 27, +17 52).* Original paper: Graham & Heyer (1990), who present a CCD image. This is a very faint little cluster of three HH knots (formerly GH 1), which may form the terminus of the blue-shifted lobe of the L1551 IRS 5 Herbig-Haro flow. Garnavich, Noriega-Crespo, Green (1992) show the object is of low-excitation. The wide-field images pf Devine, Reipurth, Bally (1999) show that HH 256 is located along the rather well defined axis of the red lobe of HH 30, and it is conceivable that it forms a distant bow shock in this flow.

HH 257 *(4 28, +17 54).* Original paper: Garnavich, Noriega-Crespo, Green (1992), who present CCD images. This is a faint object (formerly GNG 17) between HH 28 and HH 256.

HH 258 *(4 28, +17 57).* Original paper: Graham & Heyer (1990), who present CCD images. This is a group of faint HH knots, GH 2 to 8, whose individual designations should be retained, located immediately west of HH 28. GH 8 is relatively bright and very close to HH 28. The whole group is part of a large chain of HH knots winding out from L1551 IRS 5, including HH 259, HH 29, HH 260 and HH 261.

HH 259 *(4 28, +17 57).* Original papers: Stocke et al. (1988), Rodríguez et al. (1989a). This is a winding chain of HH knots, SH 229 and GNG 2, 5, 6, 7, 8, 9, 10 and 11 (it may be practical to keep these designations for individual knots), located between HH 28 and 29 and seen well in the CCD images of Graham & Heyer (1990), Garnavich, and Noriega-Crespo, Green (1992). Proper motions are measured by Devine, Reipurth, Bally (1999).

HH 260 *(4 28, +18 00).* Original paper: Garnavich, Noriega-Crespo, Green (1992), who present CCD images. This is a faint HH knot (formerly GNG 1) between HH 29 and HH 261. Further CCD images are presented by Davis et al. (1995).

HH 261 *(4 28, +18 00).* Original paper: Stocke et al. (1988), who present CCD images and spectroscopy. These are HH knots (formerly SH 219/220) located just east of HH 29, and seen in the images of Rodríguez et al. (1989a), Graham & Heyer (1990) and Garnavich, Noriega-Crespo, Green (1992).

HH 262 *(4 29, +18 05).* Original papers: Rodríguez et al. (1989a), Graham & Heyer (1990). These are a complex group of many faint HH knots, brightest among them knots GH 9 and 10, in addition to the fainter knots GNG 18,19,20,21,22 found by Garnavich, Noriega-Crespo, Green (1992); it is suggested to retain these designations for the individual knots. These knots may be either a counterflow from L1551 IRS5, or may be driven by the nearby class I source L1551 NE; this latter source has its own outflow activity (Emerson et al. 1984, Draper, Warren-Smith, Scarrott 1985b, Campbell et al. 1988, Pound & Bally 1991, Moriarty-Schieven & Wannier 1991, Barsony & Chandler 1993, Moriarty-Schieven, Butner, Wannier 1995, Rodríguez, Anglada, Raga 1995, Hodapp & Ladd 1995). Spectra of knots GH 9 and 10 are presented by Graham & Rubin (1992), who argue that the group of HH knots are likely to be a counterflow from L1551 IRS 5. López et al. (1995) found an additional extended emission region. A detailed kinematic study of HH 262 based on proper motions and Fabry-Perot data is presented by López et al. (1998). Devine, Reipurth, Bally (1999) note that the well defined flow axis of HH 454 driven by L1551-NE goes through and along the easternmost part of HH 262, called HH 262E.

HH 263 *(4 28, +18 01)*. Original paper: Stocke et al. (1988), who obtained CCD images and spectra. This is a small group of HH knots (formerly SH 214, or GNG 3) south of the HH 102 reflection nebula, seen well in the CCD images of Graham & Heyer (1990), Garnavich, Noriega-Crespo, Green (1992) and Davis et al. (1995). Garnavich, Noriega-Crespo, Green (1992) suggest that the knots, which lie along the extension of the HH 30 counterjet, may be caused by this jet.

HH 264 *(4 28, +17 59)*. Original papers: Stocke et al. (1988), Graham & Heyer (1990) and Garnavich, Noriega-Crespo, Green (1992), who all present CCD images, the first authors also present some spectroscopy. This is a large, very complex region of emission-knots (formerly GNG 4) south of the HH 102 reflection nebula. It possibly represents the shock interaction of the L1551 IRS 5 outflow with the walls of the cavity carved by the outflow in the L1551 molecular cloud. Designations, positions and [SII]/Hα ratios for individual knots are given by Garnavich, Noriega-Crespo, Green (1992). Further CCD images are presented by Davis et al. (1995).

HH 265 *(4 28, +18 05)*. Original paper: Garnavich, Noriega-Crespo, Green (1992), who present CCD images. This is an isolated low-excitation HH knot (formerly GNG 25) located in the middle of the L1551 cloud. No energy source has been identified. Wide-field CCD images showing the location of HH 265 relative to other HH flows in L1551 are presented by Devine, Reipurth, Bally (1999).

HH 266 *(4 28, +18 10)*. Original paper: Garnavich, Noriega-Crespo, Green (1992), who present CCD images. This is a faint high-excitation HH knot (formerly GNG 24) located at the north-eastern edge of the L1551 cloud, possibly related to the HH 30 jet. López et al. (1995) present wide-field CCD images of the region, and López et al. (1996) discuss proper motions and a radial velocity measurement.

HH 267 *(3 20, +30 49)*. Original paper: Bally et al. (1997), who present a CCD image. This is an extended cluster of HH knots in the L1448 cloud. For further references to the region, see notes for HH 197.

HH 268 *(3 21, +30 37)*. Original paper: Bally et al. (1997), who present CCD images and spectra. This is a small group of rather faint HH knots in the L1448 cloud. For further references to the region, see notes for HH 197.

HH 269 *(5 32, −05 25)*. Original paper: Feibelman (1976), who recognized this as a high-velocity emission feature. Cudworth & Stone (1977) measured proper motions towards the west. In an extensive study based on low- and high-resolution spectroscopy and HST images, Walter et al. (1995) found that this object appears to fit into the class of HH objects. It is an elliptical shell with dimensions $41'' \times 23''$, with a low excitation spectrum, and some parts with high velocities. O'Dell et al. (1997b) made a Fabry-Perot map of the Orion Nebula, which includes HH 269.

HH 270 *(5 48, +02 55*. Original paper: Reipurth, Raga, Heathcote (1996), who present deep Hα and [SII] images. This flow consists of a chain of five faint HH knots emanating from an embedded near-infrared source, detected at 3.6 cm by Rodríguez et al. (1998a). The flow is directed towards the apex of the HH 110 flow, and the proper motion vector of HH 270A points in the same direction. It is therefore suggested that the HH 110 flow is the result of a grazing collision between the HH 270 flow and a molecular cloud core detected at mm-wavelengths. Alternatively, Hurka, Schmid-Burgk, Hardee (1999) suggest a deflection by an ambient magnetic field.

HH 271/272/273 *(6 10, −06 11)*. Original paper: Carballo & Eiroa (1992), who present CCD images. These are HH objects (formerly GGD 17/HH1,2,3) found near the reflection nebula GGD 17 in the Mon R2 region. HH 261 is a small jet emanating from the rich emission line T Tauri star Bretz 4. HH 262 is a group of knots located further downstream and may be part of the same flow. HH 263 is a faint knot somewhat more isolated. The positions of the HH objects are very approximate. Spectroscopy of Bretz 4 is discussed by Cohen & Kuhi (1979) and Carballo & Eiroa (1992), and infrared photometry by Carballo, Eiroa, Mampaso (1988). Bretz 4 is probably identical to the IRAS source 06103−0612, and is observed at 1300 μm by Reipurth et al. (1993a) and at more sub-millimeter wavelengths by Dent, Matthew, Ward-Thompson (1998).

HH 274 *(12 49, −76 50)*. Original paper: Reipurth (unpublished). CCD images of IRAS 12496-7650, the driving source of the HH 52/53/54 complex (Cohen & Schwartz 1987, Hughes et al. 1989, 1991) reveal a faint optical stellar counterpart with a small HH object on the side of the star facing the HH 52/53/54 objects.

HH 276 *(04 19, +26 50)*. Original paper: Eislöffel & Mundt (1998), who present CCD images. This is an about 150″ long flow consisting of at least 4 faint HH knots. The axis of this flow is almost perpendicular to and in projection runs across the HH 157 jet from FS Tau B. The source of HH 276 has not yet been located.

HH 277 *(03 23, +30 28)*. Original paper: Bally et al. (1997), who present a CCD image. This is a relatively isolated HH object in L1448, which together with HH 196 lies on a line through L1448 IRS 3; these two objects are nearly equidistant from this source, suggesting a possible relation between the two HH objects. See also notes for HH 197.

HH 278 *(03 23, +30 15)*. Original paper: Bally et al. (1997), who present a CCD image. This is a large diffuse object located midway between the L1448 and L1455 clouds. See also notes for HH 279.

HH 279 *(03 24, +30 06)*. Original paper: Bally et al. (1997), who present a CCD image. This is a chain of HH emission extending over about 5 arcminutes, with several condensations, of which especially one, HH 279C, is very bright. The HH object lies in the L1455 cloud near the blue lobe of a major molecular outflow apparently driven by L1455 IRS1 (Goldsmith et al. 1984, Levreault 1988, Bachiller & Cernicharo 1986b, Juan et al. 1993). L1455 IRS1 (= IRAS 03245+3002) is a class I source with a luminosity of 9.7 $L_\odot$ (Davidson & Jaffe 1984), and is associated with an H_2O maser (Cesaroni et al. 1988, Persi, Palagi, Felli 1994).

