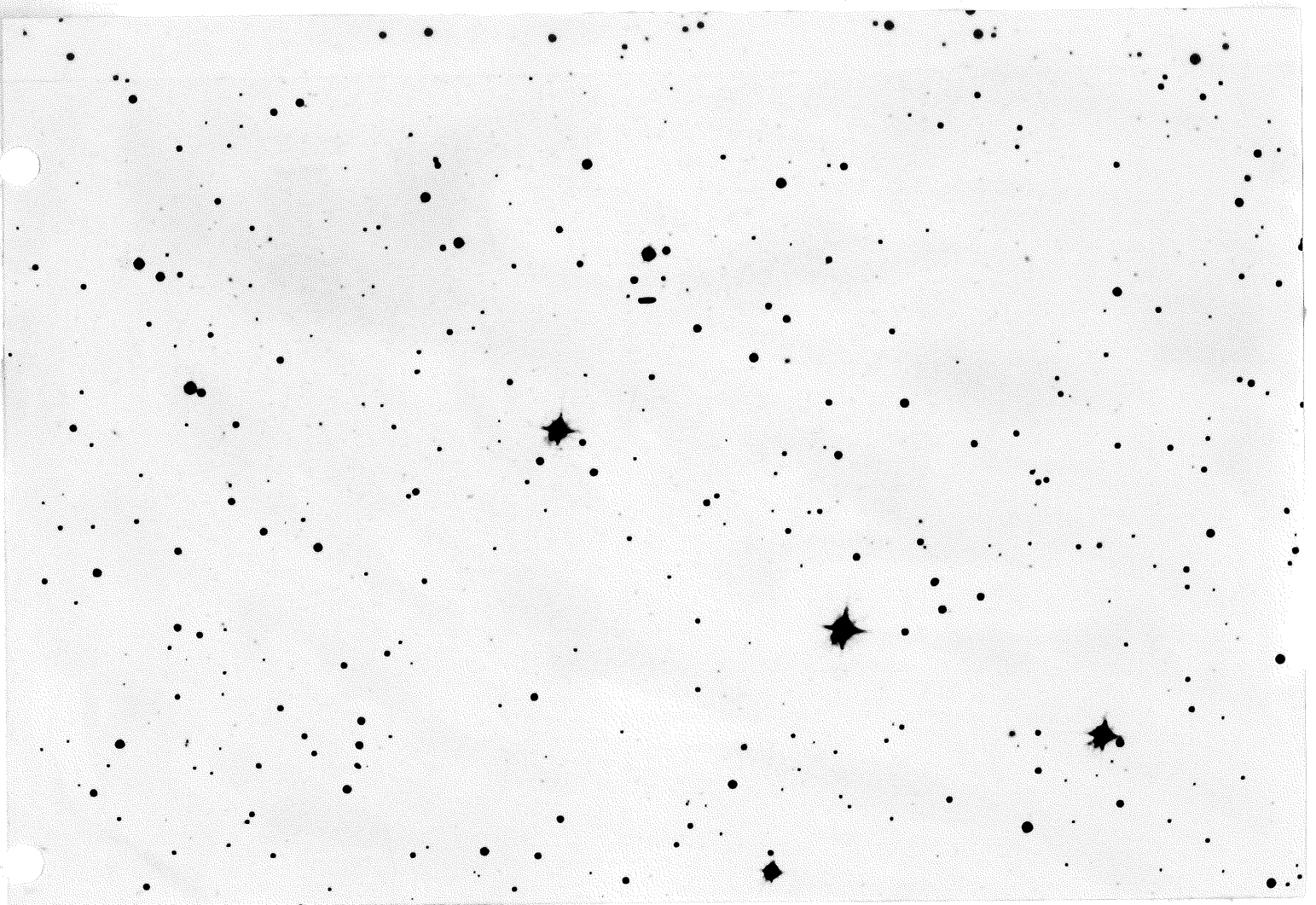


DAVID DUNLAP DOINGS

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MARCH 31, 1979



ASTEROID 2104 TORONTO

(see page 2)

Now, At Last, It Can Be Told: The Asteroid Project

Late in 1976, Don MacRae had an inspiration: as a unique Astronomy contribution to the University Sesquicentennial celebration, we would find an asteroid to be named after the university. He asked me to look into the idea and see if it was feasible. The only camera we had suitable for an asteroid search was mothballed, but Sidney van den Bergh's collection of Schmidt plates must contain quite a number of new objects, so it certainly seemed possible. I blinked a pair of vdB's 48-inch Schmidt plates taken near the opposition point on the ecliptic and found 19 objects, of which fewer than half were known. The promising news was reported to MR along with the optimistic estimate that a few man-weeks should do it. The few man-weeks were ultimately spread over two years. Naming an asteroid requires that its orbit be well determined enough that it can be recovered with some certainty. In the real world of errors, the textbook set of three observations a few weeks apart is not enough and observations at two or more oppositions are necessary. Even fulfilling the first step was difficult, since vdB's observing runs were almost always less than a week in duration. Fortunately, the usual divine intervention occurred. Ron Lyons was cleaning out abandoned desk drawers and gave me a box of Tautenburg Schmidt plates that vdB had taken between Aug. 15 and Sept. 17, 1963 of the field of M33. M33 is 25° from the ecliptic but that was a handicap turned advantage: any objects found would probably have been missed in the usual ecliptic surveys and would also have an unusual orbit. That, and the chance to try the PDS on trailed asteroid images, gave the project some redeeming scientific value. Moreover, M33 was the field in which vdB had found the first Canadian comet in 1974, so it was charmed, right?

Three objects were found after several days of tedious blinking. Two of them entered the field only for the last few days of the run, but one was there for both the mid-September and late-August blocks. There was also a single plate from August 15 with an extra but very nearly stellar image. Was it the asteroid or just some useless supernova? The plates were measured on the PDS and a polynomial fit to the later plates extrapolated backward fell within a millimeter of the August 15 image. Good enough. The positions for all three objects were sent to Paul Herget at the Minor Planet Center in Cincinnati with a request for an ephemeris for the most promising object, and an estimate of the likely position error at the present epoch, now almost three full periods later. Dr. Herget predicted a deep south return in 1978 and a likely error of 2° , mostly in R.A. It would have been quite a task to search this error footprint with the $1/4$ square degree field of our telescope at Las Campanas so MR asked Chris Smith, then at ESO, to obtain some plates with the large Schmidt, if possible, and asked that Rick Crowe be scheduled for several nights to follow up any promising objects. Fortunately, our object, now known as 1963PD, was comparatively "bright" at 16th magnitude. With the cooperation of our neighbours at ESO, a pair of plates was obtained in February of last year, but the two objects on them were not ours.

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On the northern front, a different approach was tried. It had occurred to me that the time difference between the Palomar Sky Survey and our 1963 plates was less than the 15 years to the present and that we might have a better chance going backward. An ephemeris was computed and checked against the list of PSS plate centers and dates. Luckily, a coincidence occurred in 1951. Blinking revealed a very likely candidate and the measured positions could be fit well with a small change in period. The positions were sent to Cincinatti and a revised ephemeris to Chile. Then came the gloom. Rick was still unable to find it and no reply came from the Minor Planet Center which was then being relocated from Cincinatti to SAO in Massachusetts. Chris did obtain another pair of plates in June, however, which were later shipped to Toronto arriving nearly simultaneously with a telex from Brian Marsden stating that our original positions were lost in the move from Ohio. Everything then moved quickly. The asteroid was found on the second set of ESO plates. Marsden found not only a good fit for the PSS positions but located a stray single Cape observation in 1955 and a telephoned comparison between the new ephemeris and the newly measured ESO positions was excellent. We had four oppositions and a well-determined orbit. 1963PD was assigned its permanent number, 2104, in the January Minor Planet Circular and officially named Toronto in the February issue. On March 23, it was publically announced and presented by President Ham to Mayor John Sewell at a reception in The Gallery Lounge at Hart House.