HH 280 *(03 20, +30 07)*. Original paper: Bally et al. (1997), who present a CCD image. This is a very extended and loose group of HH knots, which lies some 20 arcmin west of the L1455 cloud core. See also notes for HH 279.

HH 281/282/283/284/285 *(5 34, +31 58)*. Original paper: Torrelles et al. (1992a). This is a small cluster of HH objects (formerly AFGL 5157/HH1-5) in the region of AFGL 5157 (IRAS 05345+3157). The infrared source illuminates the reflection nebula NGC 1985. The region has a bipolar outflow (Snell et al. 1988), an ammonia core (Torrelles et al. 1992a), and H_2O maser emission (Verdes-Montenegro et al. 1989, Torrelles et al. 1992c, Xiang & Turner 1995). Chen et al. (1999) present a detailed near-infrared imaging study of the region, and give more references.

HH 286 *(04 29, +18 10)*. Original paper: Devine, Reipurth, Bally (1999), who show CCD images. This is a large incomplete bow shock, located to the north-east of L1551 along the red lobes of the flows from both L1551-NE and IRS 5. It is not known which of these two sources is responsible for HH 286.

HH 287 *(05 33, −05 07)*. Original paper: Reipurth, Bally, Devine (1997), who present interference filter CCD images. This is a faint HH knot associated with a small reflection nebula some arcminutes south of IRAS 05329−0505, which drives the HH 294 jet. Yu, Bally, Devine (1997) detect a faint H_2 knot (YBD 70) coincident with HH 287.

HH 288 *(00 34, +63 47)*. Original paper: McCaughrean (1997), who present an infrared H_2O image. This is a compact HH object associated with a dramatic, 5 arcmin long, collimated H_2 flow from the IRAS source 00342+6347 in Cassiopeia. The HH object is the only place where this infrared flow has an optical counterpart. Sub-millimeter photometry of the source is given by Dent, Matthews, Ward-Thompson (1998). The CO kinematic distance is 2 kpc.

HH 289 *(05 36, −01 44)*. Original paper: Mader et al. (1999), who present CCD images and infrared images. This is a chain of faint HH knots apparently emanating from the IRAS source 05355−0146, which is embedded in the small cometary globule Ori-I-2 in the Orion complex. A molecular outflow was noted here by Sugitani et al. (1989), and a more complete millimeter study of outflow and globule was presented by Cernicharo et al. (1992).

HH 290 *(5 44, +20 59)*. Original paper: Moreira & Yun (1995), who present CCD images and infrared H_2 images. This is a chain of HH objects emanating from a source embedded in the Bok globule CB 34. The globule contains a single IRAS source 05440+2059 and a small aggregate of embedded young stars (Alves & Yun 1995). A molecular flow has been detected by Yun & Clemens (1994). Codella & Scappini (1998) mapped CB 34 in NH_3. Launhardt & Henning (1997) present 1300 μm photometry of the source and suggest a distance of 1500 pc.

HH 291 *(5 44, +20 58)*. Original paper: Moreira & Yun (1995), who present CCD images and infrared H_2 images. This is a faint HH object in the Bok globule CB 34. See also notes for HH 290.

HH 292 *(05 34, −06 35)*. Original paper: Mader et al. (1999), who present CCD images. This is a small bipolar HH flow centered on the young star BE Ori, which is highly variable ($13 < m_{pg} < 17.5$). It has a spectral type of K0 and bright emission lines (Cohen & Kuhi 1979). Near-infrared photometry is given by Nakajima et al. (1986), and ir polarization measurements by Casali (1995). Measurements of ^{13}CO and HCO^+ gas is given by Chen, Fukui, Yang (1992).

HH 293 *(05 32, −05 03)*. Original paper: Reipurth, Bally, Devine (1997), who present interference filter CCD images. This is a short bright jet, which emits exclusively in [SII] with no Hα emission. Yu, Bally, Devine (1997) show that the jet is bright in molecular hydrogen. HH 293 is located a few arcminutes north of HH 294, and the two jets have almost parallel axes. See also notes for HH 294.

HH 294 *(05 32, −05 05)*. Original paper: Reipurth, Bally, Devine (1997), who present interference filter CCD images. This is a finely collimated chain of knots emanating along the western lobe of the Haro 5a/6a reflection nebula in Orion (Haro 1953), centered on the luminous IRAS source 05329−0505 (Wolstencroft et al. 1986), which appears to be in an FU Orionis state (Reipurth & Aspin 1997). IRAS 05329–0505 is also known as MMS 7 and is part of a long filament of 1300 μm sources in OMC 2/3 (Chini et al. 1997a). The source was detected at 3.6 cm with the VLA (Reipurth, Rodríguez, Chini 1999). The source drives a giant HH flow with HH 41, 42, 128, and 129 in its eastern lobe, and HH 295 in the western lobe (Reipurth, Bally, Devine 1997), but in a detailed molecular hydrogen study of the region, Yu, Bally, Devine (1997) suggest that other nearby sources could also play a role in driving some of these more distant HH objects. The OMC 2/3 region contains two large star forming cores, which have been extensively studied, and the following are only some of numerous studies. Infrared studies of the embedded stellar population include Gatley (1974), Cohen & Frogel (1977), Thronson et al. (1978), Thronson & Thompson (1982), Pendleton et al. (1986), Rayner et al. (1989), Johnson et al. (1990) and Jones et al. (1994). Millimeter studies are presented by Bally et al. (1987), Tatematsu et al. (1993a), Dutrey et al. (1993), Cesaroni & Wilson (1994), Castets & Langer (1995), and Chini et al. (1997a). 1300 μm and sub-millimeter maps are presented by Mezger, Wink, Zylka (1990), Chini et al. (1997a), Lis et al. (1998), and Johnstone & Bally (1999).

HH 295 *(05 32, −05 06).* Original paper: Reipurth, Bally, Devine (1997), who present Hα and [SII] CCD images. This is a loose cluster of HH knots spreading across 3 arcminutes, and located 12 arcmin west of IRAS 05329–0505. HH 295 appears to be one lobe of a giant HH flow driven by the IRAS source, and with HH 41, 42, 128, and 129 in the eastern lobe. Yu, Bally, Devine (1997) suggest that several different sources are responsible for the HH and H_2 flows in the region. See also notes for HH 294.

HH 296 *(05 33, −06 19).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. This is a faint group of HH knots in the L1641-N region. It is possibly associated with HH 297. See also notes for HH 303.

HH 297 *(05 33, −06 18).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. This is a single faint HH knot in the L1641-N region. It is possibly associated with HH 296. See also notes for HH 303.

HH 298 *(05 33, −06 23).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. This is an east-west chain of three HH knots about 70 arcsec long located in the L1641-N region. See also notes for HH 303.

HH 299 *(05 33, −06 21).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. This is a fairly bright HH object, linked to diffuse wisps of emission, and located in the L1641-N region. At 2.12 μm it displays a jet-like morphology (SMZ 9; Stanke, McCaughrean, Zinnecker 1998). See also notes for HH 303.

HH 300 *(04 22, +24 16).* Original paper: Reipurth, Bally, Devine (1997), who present interference filter CCD images. This is a giant HH flow with two major bow shocks located 1.2 pc south-west of and on a line through the IRAS 04329+2436 source embedded in the B18 cloud in Taurus. Both bow shocks are redshifted. Opposite and very close to the source there is a small blueshifted knot, HH 300D, which was also found by Gómez, Whitney, Kenyon (1997), and observed spectroscopically by Kenyon et al. (1998). The source is a class I source with a luminosity of only 1.3 $L_{\odot}$, and an unusually rich near-infrared spectrum (Greene & Lada 1996a). This source was detected in the near- and mid-infrared by Myers et al. (1987), who give JHKLMNQ photometry, at 1300 μm by Moriarty-Schieven et al. (1994), and at 3.6 cm by Rodríguez & Reipurth (1998). Polarimetric observations are presented by Lucas & Roche (1998a). Moriarty-Schieven et al. (1992) suggest that there may be a molecular outflow at the source. Ungerechts & Thaddeus (1987) include B18 in their low-resolution CO map of Taurus.

HH 301/302 *(05 34, −06 23).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. These two objects are among the brightest HH objects in the L1641-N region. They contain several bright knots plus a chain of fainter more diffuse emission knots along a well defined axis passing through the L1641-N cluster, from which it appears to originate. Both objects are detected at 2.12 μm (SMZ 12 and 11; Stanke, McCaughrean, Zinnecker 1998). See also notes for HH 303.