KK
(Karl Kamper)

C O M I N G S A N D G O I N G S

Professor *Bart Bok* of the Steward Observatory, University of Arizona will be here as a Visiting Professor for the three week period from April 14 to May 5. Professor Bok will give a public lecture entitled "Our Big and Beautiful Milky Way" on Friday April 20 at 8:00 p.m. in the Medical Sciences Auditorium. The rest of the Bok program has not been finalized yet, but there are plans for three seminars and a 3-lecture mini-course in Galactic Structure and Dynamics.

Jose Maza and *Bjarne Everson* both completed their Ph.D. requirements during the past month. On March 12, Jose defended his thesis entitled "Polarization of Seyfert Galaxies and Related Objects" (see abstract on page 8); John Landstreet of the University of Western Ontario was the external appraiser. Jose returned to Santiago on March 23 to resume his position on the staff of the Department of Astronomy at the University of Chile.

Bjarne passed his oral exam on March 30, successfully defending his thesis "Mass Transfer in Close Binary Systems" (abstract in next month's *Doings*); the external appraiser was Brian Flannery of Harvard. Bjarne has an NSERC PDF at Cambridge, and he and Carol plan to leave for England within a week or so.

Peter Martin was the thesis supervisor for both Jose and Bjarne.

On March 8, *Don and Betty MacRae* left for Forcalquier, France and l'Observatoire de Haute Provence where Don is spending the latter portion of his six-month sabbatical.

University of Toronto Eclipse Expedition

On Monday February 26, North America experienced its last total solar eclipse of the century. Among those who travelled to southern Manitoba to view this event were six of the Department's graduate students: Chris Corbally, Dennis Crabtree, Gerry Grieve, Rick McGonegal, John Reid and Donna Zubrod. The group flew to Winnipeg on Friday afternoon via a regular Nordair flight. We were fortunate in being able to stay at the Jesuit-run St. Paul's High School for the weekend. This provided us with a good base of operation as well as some good information about the City of Winnipeg.

Saturday and Sunday were spent preparing sun visors and camera filters, checking out the equipment, and scouting the area near Winnipeg for possible observing sites. The weather reports indicated that the area to the west and south-west of Winnipeg would have the best conditions. On Sunday night, after all the preparations were complete, a plan of action was decided upon. We would leave Winnipeg early (5:45 a.m.) and drive west along the Trans-Canada to Portage La Prairie (about 100 km west of Winnipeg). Then, with sun just about to rise, we would judge the weather prospects and decide if we should drive any further west.

Early Monday morning we set off down the Trans-Canada as planned, knowing that the weather conditions were not too bad, as Venus and a number of stars were clearly visible. We stopped at sunrise outside of Portage for some coffee and a snack and to discuss our course of action. With the aid of two meteorologists, Peter Chen and Gary Toth who were travelling with us, we decided that driving further west would not help us any. After a bit of searching we found a snow-covered field which had an unobstructed view of the southern horizon. We were situated a few kilometers north of the Trans-Canada and east of Portage. Quickly a large assortment of tripods, cameras and telescopes was set up in anticipation of the eclipse, making it look like the field had suddenly sprouted a strange new crop of winter wheat. Finally the moment of first contact arrived and the last total eclipse of the century was underway.

During the partial phases, a local resident and his wife, the Nelsons stopped by to investigate what we were doing with all our equipment. They had a satisfying look at the eclipse through a Questar and even helped repair one of our tripods (with a pipe wrench!) Finally the beginning of totality drew imminent and everybody got ready for the long-awaited 2 1/2 minutes. Then, there it was, the sparkling diamond ring. All of us were taken aback by the beauty of this moment. However this did not stop Chris Corbally from obtaining a splendid photograph of the flash spectrum shortly after the diamond ring. During totality the snow covered field was bathed in an eerie light that accentuated the sense of astonishment we felt from viewing the totally eclipsed sun with its various prominences and wispy corona. Then, after what seemed like only seconds, the total phase ended and the level of illumination started increasing. Everyone felt very satisfied and somewhat cold. After the partial phases ended we all proceeded to the Nelson's place for lunch and to warm our feet. We are looking forward to our next total solar eclipse, wherever that may be.