HH 303 *(05 33, −06 21).* Original paper: Reipurth, Devine, Bally (1998), who present interference filter CCD images. This is a well collimated chain of knots emanating from IRAS 05338−0624 in the L1641-N region. The flow was first seen on photographic plates by Reipurth (1985a). The HH 303 jet is coinciding with the blue lobe of the L1641-N *molecular outflow*, which has been studied by Fukui et al. (1986, 1988), Wilking, Blackwell, Mundy (1990), and Morgan & Bally (1991). A *molecular hydrogen* image is presented by Davis & Eislöffel (1995), and Stanke, McCaughrean, Zinnecker (1998). An *infrared cluster* was studied by Strom, Margulis, Strom (1989), Hodapp & Deane (1993) and Chen et al. (1993). The *source* was detected by IRAS (Strom et al. 1989), in the far-infrared by Di Francesco et al. (1998), and in the mm and cm continuum by Wilking et al. (1989), Mundy et al. (1993), Chen, Zhao, Ohashi (1995) and Anglada et al. (1998), and possibly at 10 μm by Stanke, McCaughrean, Zinnecker (1998). Sub-millimeter photometry is given by Dent, Matthew, Ward-Thompson (1998). A *water maser* was detected by Xiang & Turner (1995) and Claussen et al. (1996). *Dense molecular cores* are discussed by Fukui et al. (1988), Chen, Fukui, Iwata (1993), McMullin, Mundy, Blake (1994), Chen, Ohashi, Umemoto (1996), Anglada et al. (1997) and Reipurth, Devine, Bally (1998).

HH 304 *(05 34, −06 16).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. This is a group of HH knots with a complex morphology, and an axis pointing back towards the L1641-N cluster. It is detected at 2.12 μm (SMZ 5) by Stanke, McCaughrean, Zinnecker (1998). See also notes for HH 303.

HH 305 *(05 34, −06 19).* Original paper: Reipurth, Devine, Bally (1998), who present a [SII] image. These six HH objects form a 4 arcmin long chain, possibly a bipolar structure with a center near the variable star PR Ori, which, however, may not be related to the flow.

HH 306/307/308/309/310 *(05 33, −05 51).* Original paper: Reipurth, Devine, Bally (1998), who present various CCD images. This is a giant chain of what appears to be very large bow shocks all facing away from the L1641-N cluster (see references to the cluster under HH 303). HH 310 is 47 arcmin from the center of the L1641-N cluster, corresponding to a projected length of 6.3 pc. It is possible that the infrared flow SMZ 23 forms a 1.8 pc long counterflow (Stanke, McCaughrean, Zinnecker 1998).

HH 311 *(05 47, +02 52).* Original paper: Winkler & Reipurth (1992), who present interference filter CCD images and a few spectra. This is a several arcminute large and rather filamentary complex of knots half a degree from the nearest molecular cloud in Orion, and Winkler & Reipurth (1992) speculated that it could be a supernova remnant. However, in an imaging and proper motion study, Reipurth, Bally, Devine (1997) demonstrated that it is actually a distant bow shock in the blue lobe of the HH 111 jet complex. Rosado, Raga, Arias (1999) present a kinematic study based on Fabry-Perot observations. See also notes for HH 111.

HH 312 *(16 22, −24 14).* Original paper: Wilking et al. (1997a), who present a [SII] CCD image. This is a well collimated jet that extends 1.5 arcminutes southeast from SR4, which is an emission line star (Struve & Rudkjøbing 1949) of spectral type K5-K7 (Cohen & Kuhi 1979) and with a bolometric luminosity of 5.5 $L_\odot$ (Wilking, Lada, Young 1989). It is also a weak X-ray source (Casanova et al. 1994). The jet is located in a dense region of the ρ Ophiuchi cloud, which is very rich in star formation. Gómez, Whitney, Wood (1998) also show a [SII] CCD image.

HH 313 *(16 23, −24 16)*. Original paper: Wilking et al. (1997a), who present a [SII] CCD image. This is a slightly extended [SII] emission knot (also shown in an image by Gómez, Whitney, Wood 1998), which coincides with the *infrared H_2 knot* labeled 2317.6–1622 (Cómeron et al. 1993) or H5 (Dent, Matthews, Walter 1995) or knot A by Davis & Eislöffel (1995). It is located in the northwest lobe of a well collimated *molecular outflow* (André et al. 1990, Dent, Matthews, Walter 1995, Yu & Chernin 1997) which is driven by the class 0 object VLA 1623 (André et al. 1993, Pudritz et al. 1996). Holland et al. (1996) and Greaves, Holland, Ward-Thompson (1997) present sub-mm polarimetry. The source is associated with an H_2O maser (Claussen et al. 1996). Ceccarelli et al. (1997) determined the mass loss rate from the source through OI 63 μm emission measurements.

HH 314 *(16 23, −24 34)*. Original paper: Wilking et al. (1997a), who present a [SII] CCD image. This is an isolated HH knot in the ρ Ophiuchi clouds. Wilking et al. (1997a) tentatively associate it with the young star DoAr 25. Gómez, Whitney, Wood (1998) show a [SII] CCD image, and find another object, HH 418, seven arcminutes further to the west.

HH 315 *(20 45, +67 49)*. Original papers: Gómez, Kenyon, Whitney (1997) and Reipurth, Bally, Devine (1997), who independently discovered this HH flow and present interference filter CCD images. This is a giant bipolar HH flow consisting of a number of groups of HH knots displaying s-shaped point symmetry around the young star PV Cep. The total extent is almost 20 arcminutes, corresponding to 2.6 pc in projection. The northern lobe is blueshifted and the southern redshifted. Levreault (1984) mapped a large molecular outflow, which is coincident with the HH flow. PV Cep is surrounded by a reflection nebula GM 29 (Gyulbudaghian & Magakyan 1977b) or RNO 125 (Cohen 1980a), which is highly variable (Cohen, Kuhi, Harlan 1977, Cohen et al. 1981) and consists of two lobes (Levreault & Opal 1987). PV Cep may be an EXor (Herbig 1989). It was detected in the radio continuum by Anglada et al. (1992). Near-infrared spectroscopy of PV Cep is presented by Hamann et al. (1994) and Greene & Lada (1996b), and optical spectroscopy by Corcoran & Ray (1997). Close to the star there is a group of HH knots, HH 215, found by Neckel et al. (1997), which forms the innermost part of the giant HH 315 flow. A small HH knot, HH 415, is located north-east of PV Cep, and it is unclear if it belongs to the HH 215/315 flow or is from a separate flow in the region.

HH 316 *(05 33, −06 06)*. Original paper: Reipurth, Devine, Bally (1998), who present an Hα CCD image. This is a finely collimated, slightly curved jet, stretching over 2 arcminutes. It is located just west of the giant HH 307 bow shock in the L1641-N region.

HH 317 *(03 24, +30 01)*. Original paper: Bally et al. (1997) who present a CCD image. This is a large group of HH knots located in the outskirts of the L1455 cloud core. See also notes for HH 279.

HH 318 *(03 24, +30 03)*. Original papers: Bally et al. (1997) and Davis et al. (1997b), who present CCD images. This is a several arcmin long chain of HH knots (B,C,D) north-east of and on a line through the source L1455 IRS1 (= RNO 15-FIR = IRAS 03245+3002 = L1455 FIR). Knot A, which is south-west of the source, is only seen in H_2 in the near-infrared images of Hodapp (1994) and Davis et al. (1997a). The HH flow is co-axial with a well-collimated *molecular outflow*, which is one of several overlapping CO flows in the region, observed at mm-wavelengths by Frerking & Langer (1982), Goldsmith et al. (1984), Bachiller & Cernicharo (1986b), Levreault (1988), Juan et al. (1993), and Davis et al. (1997b). The *source* L1455

IRS1 is a cold far-infrared source (Davidson & Jaffe 1984, Tapia et al. 1997) and is associated with an *H_2O maser* (Cesaroni et al. 1988, Persi, Palagi, Felli 1994). Wiggling of the molecular outflow is interpreted as possibly due to the source being a binary (Terquem et al. 1999).

HH 319 *(4 29, +24 15)*. Original paper: Haro, Iriarte, Chavira (1953). This is an Hα emission object, also known as Haro 6-19, with a characteristic HH spectrum. On CCD images it shows complex structure (Mundt, priv. comm.).

HH 320 *(11 58, −64 51)*. Original paper: Corporon & Reipurth (1997), who present CCD images. These are two HH knots located in the red lobe of the molecular outflow from the embedded source IRAS 11590–6452 in the Sa 136 (= BHR 71) globule. Since the objects appear rather unobscured and look like bow shocks facing *towards* the IRAS source, it is not clear that they are driven by this source. See also notes for HH 321.

HH 321 *(11 59, −64 53)*. Original paper: Corporon & Reipurth (1997), who present CCD images. These are two HH knots located inside a large impressive flow cavity illuminated by the source IRAS 11590–6452, which is embedded in the Sa 136 (= BHR 71) globule. The source drives a well collimated CO outflow, which has strong enhancements of silicon monoxide and methanol (Bourke et al. 1997, Garay et al. 1998). Infrared images are presented by Bourke et al. (1993) and Yun et al. (1997).

HH 322 *(05 32, −06 22)*. Original papers: Eislöffel & Mundt (1997) and Devine et al. (1997), who present CCD images. This is a single HH knot south-west of HH 33/40, which together with diffuse emission to the east may form part of the large HH 33/40 working surface (Bally & Devine 1994).

HH 323 *(05 32, −06 20)*. Original paper: Devine et al. (1997), who present CCD images. This is a large, slightly diffuse HH object an arcminute west of HH 33. It is probably part of the large bow shock involving HH 33/40 and probably HH 322. Eislöffel & Mundt (1997) also imaged this object and called it HH 33X.

HH 324 *(05 33, −06 20)*. Original paper: Devine et al. (1997), who present CCD images. This is a single faint HH knot east of the giant HH 34 flow. No source is known.

HH 325 *(05 33, −06 31)*. Original paper: Devine et al. (1997), who present CCD images. This is a a group of very faint diffuse HH knots to the east of HH 134. No source is known.

HH 326 *(05 33, −06 34)*. Original paper: Devine et al. (1997), who present CCD images. This is a group of very faint HH knots north-east of HH 86-88. No source is known.

HH 327 *(05 33, −06 37)*. Original paper: Eislöffel & Mundt 1997) and Devine et al. (1997), who present CCD images. This is a jet-like group of HH knots east of HH 86-88. It seems to be an independent HH flow, although it cannot at present be excluded that it forms part of the giant HH 86-88 working surface.

HH 328 *(05 15, +07 12)*. Original paper: Reipurth, Bally, Devine (1997), who show a CCD image. This is a single HH knot near the HH 114 flow. It is possibly related to HH 329.

HH 329 *(05 15, +07 05)*. Original paper: Reipurth, Bally, Devine (1997), who show a CCD image. This is a single HH knot near the HH 115 flow. It may form a giant HH flow together with HH 328, parallel to the HH 114/115 flow.

HH 330 *(05 33, −05 06)*. Original paper: Yu, Bally, Devine (1997), who note that this is an optical counterpart to the H_2 knot YBD 80. This is possibly a bow shock in the east-west flow originating in IRAS 05329−0505, but the outflow activity in the region is highly complicated, see notes for HH 294.

HH 331 *(05 32, −05 02)*. Original paper: Yu, Bally, Devine (1997), who note that it is an optical counterpart to the H_2 knot YBD 1, which together with YBD 2, 3 and 7 appears to form a collimated flow in the OMC 2/3 region.

HH 332 *(19 18, +10 55)*. Original paper: Davis, Eislöffel, Smith (1996), who present interference filter CCD images. These objects are close to HH 32 and AS 353A, but has a quite different angle to AS 353A than does HH 32, so it is unclear if they come from this source. See also notes for HH 32.

HH 333 *(03 26, +31 15)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a very thin and about 5 arcmin long jet, thus exceedingly collimated, located in the northern part of the NGC 1333 cloud core. The jet is gently curved, with s-shaped point symmetry around a central faint Hα emission star. The western half is blueshifted and the eastern is redshifted.

HH 334 *(03 25, +31 12)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is an HH jet located about an arcminute north of HH 12, extending on both sides of a bright Hα emission star in the NGC 1333 cloud. A possibly related isolated HH knot lies about 1 arcminute beyond the eastern end of the jet. A small bow shaped knot lies 2 arcminutes northwest of the bright Hα star.

HH 335 *(03 26, +31 12)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a [SII] bright HH flow located near the center of NGC 1333, and is mostly lost in the glare of the bright stars, but it is easily seen in Hα–[SII] difference images. The flow appears to emanate from the emission line star LkHα 270.

HH 336 *(03 26, +31 09)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a bipolar HH jet centered on a faint Hα emission star located east of the NGC 1333 cloud core.

HH 337 *(03 25, +31 15)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This turns out not to be an HH object, but a glint due to a problem in the optical path of the instrument used.

HH 338 *(03 25, +31 09)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a large conglomerate of HH knots outside and to the west of the NGC 1333 cloud core. HH 338, HH 339 and HH 15 lie on a line through IRAS 03255+3103 (IRAS 1), which Phillips et al. (1988) found to drive a CO outflow along the same axis; the outflow was not detected by Knee, Cameron, Liseau (1990). IRAS 1 was first studied by Jennings et al. (1987).

HH 339 *(03 25, +31 04)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This HH object lies close to IRAS 03255+3103 (IRAS 1), and on a line defined by HH 15 and HH 338. See also notes for HH 338.

HH 340 *(03 25, +30 55)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. These are two HH knots in the southern part of the NGC 1333 cloud.

HH 341 *(03 25, +30 59)*. Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a tight cluster of HH knots with some resemblance to a bow shock, and located in the NGC 1333 cloud core. It lies in the extension of the blue molecular outflow lobe driven by IRAS 2 (Jennings et al. 1987); this source powers a quadrupolar molecular outflow (Liseau, Sandell, Knee 1988, Langer, Castets, Lefloch 1996, Bachiller et al. 1998a). Hodapp & Ladd (1995) find evidence for H_2 flows from IRAS 2. This source is observed in the infrared (Jennings et al. 1987), and submillimeter regime (Sandell et al. 1994, Lefloch et al. 1998a) and evidence for infall is presented by Ward-Thompson et al. (1996). Greaves, Holland, Ward-Thompson (1997) present 800 μm polarimetry.

HH 342 *(03 25, +31 00).* Original paper: Bally, Devine, Reipurth (1996), who present CCD images. These are two close HH knots lying on a line between NGC 1333 - IRAS 2 (Jennings et al. 1987) and HH 341, see notes for that object.

HH 343 *(03 25, +30 55).* Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a well-collimated chain of red-shifted HH knots in the southern part of the NGC 1333 cloud region. No probable source has been identified.

HH 344 *(03 25, +31 02).* Original paper: Bally, Devine, Reipurth (1996), who present CCD images. These are two HH knots near the center of the NGC 1333 cloud core. HH 344A coincides with the H_2 filament ASR 98 (Aspin, Sandell, Russell 1994), and HH 344B lies further to the south and is connected to HH 344A by diffuse emission.

HH 345/346 *(03 26, +31 03).* Original paper: Bally, Devine, Reipurth (1996), who present CCD images. These two objects together form a fine collimated HH flow in position angle 215 degrees emanating from the young star SVS 20 (LkHα 271). A compact, bright bow shock, HH 346A, is located $10''$-$15''$ southwest of SVS 20. An Hα bright bubble of emission extends further to the southwest. Faint Hα emission can be traced another 3 arcminutes to the southwest, where it encounters a large Hα bright arc, HH 345. Northeast of SVS 20 there are faint wisps of Hα emission which traces a counterflow. Spectra show that the HH 345/346 lobe SW of SVS 20 is blueshifted, and the NE side is red-shifted.

HH 347 *(03 26, +31 05).* Original paper: Bally, Devine, Reipurth (1996), who present CCD images. This is a pair of faint HH knots, which coincide with the H_2 patch HL 11 (Hodapp & Ladd 1995). The H_2 knots HL 3, 6, 10 and 11 plus ASR 57 (Aspin, Sandell, Russell 1994) form an *infrared bipolar flow* emanating from NGC 1333 - IRAS 4a, which is one of a pair of class 0 sources. Haschick et al. (1980) detected a pair of highly variable *H_2O masers*, and at the location Jennings et al. (1987) found a far-infrared source IRAS 4, which Sandell et al. (1991) revealed to be a $30''$ separation *sub-millimeter binary.* Lay, Carlstrom, Hills (1995) performed *mm interferometry*, which resolved each of IRAS 4a and 4b into close binaries. Liseau, Sandell, Knee (1988) found a *molecular outflow* emanating from IRAS 4, which Blake et al. (1995) showed to be quadrupolar. Lefloch et al. (1998a) found 1.3 mm continuum emission tracing the outflow cavity. Chernin, Masson, Fuller (1994) detected high velocity sulfur monoxide emission towards IRAS 4. Lefloch et al. (1998b) found widespread SiO emission in the region. Ceccarelli et al. (1997) measured [OI] 63 μm emission towards IRAS 4A, and Ceccarelli et al. (1999) detected water emission lines. A detailed study in CS is presented by Langer, Castets, Lefloch (1996). *Polarization measurements* at sub-mm wavelengths of IRAS 4a and 4b are presented by Minchin, Sandell, Murray (1995) and Greaves, Holland, Ward-Thompson (1997), at 3.4mm of IRAS 4a by Akeson et al. (1996), and at 3 mm by Akeson & Carlstrom (1997).

HH 348/349 *(03 26, +31 03).* Original paper: Bally, Devine, Reipurth (1996), who present CCD images. These are two faint HH knots in the NGC 1333 cloud core, and they appear to be connected by faint diffuse emission. They are possibly related to one of the components of the IRAS 4 quadruple system (see notes for HH 347).

HH 350 *(03 25, +30 54)*. Original paper: Bally, Devine, Reipurth (1996), who present a CCD image. This is a bow shaped filament just south of HH 343 in the southern part of the NGC 1333 cloud region.

HH 351 *(03 25, +30 40)*. Original paper: Bally, Devine, Reipurth (1996), who present a CCD image. This is an extended cluster of HH filaments south of the NGC 1333 cloud core. It could be a distant bow shock in a parsec scale flow from one of the IRAS sources embedded in the cloud core.

HH 352 *(03 26, +30 49)*. Original paper: Bally, Devine, Reipurth (1996), who present a CCD image. These are a few HH knots located south of the NGC 1333 cloud core. Bachiller et al. (1998b) note that these knots are lying along the axis of a molecular jet from SVS 13b.

HH 353 *(03 26, +31 19)*. Original paper: Bally, Devine, Reipurth (1996). This is a large, faint and diffuse HH object located north of the NGC 1333 cloud core, and outside of the CCD images published by Bally, Devine, Reipurth (1996).

HH 354 *(22 06, +58 57)*. Original paper: Reipurth, Bally, Devine (1997), who present a CCD image. This is a single HH object, which is a distant bow shock in a giant flow from the IRAS source 22051+5848 located in the windswept cloud L1165 in Cepheus. Parker, Padman, Scott (1991) found a *molecular outflow*. The source is associated with a small *reflection nebula* GY 22 (Gyulbudaghian 1982), which has been imaged in the optical and infrared by Tapia et al. (1997), Reipurth, Bally, Devine (1997) and Reipurth & Aspin (1997). *Infrared photometry* of the source is given by Persi et al. (1988), and *infrared spectroscopy* by Reipurth & Aspin (1997) indicates that the source is in a FUor state.