The R.A.S.C. Solar Eclipse Expedition

On the tarmac, at Gimli Airfield, about one hour before totality, a hasty meeting of the 106 participants in the R.A.S.C. Eclipse Expedition convened with organizer Mike Watson chairing from the top of a snowbank. With some uncertain thin cloud at 30,000 feet a consensus was needed to choose between remaining on the ground or going airborne in the two chartered Convair 640 aircraft. Two factors swayed the opinion in the end. In the early morning hours on the flight out from Toronto, a test run had been staged to smooth out the collisions involved in changing seats so that all could catch at least a third of totality through the windows on the right-hand side of the plane. Memories of the rehearsal and a disclosure that the Convairs could only climb to 20,000 feet turned the tide, and the assembled decided to try their luck on the ground.

Gimli Airport had undergone a transformation since the expedition had landed and been welcomed by the airport manager, Mr. James Dunlop and his huge dog. With extension cords radiating outward from a nearby hanger, observers arranged and rearranged their equipment, shot photos and took occasional jaunts inside to warm hands and feet. Gimli lies 60 miles north of Winnipeg, on the western shore of Lake Winnipeg. The town was named after a dwarf in Norse mythology by Icelandic immigrants who arrived at the turn of the century. The airport was at one time an RCAF base and was placed a safe 2 1/2 miles west of town. The eclipse activity at the airport attracted some of the locals and other groups who had motored or flown in from as far as the American midwest. The Toronto Mafia was readily identifiable though by their dedicated use of sunglasses for dark adaptation. The Toronto Centre was well represented and equipped. Jim Tow and his family were along. This was Jim's seventh eclipse expedition (and fifth successful one, it turned out). Andreas Gadd was shooting through his handmade instrument, Mike Watson with a five inch refractor and others with instruments varying from pin-hole cameras to large Celestrons. Participants from the University of Toronto included Nebojsa Duric, Douglas Gies, Kai Millyard, Jim Prentice, Alfred Stalginskas and Tom Wells.

Just before totality, the scene was bathed in a dull light by a thin sun casting unusually sharp shadows. The sky was improving with still some high lingering cirrus cloud. Perhaps the slight overcast provided better conditions to observe the approach of totality. Of course, no one was quite prepared for how beautifully the eclipse finally presented itself. There was a collective gasp with the appearance of the diamond ring and continued gestures of amazement for the 167 second duration. The prominences around the limb were many and varied, and the veiled radial structure in the corona was breathtaking. When the sun reappeared as a thin crescent (to shouts of "Encore"), a case of champagne magically appeared, corks began to fly over cameras and tripods and the conversation turned to Africa, for next year's eclipse.

Doug Gies

Ten Years Ago

From DDD vol. 2, No. 3 March 26, 1969

-New Telescope in Prospect

The National Research Council has just awarded to the Department a generous grant towards the acquisition of a 24-inch telescope to be erected in Chile. The remainder of the funds required have already been made available by the Chant Advisory Committee from the earnings of the Chant Fund. Naturally, this calls for jubilation. To those who ask, when? Dr. MacRae replies "at the end of the summer", but he doesn't say which summer or which hemisphere's summer. In any event design features are already under discussion.

-The four speakers for the third June Institute were announced as Geoffrey Burbidge, Herbert Friedman, Kevin Prendergast, and Kip Thorne.

P o t p o u r r i

Halton Arp paid a one-day visit to Toronto on March 23 and described his most recent discoveries concerning the association of quasars with low red-shift galaxies. Needless to say, his talk entitled "New Observations of Galaxies and Quasars" was provocative and very well attended.

Don Fernie's spring half-course "Astronomy through the Ages" has attracted 375 students! No classroom was available which could hold this number so it was necessary to split the course into two lectures sections. Don now lectures Monday, Tuesday, Wednesday, Thursday so we see a lot of him downtown.

Bob Garrison participated in a workshop on Photometric Calibrations at Dudley Observatory on March 16-17. Bob was at Goddard Space Flight Center for an observing run on the IUE March 24-26. His project is UV Spectral Classification.

Chris McAlary had an extensive observing session in late February and early March. He spent 7 nights at Las Campanas doing visible photometry on the U. of T. 24" and then went to CTIO for 4 nights of IR photometry on the 1.5 m. This was followed by three nights of IR spectrophotometry on the KPNO 4 m with only 1 day in between for travelling.