HH 355 *(04 19, +19 36)*. Original paper: Reipurth, Bally, Devine (1997), who present interference filter CCD images. This is a pair of very large bow shocks located about 15-20 arcminutes north and south of T Tauri, thus forming a giant bipolar HH flow with a total projected extent of about 1.5 pc. Spectra show that the northern lobe is redshifted and the southern blueshifted. HH 355 thus shares the same axis as the tiny HH 255 flow, which also has the same polarity of its blue and red lobes. Both HH 255 and HH 355 are most probably driven by the infrared companion to T Tauri. See also notes for HH 155 and HH 255.

HH 356 *(03 30, +31 16)*. Original paper: Alten et al. (1997). This is a diffuse HH object about one degree NW of the NGC 1333 cloud core.

HH 357 *(05 32, −05 08)*. Original paper: Yu, Bally, Devine (1997). This is an HH object in the OMC 3 cloud, which coincides with the bright H_2 knots YBD 4/5.

HH 358 *(23 22, +73 56)*. Original paper: Alten et al. (1997). This is a bright HH object and several fainter knots in the L1262 cloud. Kun (1998) suggest a distance of 180 pc.

HH 359 *(23 24, +74 06)*. Original paper: Alten et al. (1997). This is a single isolated HH knot in the L1262 cloud.

HH 360 *(04 01, +26 10)*. Original paper: Alten et al. (1997). These are two HH objects in the L1489 cloud, HH 360A is a fairly bright compact nebula, while HH 360B is a fainter more extended structure. Hodapp (1994) shows a K′ band image of the region. HH 360A is located very close to IRAS 04016+2610 = L1489 IRS, which was observed at sub-mm wavelengths by Moriarty-Schieven et al. (1994), and with near-infrared spectroscopy by Greene & Lada (1996b) and Chiar et al. (1998). Hogerheijde et al. (1997a,1998) present high resolution mm maps. Optical spectroscopy of the source is discussed by Kenyon et al. (1998), and near-infrared polarimetry by Whitney, Kenyon, Gómez (1997). Padgett et al. (1999) present HST/NICMOS images of the compact reflection nebula around the star.

HH 361 *(04 01, +26 13)*. Original paper: Alten et al. (1997). This is a faint HH object with some resemblance to a bow shock. It is located some arcminutes NW of HH 360A in the L1489 cloud.

HH 362 *(04 01, +26 12)*. Original paper: Alten et al. (1997). These are two faint diffuse HH objects a few arcminutes west of HH 361 in the L1489 cloud.

HH 363 *(22 26, +68 45)*. Original paper: Alten et al. (1997), who present a CCD image. The HH object, which is equally bright in Hα and in [SII], consists of two relatively bright knots, located close to the IRAS source 22266+6845. This source is embedded in the small compact and very opaque cloud L1221, and drives a U-shaped molecular outflow (Umemoto et al. 1991). The region is imaged at K$'$ by Hodapp (1994).

HH 364 *(22 37, +74 57)*. Original paper: Alten et al. (1997). This is a faint HH knot west of the HH 189 flow in the L1251 cloud. See notes for HH 189.

HH 365 *(19 41, +23 22)*. Original paper: Alten et al. (1997). This is a bow shaped HH object which lies 9 arcminutes north-east of 1548C27, and along the axis of the HH 165 jet emanating from this source. The HH 365 object appears to be a bow shock for the HH 165 jet. At the presumed distance of 2400 pc, the projected separation of HH 165 and HH 365 is 6.2 pc, but the distance is very uncertain. For references to 1548C27, see the notes for HH 165.

HH 366 *(03 43, +32 36)*. Original paper: Bally, Devine, Alten (1996), who present Hα + [SII] filter CCD images and high-resolution optical spectra. HH 366 is a giant bipolar HH flow stretching across 22 arcmin, corresponding to a projected length of 2.2 pc at a distance of 350 pc. The brighter southwestern lobe is redshifted, and the fainter eastern lobe is blueshifted. The HH flow is co-axial with a CO flow studied by Goldsmith, Langer, Wilson (1986), Fuller et al. (1991), Langer, Velusamy, Xie (1996) and Velusamy & Langer (1998). The outflow is driven by the class I object B5 IRS1 (Benson, Myers, Wright 1984, Beichman et al. 1990), detected at 3.6 cm by Rodríguez & Reipurth (1998), and is associated with a faint reflection nebula (Heyers et al. 1990, Moore & Emerson 1992). The source is fading with time at near-infrared wavelengths (Moore & Emerson 1994). The cloud core, Barnard 5, has a mass of about 50 $M_\odot$ (Langer et al. 1989) and is mapped in NH_3 by Benson, Myers, Wright (1984), and in ^{13}CO and at 100 μm by Beichman et al. (1988). Chemical evolution in the circumstellar structure of B5 IRS1 is suggested by Kelly, Macdonald, Millar (1996). Polarization studies of stars behind B5 are given by Joshi et al. (1985), Goodman et al. (1990) and I'lin, Khudyakova, Reshetnikov (1994). Starlight through the halo of B5 has been studied by Wannier et al. (1999).

HH 367 *(03 43, +32 33)*. Original paper: Bally, Devine, Alten (1996), who present Hα + [SII] filter CCD images. These are two faint HH knots apparently emerging from B5 IRS3. This source drives its own molecular outflow (Goldsmith et al. 1986). See also notes for HH 366.

HH 368 *(03 27, +30 20)*. Original paper: Alten et al. (1997). A single faint HH knot.

HH 369 *(03 27, +30 18)*. Original paper: Alten et al. (1997). A single faint HH knot two arcminutes south of HH 368.

HH 370 *(03 27, +30 17)*. Original paper: Alten et al. (1997). A single faint and diffuse HH knot an arcminute ESE of HH 369.

HH 371 *(03 27, +30 20)*. Original paper: Alten et al. (1997). These are two closely connected HH knots one and a half arcminutes north of HH 372.

HH 372 *(03 27, +30 19)*. Original paper: Alten et al. (1997). These are three bright HH knots forming a small compact cluster.

HH 373 *(22 35, +74 59)*. Original paper: Alten et al. (1997). This is a bright, large complex of HH knots north-west of the HH 189 flow in the L1251 cloud. See also notes for HH 149 and HH 189.

HH 374 *(22 36, +74 52)*. Original paper: Alten et al. (1997). This is a chain of two or three HH knots south-west of the HH 189 flow in the L1251 cloud.

HH 375 *(20 38, +67 50)*. Original paper: Devine, Reipurth, Bally (1997), who show an Hα + [SII] CCD image of the entire L1157 cloud. This is a single HH object, which coincides precisely with the southern one (A) of several infrared H_2 objects emanating from the embedded source IRAS 20386+6751 (Hodapp 1994, Davis & Eislöffel 1995). These objects coincide with a molecular outflow, which has strong enhancements of several species, e.g. SiO, ammonia and methanol (Umemoto et al. 1992, Mikami et al. 1992, Bachiller, Martin-Pintado, Fuente 1993, Tafalla & Bachiller 1995, Bachiller et al. 1995a, Zhang et al. 1995, Avery & Chiao 1996, Bachiller & Pérez Gutiérrez 1997). Interferometer data in CO are presented by Gueth, Guilloteau, Bachiller (1996), and in SiO by Gueth, Guilloteau, Bachiller (1998). Mm interferometer data of the circumstellar gas of the source are discussed by Gueth et al. (1997) and Meehan et al. (1998). The source is associated with an H_2O maser (Claussen et al. 1996). A distance of 440 pc is estimated by Viotti (1969). The source was detected at 3.6 cm by Rodríguez & Reipurth (1998).

HH 376 *(20 35, +67 43)*. Original paper: Reipurth, Bally, Devine (1997), who present a CCD image. This HH flow consists of a bright bow shock HH 376A, and a more distant fainter knot, HH 376B, both on a line passing through the IRAS source 20359+6745 located in the small cloud L1152 in Cepheus. The source is associated with a reflection nebula GM 1-12 (Gyulbudaghian & Magakyan 1976) or RNO 124 (Cohen 1980a).

HH 377 *(23 01, +61 25)*. Original paper: Devine, Reipurth, Bally (1997), who present a [SII] CCD image. This is the optical counterpart to a bright compact H_2 knot in the southern, blueshifted lobe of a molecular outflow (Eislöffel et al. 1996, Ladd & Hodapp 1997, Noriega-Crespo, Garnavich, Molinari 1998). Molecular hydrogen images at 6.9 and 9.6 μm are discussed by Noriega-Crespo, Garnavich, Molinari (1998). The driving source is IRAS 23011+6126, a bright class 0 source in the Cep E cloud (Lefloch, Eislöffel, Lazareff 1996), associated with an H_2O maser (Wouterloot & Walmsley 1986). The presence of two outflows suggests that the source is a close binary (Terquem et al. 1999).

HH 378 *(04 32, +54 32)*. Original paper: Devine, Reipurth, Bally (1997), who present an Hα CCD image. This is a very well collimated chain of four HH knots with a total extent of 7 1/2 arcminutes, forming a bipolar HH flow from the class I source IRAS 04327+5432, located on the flow axis.

HH 379 *(21 42, +47 18)*. Original paper: Devine, Reipurth, Bally (1997), who present an Hα + [SII] CCD image. The HH object is located outside a sharp-edged dark cloud, which contains a cometary reflection nebula, and the nearby IRAS source 21432+4719. The three objects are probably related.

HH 380 *(20 57, +52 22).* Original paper: Devine, Reipurth, Bally (1997), who show an Hα + [SII] CCD image. The HH flow consists of two groups containing several HH knots. They are located about 10 arcminutes north-east of IRAS 20568+5217, and the HH 381 objects are on the opposite side of the IRAS source, possibly suggesting that they together form a single large HH flow.

HH 381 *(20 56, +52 17).* Original paper: Devine, Reipurth, Bally (1997), who show an Hα + [SII] CCD image. These are two very faint HH knots located less than an arcminute from the IRAS source 20568+5217, which illuminates a large reflection nebula that opens up to the NNW, suggesting a flow axis at a large angle to the axis defined by the IRAS source and HH 380 and HH 381. Possibly several outflows are present in the region.

HH 382 *(20 56, +52 05).* Original paper: Devine, Reipurth, Bally (1997), who show an Hα + [SII] CCD image. These are three HH knots located about 12 arcminutes south of IRAS 20568+5217, approximately along the axis defined by its associated reflection nebula.

HH 383 *(05 32, −05 09).* Original paper: Yu, Bally, Devine (1997), who note that it is an optical counterpart to the H_2 knot YBD 58 in the OMC 2/3 region.

HH 384 *(05 32, −05 11).* Original paper: Yu, Bally, Devine (1997), who note that it is an optical counterpart to the H_2 knot YBD 52 in the OMC 2/3 region.

HH 385 *(05 32, −05 09).* Original paper: Yu, Bally, Devine (1997), who note that it is an optical counterpart to the H_2 knot YBD 24 in the OMC 2/3 region.

HH 386 *(04 48, +30 42).* Original paper: Hirth, Mundt, Solf (1997). This is a bipolar microjet stretching a few arcseconds on either side of UY Aur at a position angle of approximately 40 degrees. UY Aur is a binary with 0.89 arcsec separation (Joy & van Biesbrock 1944, Leinert et al. 1993, Ghez, Neugebauer, Matthews 1993, Ghez et al. 1995, Koresko, Herbst, Leinert 1997, Close et al. 1998). A low-dispersion spectrum is presented by Cohen & Kuhi (1979). Molecular hydrogen emission was detected towards the companion by Herbst, Koresko, Leinert (1995). The accretion luminosity is derived from Paβ and Brγ emission by Muzerolle, Hartmann, Calvet (1998). Duvert et al. (1998) present ^{13}CO mm interferometry of a circumbinary disk.

HH 387 *(19 36, +10 23).* Original paper: Hirth, Mundt, Solf (1997). This is a bipolar microjet, with faint knots stretching up to 10 - 15 arcsec from V536 Aql at a position angle of about 110 degrees. Mundt & Eislöffel (1998) present interference filter images. The star is a classical T Tauri star (Cohen & Kuhi 1979, Appenzeller, Jankovics, Östreicher 1984), with a large polarization. It is a close binary with separation 0.52 arcsec (Ageorges et al. 1994).

HH 389 *(20 59, +50 09).* Original paper: Mundt & Eislöffel (1998), who present interference filter CCD images. This is a 3 arcmin long HH flow emanating to the south from the peculiar T Tauri star V1331 Cyg (IRAS 20595+5009). The star has been studied in the optical by, among others, Kuhi (1964), Chavarria-K. (1981), Kolotilov (1984), Mundt (1984), Shevchenko et al. (1991), Ivanova (1994) and Hamann et al. (1994). Infrared CO spectra are shown by Biscaya et al. (1997). Weintraub, Sandell, Duncan (1991) present 450 - 1300 μm photometry. Henning et al. (1998) present a 1300 μm map. McMuldroch, Sargent, Blake (1993) use aperture synthesis ^{13}CO and continuum observations to detect a disk and circumstellar envelope, as well as a molecular outflow, also studied by Levreault (1988). Terquem et al. (1999) discuss precession of the HH jet axis due to a possible binary nature of the source. Shevchenko et al. (1991) suggest a distance of 550 pc.

HH 390 *(04 16, +27 08).* Original paper: Gómez, Whitney, Kenyon (1997), who present a [SII] CCD image. This is a double knot on a line through the IRAS source 04166+2706 in Taurus. The object is close to the redshifted lobe of a *molecular outflow* (Bontemps et al. 1996).

HH 391 *(04 16, +27 02).* Original paper: Gómez, Whitney, Kenyon (1997), who present a [SII] CCD image and an H_2 image. This is a chain of several HH knots, which may form a single HH flow from the IRAS source 04169+2702. The source drives a *molecular outflow* (Bontemps et al. 1996) and is associated with a compact *reflection nebula* (Tamura et al. 1991, Kenyon et al. 1993, Whitney, Kenyon, Gómez 1997). The source was measured at 1300 μm by Moriarty-Schieven et al (1994), and Ohashi et al. (1997b) find a flattened envelope in $C^{18}O$.

HH 392 *(04 18, +26 55).* Original paper: Gómez, Whitney, Kenyon (1997), who present a [SII] CCD image. These are three HH knots A, B, and C spread over 5 arcminutes in the vicinity of IRAS 04181+2655, but there are other infrared sources nearby, and it is unclear if the three knots form one or more HH flows. Knots A and B are within the redshifted lobe of a *molecular outflow* possibly associated with IRAS 04181+2655 (Moriarty-Schieven et al 1992, Bontemps et al. 1996). The IRAS source was measured at 1300 μm by Moriarty-Schieven et al. (1994), with near-infrared spectroscopy by Greene & Lada (1996b), and with near-infrared polarimetry by Whitney, Kenyon, Gómez (1997).

HH 393 *(04 27, +24 34).* Original paper: Gómez, Whitney, Kenyon (1997), who present a [SII] CCD image. This is a diffuse knot south of the T Tauri star ZZ Tau. There are other young stars in the region, so it is not clear which is the driving source.

HH 394 *(04 30, +22 48).* Original paper: Gómez, Whitney, Kenyon (1997), who present a [SII] CCD image. This is a chain of HH knots on a line through the IRAS source 04302+2247. The source drives a *molecular outflow* and is associated with a *reflection nebula* (Tamura et al. 1991). The nebula was observed with near-infrared images and displays a butterfly morphology, with a dark lane, which appears to be a disk seen edge-on (Lucas & Roche 1997,1998b). More detailed HST/NICMOS images of the nebula are presented by Padgett et al. (1999). The source was observed at 1300 μm by Moriarty-Schieven et al. (1994). Strong near-infrared polarization was detected by Whitney, Kenyon, Gómez (1997).

HH 395 *(04 37, +25 40).* Original paper: Gómez, Whitney, Kenyon (1997), who present a [SII] CCD image. There are two HH knots on a line through IRAS 04369+2539 which illuminates the large *reflection nebula* IC 2087.

HH 396/397 *(05 55, +16 31).* Original paper: Devine et al. (1999b), who present CCD images. This is a giant bipolar HH flow stretching over a total of 10 pc and centered on the 3000 $L_\odot$ B star IRAS 05553+1631 associated with the compact HII region G192.16-3.82 located at 2 kpc distance in Gemini (Hughes & MacLeod 1993, Shepherd et al. 1998). The young star is embedded in a dense cloud core observed in ammonia by Molinari et al. (1996), and is associated with a strong H_2O maser (Codella, Felli, Natale 1996, Shepherd & Kurtz 1999). The source drives a massive molecular outflow (Snell, Dickman, Huang 1990, Shepherd & Churchwell 1996, Shepherd et al. 1998, Shepherd & Kurtz 1999). Near-infrared images show a an infrared reflection nebula and H_2 emission knots (Hodapp 1994, Shepherd et al. 1998, Devine et al. 1999b).

HH 398 *(22 32, +40 24)*. Original paper: Corcoran & Ray (1998), who present long slit spectroscopy. This is a bipolar HH jet emanating from the Herbig Ae/Be star LkHα 233. It is associated with a bipolar nebula (Herbig 1960, Calvet & Cohen 1978). Broadband imaging polarimetry suggests the presence of a torus around the star (Aspin, McLean, McCaughrean 1985). Near infrared speckle interferometry shows that the source is surrounded by a highly scattering halo 1$''$ in size (Leinert, Haas, Weitzel 1993). Hamann (1994) found the [FeII] lines to be strongly blueshifted. Fuente et al. (1998) present ^{13}CO, CS and 1.3 mm continuum maps.

HH 399 *(17 59, −23 04)*. Original papers: Cernicharo et al. (1997,1998), who present a CCD image. This is a 22 arcsec long well-collimated jet emanating from a cometary globule, which points towards HD 164492A, the central massive star in the Trifid Nebula. About 65 arcsec further downstream the flow terminates in a bow shock. At the assumed distance of 1680 pc, this corresponds to a projected size of 0.7 pc. The source is deeply embedded, is very cold and has only been detected at 1300 μm.

HH 401/402 *(05 32, −06 31)*. Original paper: Ogura (1995), who presents a large-field photograph of both objects, and a low-dispersion spectrum of HH 401. The two objects are separated by 5.9 pc and centered on the HH 1/2 driving source. HH 401 is a giant bow shock shaped feature north-west of HH 1, while HH 402 is a much fainter diffuse feature south-east of HH 2. See also references under HH 1/2.