Bob McLaren joined Chris at KPNO to pick up the pieces. Chris is studying Seyfert nuclei and other extragalactic x-ray sources for his thesis.

Peter Martin has been spending the winter of his sabbatical year at Steward Observatory in sunny Tucson. While there, he has been taking flying lessons, (you gotta do something besides observe!) and recently he obtained his Private Pilot's Licence. Congratulations Peter! When do we get a ride?

Talks Given

On March 16, *Dave Turner* gave the annual H.R. Kingston Memorial Lecture to the London Centre of the RASC. His topic was "The Interstellar Yardstick".

Bob Garrison gave a colloquium entitled "The Canada-France-Hawaii Telescope: A New Facility for Canadian Astronomers" at York University on March 1. Bob also gave a dinner talk at New College on March 12 on the well-worn topic of UFO's - "UFO's, a Balanced View".

John Percy, in his capacity as National President of the RASC, gave lectures at the Hamilton Centre on February 1 ("Observing Variable Stars for Fun and Profit"), at the Kingston Centre on February 22 ("The Early-Type Stars"), and at the Winnipeg Centre on February 26 ("Stellar Eclipses"). The latter was presented at a post-eclipse celebration banquet. John presided over a meeting of the RASC National Council on February 25.

Wearing one of his numerous other hats - that of the School Liason Programme - John gave talks at University of Toronto Schools on February 21 and at Oakville - Trafalgar High School on February 28. On March 3 he helped judge the Metro Toronto Separate School Board's Science Fair.

Maurice Clement gave a colloquium entitled "Current Problems in the Theory of Rotating Stars" at the University of Western Ontario on March 27.

Dorothy Fraquelli gave a colloquium at Laval on March 13. Her topic was "Optical Characteristics and Observations of RS CVn Stars". Dorothy also spoke about RS CVn stars to the Richmond Hill chapter of the Canadian Progress Club in February.

Bob McLaren spoke about "Winds on Venus" at the University of Guelph on March 20 and gave a more general talk about Venus to the AST 100 class at Brock on March 27.

Erindale College's public lecture series "Frontiers of Astronomy" included a talk by *John Percy* on February 8 entitled "Life on Other Worlds?" and one by *John Lester* on "Quasars" on March 29.

Colloquia

April 4 *Joan Wrobel and Gerry Grieve, University of Toronto*
G 2000 - Current Literature Seminar

April 11 *Dominique Barceloux and Douglas Gies*
G 2000 - Current Literature Seminar

April 20 (Fri) *Bart Bok, Steward Observatory, University of Arizona*
"Our Big Beautiful Milky Way"
(Public Lecture, Medical Sciences Auditorium, 8:00 p.m.)

N.B. *It is expected that Prof. Bok will give a number of specialized talks on topics such as Globules and Star Formation, Space Telescope, and the Magellanic Clouds. In addition there are plans for a three-lecture mini-course on Galactic Structure and Dynamics. Dates and times are not finalized at this time.*

PAPERS SUBMITTED

E.R. Seaquist,
R.F. Garrison et al

Radio and Optical Observations of SS 433

D.G. Turner

Possible Association Membership for the Three
Long Period Cepheids RZ Velorum, SW Velorum,
and KQ Scorpii

Thesis Abstract

"Polarization of Seyfert Galaxies and Related Objects"

Jose Maza

A survey of the optical polarization of Seyfert galaxies is presented. Measurements of a total of 47 galaxies were obtained with the 90-inch telescope, Steward Observatory, University of Arizona, using a dual-channel Pockels-cell polarimeter.

Three new highly polarized objects were discovered: Markarian (Mrk) 376, Mrk 486 and IC 4329A. However, it was found that more than 80% of the Seyfert (Sy) galaxies have optical polarizations less than 1.5%; more than 70% have a polarization less than 1%. Highly polarized objects occur more frequently among Sys than among quasars.

The contribution to the polarization by interstellar dust in our Galaxy is analyzed and corrected data are tabulated. The frequency distribution of intrinsic polarization is then obtained.