HH 403 *(05 34, −05 54)*. Original paper: Reipurth, Devine, Bally (1998), who present a CCD image. This is a several arcminute large fragmented bow shock, which faces away from the L1641-N cluster half a degree away to the SW. Together with HH 404 it forms a giant HH flow.

HH 404 *(05 34, −05 45)*. Original paper: Reipurth, Devine, Bally (1998), who present a CCD image. The object has a strong resemblance to a large bow shock. It is 5.4 pc in projection from the L1641-N cluster from where it appears to come, together with the nearby HH 403. Reipurth, Devine, Bally (1998) suggest that HH 127 forms the counterlobe to this flow.

HH 405/406 *(05 34, −05 41)*. Original paper: Reipurth, Devine, Bally (1998), who present CCD images. HH 405 appears to be a small jet pointing towards HH 406, which has the morphology of a bow shock. No source is known.

HH 407 *(5 32, −06 01)*. Original paper: Mader et al. (1999), who present CCD images. This appears to be a large fractured bow shock, and it is possible that it is part of a giant HH flow from the L1641-N region. See also notes for HH 303.

HH 408 *(04 38, +25 50)*. Original paper: Stapelfeldt et al. (1999b), who present CCD images. This is a bipolar HH flow associated with the T Tauri star Haro 6-33 (IRAS 04385+2550). There are two short jets as well as several more distant bow shocks on either side of the star. Optical, near- and mid-infrared photometry of Haro 6-33 is given by Myers et al. (1987). Kenyon et al. (1998) suggest a spectral type of M0, and give emission line strengths. The star is located in a small cloud core mapped in C^{18}O by Onishi et al. (1998).

HH 410/411 *(04 25, +24 12)*. Original paper: Devine et al. (1999a), who present CCD images. HH 410 is a major bright complex of HH knots, which forms a bow shock in a giant flow from Haro 6-10. It is located 24 arcmin to the SW of Haro 6-10. HH 411 lies on the same flow axis, but on the opposite side of

Haro 6-10, 14 arcmin NE of this star. The total projected extent of the complex at the assumed distance of 140 pc is 1.6 pc. HH 411 is a highly unusual object, consisting of thin filaments emitting mostly in Hα and lying perpendicular to the flow axis. Both HH 410 and 411 have burst completely out of the L1524 cloud and are seen against a background of stars and galaxies. See also notes for HH 184.

HH 412 *(04 26, +24 30)*. Original paper: Devine et al. (1999a), who present CCD images. This is a one arcminute long fairly diffuse emission feature located about 7 arcmin NE of Haro 6-10 and on the well defined flow axis of HH 410/411. It is presumably part of this giant flow.

HH 413/414 *(04 26, +24 31)*. Original paper: Devine et al. (1999a), who present CCD images. HH 414 is a small bipolar jet coinciding with the IRAS source 04264+2433. It points towards HH 413, 5 1/2 arcmin to the ESE, which has the morphology of two bow shocks. HH 413 is located on the HH 410/411 flow axis, but this appears to be coincidental. HH 414 IRS is a near- and far-infrared source with significant polarization and with a total luminosity of only 0.4 $L_\odot$ (Kenyon et al. 1993, 1994, Whitney, Kenyon, Gómez 1997). Optical spectroscopy towards the source reveals a red veiled continuum and typical HH emission lines (Kenyon et al. 1998).

HH 415 *(20 45, +67 49)*. Original paper: Reipurth, Bally, Devine (1997), who present a CCD image. This is a single faint HH knot north-east of PV Cep, and it is unclear if it is related to the HH 215/315 flow (see notes for these objects) or belongs to a separate flow.

HH 416 *(16 24, −24 42)*. Original papers: Wilking et al. (1997a) and Gómez, Whitney, Wood (1998), who present CCD images. This is a structured HH complex in the ρ Ophiuchi clouds.

HH 417 *(16 25, −24 21)*. Original paper: Gómez, Whitney, Wood (1998), who present a CCD image. This is a bright, one arcminute wide complex of a multitude of HH knots in the ρ Ophiuchi cloud region.

HH 418 *(16 23, −24 34)*. Original paper: Gómez, Whitney, Wood (1998), who present a CCD image. This is a faint elongated HH knot in the ρ Ophiuchi clouds, near HH 314.

HH 419 *(16 23, −24 24)*. Original paper: Gómez, Whitney, Wood (1998), who present a CCD image. This is a large and diffuse HH object in the ρ Ophiuchi clouds.

HH 420 *(16 25, −24 30)*. Original paper: Gómez, Whitney, Wood (1998), who present a CCD image. This is a diffuse HH object in the ρ Ophiuchi clouds.

HH 421 *(21 00, +49 39)*. Original paper: Mundt & Eislöffel (1998), who present CCD images. This is a 22 arcsec long jet coming from the emission line star LkHα 321 (IRAS 21002+4939). The star has been observed spectroscopically by Cohen & Kuhi (1979) and Mundt (1984), and photometrically by Shevchenko et al. (1991), who suggest a distance of 550 pc.

HH 422 *(3 24, +30 01)*. Original paper: Davis et al. (1997b), who present a CCD image. This is a faint HH knot 30$''$ south of the reflection nebula RNO 15 (Cohen 1980), associated with the source L1455 IRS2 (= IRAS 03247+3001). It is, however, not clear that the HH knot is associated with this source considering the complexity of outflows in the region (see notes for HH 318).

HH 423 *(3 24, +30 05)*. Original paper: Davis et al. (1997b), who present a CCD image. This is a faint HH knot some arcminutes NNW of L1455 IRS 1 = RNO 15-FIR, but it is unclear if they are related.

HH 424 *(21 00, +49 40)*. Original paper: Mundt & Eislöffel (1998), who present CCD images. This is an emission line knot located a few arcseconds from a faint source, called LkHα 321B due to its location 170 arcsec west of LkHα 321. See also notes for HH 421.

HH 425 *(20 18, +41 11)*. Original paper: Magakyan & Movsesyan (1997b), who present long-slit spectra and images. This is a nebulous knot, also seen in the images of Aspin, Sandell, Weintraub (1994), which is spectroscopically identified as an HH object. It is associated with the young rather luminous emission line star LkHα 225 (Herbig 1960), also known as V1318 Cyg. The star is highly variable (see references in Ibragimov et al. 1988 and Hillenbrand et al. 1995), and it is a binary (Aspin, Sandell, Weintraub 1994, Palla et al. 1995). The southern component may drive a molecular outflow (Palla et al 1995). Henning et al. (1998) present a 1300 μm map.

HH 426 *(3 25, +30 42)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. These are two close HH knots located about 9 arcminutes south of HH 14 near NGC 1333.

HH 427 *(3 27, +30 11)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. A faint HH knot in the Perseus clouds.

HH 428 *(3 27, +30 27)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. A relatively bright HH object in the Perseus clouds.

HH 429 *(3 28, +30 59)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. These are two HH knots in the Perseus clouds, HH 429A is the brighter one, while HH 429B, located an arcminute further east, is fainter and more diffuse.

HH 430 *(3 29, +31 14)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. This is a cluster of faint HH knots in the Perseus clouds.

HH 431 *(3 30, +30 59)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. Two close somewhat diffuse HH knots in the B1 core in the Perseus clouds. They are located very close to the source IRAS 1 (IRAS 03301+3057), which may be the driving source. A molecular outflow is driven by this source (Bachiller, Menten, del Rio-Alvarez 1990, Yamamoto et al. 1992, Hirano et al. 1997). The magnetic field strength in Barnard 1 is discussed by Goodman et al. (1989) and Crutcher et al. (1994).

HH 432 *(3 30, +30 59)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. These are two faint HH objects in the B1 core in the Perseus clouds, about an arcminute apart. HH 432A is larger and more diffuse, and HH 432B further to the south-east, contains at least two knots. See notes for HH 433.

HH 433 *(3 30, +30 54)*. Original paper: Yan et al. (1998), who present a [SII] CCD image. This is a compact cluster of at least 4 HH knots in the B1 core in the Perseus clouds. Together with HH 432, these objects are well aligned with a line through the nearby source IRAS 2 (IRAS 03304+3100 = LkHα 327), a 15th magnitude star of spectral type K2 studied by Cohen & Kuhi (1979) and Rydgren & Vrba (1983). The B1 core has been studied in mm-transitions by Bachiller, Menten, del Rio-Alvarez (1990).

HH 444 *(05 37, −02 33)*. Original paper: Reipurth et al. (1998), who present a CCD image and low-dispersion spectroscopy. This is a compact jet with several bow shocks stretching over 2 1/2 arcminutes from the visible T Tauri star V510 Orionis in the σ Orionis HII region (for details on this variable star, see

Herbig & Bell 1988).

HH 445 *(05 37, −02 35).* Original paper: Reipurth et al. (1998), who present a CCD image. This is a monopolar jet that is 18 arcsec long, and emanating from the visible Hα emission star A-0976-357 (Wiramihardja et al. 1991) in the σ Orionis HII region. A second fainter jet, called HH 445X appears from the same source, suggesting that it could be a close binary.

HH 446 *(05 37, −02 40).* Original paper: Reipurth et al. (1998), who present a CCD image. This is a short, highly asymmetric bipolar jet driven by a faint visible star in the σ Orionis HII region.

HH 447 *(05 38, −02 35).* Original paper: Reipurth et al. (1998), who present a CCD image. This is a 7 arcsec long jet coming from the visible star Haro 5-39 in the σ Orionis HII region.