Dilution of the polarization by starlight of the underlying galaxy is considered. A "normalized" polarization, corrected for interstellar polarization and reduced to a standard dilution to be independent of redshift, is derived. The distribution of normalized polarization has a peak at a low value of 0.8%. After the standard dilution is taken into account, the light from Seyfert nuclei seems to be more polarized than that of QSOs. It is suggested that the presence of dust in Sy nuclei is the most plausible explanation.

The application of Sandage's two component model for N galaxies (galaxy [G component] plus mini-quasar [Q component]) to Sy nuclei is discussed in some detail. It is shown that if the Q component is reddened, multiaperture photometry will produce colors describing a locus in the color-color plane which is very different from those of an unreddened two-component model.

A plot of normalized polarization versus $(B-V)_0$ reveals a clear distinction between class 1 and class 2 Sy; the probability of finding a large polarization among Sy galaxies increases for bluer Sy1s and for redder Sy2s. This is suggestive of a non-thermal origin for the polarization of Sy1s and polarization produced by dust in Sy2s. The average polarization and its dispersion increases with increasing Balmer decrement.

The infrared, X-ray and radio properties of the galaxies are compared with their polarization properties, but no correlations are seen. Fe line emission and optical morphology were also studied in connection with polarization. The presence of inner rings is used to infer an average absolute magnitude for Sy galaxies of $\langle M(B) \rangle \sim -21.8$.

Wavelength dependent polarization is found in most strongly polarized objects. A correlation is found between the steepness of the wavelength dependence and the (U-B)_o color of the galaxy. This can be interpreted as the effects of varying amounts of dilution of the nuclear light by the host galaxies. On the other hand, if the polarization is produced by aligned dust particles, they should be from 2 to 5 times smaller than normal grains in our Galaxy. That would imply a color excess ratio $E(U-B)/E(B-V) \sim 1.4$. For a few dusty galaxies, like Mrk 231 and IC 4329A, that is approximately the ratio needed to reproduce the observed nuclear colors if the unreddened nuclei have colors comparable to those of the bluest Sy nuclei.

The most interesting objects are discussed individually. For N 1275 the polarization measured during four consecutive nights in October 1976 confirms and extends the variability found during the previous January and reported by Martin, Angel and Maza (1976).

Three-sigma upper limits for the circular polarization of a few objects were established as follows: Mrk 3 (<0.07%), Mrk 231 (<0.07%), Mrk 376 (<0.3%), N 1275 (<0.03%), IC 4329A (<0.2%), and M 82 (<0.03%).

Tentative conclusions concerning the origin of the polarization in Sy Galaxies are:

- 1) There are a few exceptional cases of strong polarization of non-thermal origin as in N 1275 and possibly Mrk 486.
- 2) Dust is known to be responsible for the strong polarization in a few objects like N 1068, Mrk 231, Mrk 376, and IC 4329A.
- 3) Strongly polarized objects are more common among Sy than quasars.
- 4) Most Sys have a low polarization. However this does not argue against the presence of a non-thermal source of continuum radiation, since even quasars have a characteristically low polarization. The typical Sy polarization, though low, is not as small as that of quasars, perhaps because of more dust in Sy nuclei. For many Sy galaxies the polarization might to be a mixture of non-thermal and dust-produced polarization.

Systematic high quality polarimetry and simultaneous photometry is suggested as a method to assess the strength of the non-thermal component of the polarization. Accurate position angles measured over a period of a few years could prove extremely valuable.

Appendix A presents the results of a program to monitor the optical polarization of N 1275 and several BL Lacertae objects. The amounts of polarization were found to be high and variable on time-scales as small as 10 hours. Interpreted in the context of a massive black hole powering the nucleus of BL Lac objects, a lower limit to the black hole mass is obtained ($m = 7.8 m_{\odot}$). The extremely rapid variability of OI 090.4 and OJ-131 led us indirectly to upper limits for their redshifts: $z(\text{OI } 090.4) < 0.11$ and $z(\text{OJ-131}) < 0.18$.

Appendix B presents a detailed analysis of the wavelength dependence of the optical polarization of the BL Lacertae objects Mrk 421 and Mrk 501, published by Maza, Martin and Angel (1978).