HH 449 *(05 36, −07 14).* Original paper: Strom et al. (1986). This is a faint chain of HH knots emanating from the young star Haro 4-249 (sometimes incorrectly listed as Haro 2-249), which is associated with a prominent reflection nebula. The star was first noted by Haro (1953), and was observed spectroscopically by Cohen & Kuhi (1979). It is associated with IRAS 05363–0714, a 6 $L_\odot$ source. Near-infrared photometry is given by Nakajima et al. (1986).

HH 454 *(04 28, +18 02).* Original paper: Devine, Reipurth, Bally (1998), who present CCD images. These are three HH knots forming a bipolar HH flow centered on L1551-NE, a low-luminosity deeply embedded source discovered by Emerson et al. (1984). Optical, infrared and mm observations of the source region are discussed by Draper, Warren-Smith, Scarrott (1985b), Campbell et al. (1988), Pound & Bally (1991), Moriarty-Schieven & Wannier (1991), Barsony & Chandler (1993), Moriarty-Schieven, Butner, Wannier (1995), Rodríguez, Anglada, Raga (1995), Hodapp & Ladd (1995), Whitney, Kenyon, Gómez (1997).

HH 455 *(18 27, +01 14).* Original papers: Davis et al. (1999) and Ziener & Eislöffel (1999), who present CCD images. This is a fine extended and collimated HH flow, with a bright bow shock at its apex. It points back towards a source, PS 2, seen in the IRAS 12 μm HIRES data of Hurt & Barsony (1996). It is close to the Serpens Reflection Nebula and the surrounding rich star forming region, and the following list of references to this well studied region is not exhaustive. The region has been studied at optical, infrared, sub-millimeter and millimeter wavelengths by Strom, Vrba, Strom (1976b), Loren, Evans, Knapp (1979), Nordh et al. (1982), Bally & Lada (1983), Ungerechts & Güsten (1984), Gomez de Castro, Eiroa, Lenzen (1988), Rodríguez et al. (1989d), Eiroa & Casali (1989, 1992), de Lara, Chavarria-K., López-Molina (1991), Casali, Eiroa, Duncan (1993), Curiel et al. (1993), McMullin et al. (1994), White, Casali, Eiroa (1995), Hurt & Barsony (1996), Hodapp et al. (1996), Herbst, Beckwith, Robberto (1997), Huard, Weintraub, Kastner (1997), Testi & Sargent (1998), Giovanetti et al. (1998), Hogerheijde et al. (1999), Codella, Bachiller, Reipurth (1999), Davis et al. (1999), Ziener & Eislöffel (1999).

HH 456/457 *(18 27, +01 09).* Original paper: Davis et al. (1999), who present CCD images. This is a little compact group of HH knots near the Serpens Reflection Nebula, and of uncertain origin. See also notes for HH 455.

HH 458/459 *(18 27, +01 12).* Original papers: Davis et al. (1999) and Ziener & Eislöffel (1999), who present CCD images. This appears to be two lobes of a bipolar HH flow, which may originate in the source SMM 3, just south of the Serpens Reflection Nebula. See also notes for HH 455.

HH 460 *(18 27, +01 16).* Original papers: Davis et al. (1999) and Ziener & Eislöffel (1999), who present

CCD images. This is a group of HH knots, which is located at the bright north-western tip of a molecular outflow lobe. The high density of active sources in the region makes it difficult to assign a source. See also notes for HH 455.

HH 461 *(00 08, +58 31).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a rather bright compact HH object, located about 1.5 arcmin SSE of LkHα 198, on the axis of the HH 164 flow, which emanates from this star. HH 461 is probably a bow shock of the HH 164 flow, see also notes for HH 161 and 164.

HH 462 *(03 50, +38 01).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a small HH flow located along the symmetry axis of the cometary nebula PP 11, a reflection nebula illuminated by the partly embedded IRAS 03507+3801 source. Levreault (1988) estimated a V-magnitude of 21.4 for the emerging star, in the near-infrared it is much brighter (Tapia et al. 1997).

HH 463 *(04 07, +38 00).* Original paper: Aspin & Reipurth (1999), who present CCD images. Parsamian & Petrosian (1979) noted a small nebula, PP 13, which Cohen et al. (1983) in an infrared study showed to be associated with two young stars. HH 463 is a short stubby jet emanating from the southern component, PP13S, which Sandell & Aspin (1998) studied in detail, and found to be a FUor candidate. A faint emission knot is located an arcmin further along the jet axis. Near-infrared spectroscopy and imaging of PP13S is also presented by Smith (1993), and Tapia et al. (1997) show optical and near-infrared images.

HH 464 *(04 07, +37 59).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a faint curved chain of HH knots probably driven by the young T Tauri star PP 13N. See notes for HH 463.

HH 465 *(04 07, +38 00).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a small cluster of HH knots north of PP13N. See notes for HH 463.

HH 466 *(04 30, +24 15).* Original paper: Aspin & Reipurth (1999), who present CCD images. These are two HH knots to the NNE of and pointing back towards the well studied T Tauri star GK Tau, and only a few references are given here. GK Tau has a spectral type of K7 V (Herbig 1977) and coincides with the IRAS source 04305+2414. It forms a wide pair with the nearby GI Tau with which it appears to be coeval (Hartigan, Strom, Strom 1994). Accretion luminosities for GK and GI Tau are derived from Paβ and Brγ emission by Muzerolle, Hartmann, Calvet (1998). GK Tau has a faint companion 2.5 arcsec to the east (Reipurth & Zinnecker 1993). GK and GI Tau are associated with a reflection nebula, and appear to have recently emerged from the B18 cloud in Taurus.

HH 467 *(04 30, +24 14).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a faint HH knot and an emission streamer about 45 arcsec SW of GK Tau. See also notes for HH 466.

HH 468 *(04 30, +24 15).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a faint diffuse HH knot NE of GK Tau. See notes for HH 466.

HH 469 *(05 36, −07 28).* Original paper: Aspin & Reipurth (1999), who present CCD images. This is a small HH knot associated with the embedded source Haro 4-255 FIR, a far-infrared source detected by Evans et al. (1986) about an arcmin NW of the T Tauri star Haro 4-255. The HH knot is located next to a compact reflection nebula (dubbed "NW") illuminated by Haro 4-255 FIR. Anglada et al. (1992, 1998) detected Haro 4-255 in the cm radio continuum. Davis & Eislöffel (1995) find an H_2 flow associated with Haro 4-255 FIR. Their knot G appears to coincide with HH 469. See also notes for HH 470.

HH 470 *(05 37, −07 29)*. Original paper: Aspin & Reipurth (1999), who present CCD images. This is a finely collimated jet and a bright bow shock associated with the young star Haro 4-255 (Haro 1953). Cohen & Kuhi (1979) estimate a spectral type of K7, a large Hα equivalent width of 100, and an approximate V-magnitude of 15.7. Infrared observations are discussed by Cohen (1974b) and Nakajima et al. (1986). The IRAS source 05369-0728 is a mixture of emission from Haro 4-255 and the more deeply embedded source Haro 4-255 FIR an arcmin further NW. Both stars are clearly seen in the ir images of Hodapp (1994). Levreault (1988), Morgan et al. (1991) and Tatematsu et al. (1993b) detect a molecular outflow in the region, and Aspin & Reipurth (1999) argue that it can be separated into two bipolar outflows. Tatematsu et al. (1993) present detailed mm observations of the surrounding cloud core.

HH 471/472/473/474 *(05 45, +00 37)*. Original paper: Aspin & Reipurth (1999), who present CCD images. These are a cluster of HH knots located in the northern part of the L1630 cloud. They appear to be associated with a little group of young stars. The brightest is the nebulous star LkHα 316, which was found by Herbig & Kuhi (1963). It has a V-magnitude of around 14.1, a continuous spectrum and strong Hα emission according to Cohen & Kuhi (1979), who also noted a fainter nearby star, LkHα 316/c (=HBC 511), with V=16.7, a spectral type of M0.5 and very weak Hα emission. About 1.5 arcmin further east is the embedded source IRAS 05451+0037. This source was suggested to drive a molecular outflow (Iwata, Fukui, Ogawa 1988), but HH 472 and its associated faint star is located at the center of the bipolar CO flow, with the jet along the flow axis, suggsting that it is a better candidate for driving the CO flow than IRAS 05451+0037.. The nearby HH 71 may be associated with the HH objects in this area.

HH 475 *(20 22, +42 05)*. Original paper: Aspin & Reipurth (1999), who present CCD images. The little nebula PP 95 is located in Cygnus (Parsamian & Petrosian 1979). HH 475 is located several arcminutes to the NE of PP 95, but is not necessarily associated with it. If at the same distance as several other nearby star forming regions, notably AFGL 2591, then HH 475 is 2 kpc away.

HH 476 *(18 26, +00 27)*. Original paper: Ziener & Eislöffel (1999), who present a CCD image. This is a single HH knot close to several IRAS sources and nebulous stars. See also notes for HH 455.

HH 477 *(18 27, +01 18)*. Original paper: Ziener & Eislöffel (1999), who present a CCD image. This is a single HH knot located between the active T Tauri star ESO Hα 279 (IRAS 18269+0116) and HH 107 in the Serpens molecular clouds. It is possibly associated with the large HH 106/107 flow, see notes for these objects.

HH 478 *(18 27, +01 13)*. Original paper: Ziener & Eislöffel (1999), who present a CCD image. These are two HH knots located just north of the Serpens Reflection Nebula. See also notes for HH 455.