spaces, but especially in brain parenchyma (Fig. 1). They had to be of host origin because donor lymph node suspensions had few or no polymorphonuclears. Smaller and larger doses of cyclophosphamide (75 or 200 mg/kg) were effective but the lower dose allowed the emergence of somewhat more mononuclear cells. Administration of the drug 2 days before cell transfer decreased the polymorphonuclear infiltration somewhat, and treatment 3 or 6 days before transfer inhibited it completely so that there were no EAE lesions of any type. The occurrence of lesions with polymorphonuclears corresponds to the period of selective lymphopenia before pancytopenia prevails after cyclophosphamide treatment (*4*). Thermal injuries 2, 3, or 6 days before cell transfer were satisfactory, but the 3-day interval was optimum. Neither polymorphonuclears nor mononuclears were observed adjacent to thermal injuries, regardless of whether or not cyclophosphamide had been injected, provided that lymph node cell transfer was omitted or replaced by serum from donors with EAE, or replaced by cells from donors immunized with nonneural tissue (adrenal) and adjuvants (*7*).

Two additional experiments proved that the polymorphonuclear infiltrates were the direct consequence of the immunological activity of donor EAE cells. First, neither polymorphonuclear nor mononuclear leukocytes appeared when cyclophosphamide-treated recipients were given 0.2 mg of guinea pig myelin basic protein intravenously 1 hour after the lymph node cell transfer. This is in accord with the previous demonstration of immunologically specific inhibition of EAE by basic protein, probably due to a type of desensitization (*8*). Second, neither polymorphonuclear nor mononuclear infiltrates were produced when Lewis EAE cells were administered to appropriately prepared but *histoincompatible* BN rats. This agrees with the failure of passive transfer to cross major histocompatibility barriers unless the recipient is rendered tolerant of donor transplantation antigens (*9*).

Although it is likely that host polymorphonuclear cells have responded in our system simply because the host had few functioning mononuclear cells, the mechanism involved is unknown. Also, it is uncertain whether the few mononuclear cells found in the lesions are the immunologically specific donor cells, unsensitized nonspecific donor cells inadvertently included in the EAE lymph node suspension, or host mononuclear cells that have escaped the cyclophosphamide effect. As these problems are resolved, the new form of EAE should be useful for deciphering the manner in which specific and nonspecific lymphoid cells cause injury in autoimmune diseases and other forms of delayed hypersensitivity.

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References and Notes

1. The hyperacute form of EAE is an exception [S. Levine and E. J. Wenk, *Science* **146**, 1681 (1964)]; the large numbers of polymorphonuclear leukocytes in this condition appear to be related to its extreme severity and are accompanied by edema and fibrin exudation. Neither the histology nor the manner of production suggest an intimate relation to the new form of EAE presented in this report.
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6. Polymorphonuclear leukocytes were increased in absolute numbers and were not merely increased in relation to the sparse mononuclear cells. This was obvious on inspection and was confirmed by cell counts. With the aid of an ocular grid, an area of 0.0335 mm² was studied in seven high-power fields from five rats with the new form of EAE and in 14 fields from five control rats with conventional EAE. The fields selected for study were areas of heavy inflammatory infiltration adjacent to the thermal injury. The controls had only two to ten polymorphonuclear cells in the grid area (average 5.5) amid the large numbers of mononuclear cells. The new form of EAE had 29 to 78 polymorphonuclear cells in the same area (average 55).
7. A few polymorphonuclear cells occurred within the necrotic brain tissue, independent of the administration of drug and cells. This was of no importance because EAE lesions of whatever type occupied the adjacent viable tissue and not the dead cerebral debris.
8. S. Levine, E. M. Hoenig, M. W. Kies, *Science* **161**, 1155 (1968); *Clin. Exp. Immunol.* **6**, 503 (1970).
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Promising Catalyst for Auto Exhaust

For some time we have been studying the transition element oxides, in particular the perovskites and the tungsten bronzes, for activity as heterogeneous catalysts. Therefore Meadowcraft's (*1*) report that $Sr_{0.2}La_{0.8}CoO_3$ rivaled platinum at the aqueous oxygen electrode has led us to test $LaCoO_3$ itself for activity in the gas phase. We now report that it does appear to rival platinum in the gas phase as well and suggest that it should be tested as a potential auto exhaust catalyst. Meadowcraft (*1*) estimates that the cost of this catalyst would be about $1 per pound.

Table 1. Catalytic activity of $LaCoO_3$ (1.7 with a specific area of 1.4 m^2/g) from 25° to 450°C. The minus sign indicates that no peak was detected; F.G., feed gas. Flow rate was measured in cubic centimeters per minute.

T (°C)	Flow rate (cm^3/min)	Mole percent						
		CH_4	C_2H_6	C_2H_4 or C_3H_8*	C_4H_{10}	1-Butene	*trans*-Butene	*cis*-Butene
25	F.G.	—	—	0.006	0.377	0.831	2.301	96.482
25	13.2+	—	—	0.032	1.756	0.813	2.568	88.987
25	F.G.	—	—	0 002	1.133	0.888	3.727	94.246
25	4.5+	—	—	0.004	4.033	2.455	6.803	86.703
50	4.5	—	—	0.003	8.687	5.983	12.992	72.333
75	4.5	—	—	0.001	13.144	6.242	14.590	66.021
100	6.0	—	—	0.005	21.770	10.462	25.271	42.467
125	5.7	—	—					
	F.G.	—	—	—	8.587	0.474	5.259	85.676
150	7.2	—	0.001	0.057	75.294	1.001	5.480	18.162
180	6.6	—	0.022	1.994	71.808	0.442	8.911	16.817
200	6.6	0.782	0.403	1.960†	69.024	0.777	9.152	17.897
230	4.2	10.371	2.981	6.087	55.075	0.683†	7.272	17.525
260	3.9	14.190‡	4.584‡	6.443	29.461	4.215	7.169	33.933
270	3.3	31.145‡	8.332‡	9.390	10.362	0.144	4.558	9.381
	F.G.	—	—	0.025	4.275	0.177	0.756	94.763
300	5.7	23.013‡	7.378†‡	8.987	36.657	0.932	4.677	18.349
325	5.7	30.494‡	16.809‡	10.407	26.470	1.337	4.360	10.110
350	4.2	37.070‡	14.299‡	11.384	27.603	0.761	3.013	5.866
375	8.4	36.400‡	16.158‡	10.535	21.550	2.370	4.895	8.086
425	7.2	32.103‡	8.150‡	7.589	29.938	2.972	8.705	10.538
450	7.8	12.626‡	3.127‡	4.657	42.402	5.254	14.541	17.388

* Identification uncertain. † Peak areas estimated. ‡ Overlapping peaks.

Some 1.7 g (specific area, 1.4 m^2/g) of $LaCoO_3$ (*2*) at room temperature (25°C) and at a flow rate of about one new volume of intercrystalline gas every second showed 4 percent reduction of butene-2 to *n*-butane with substantial isomerization. The feed gas was hydrogen with about 2 percent olefin (*cis*-2-butene) by volume. At 100°C the yield of *n*-butane was 22 percent at the same time there was essentially an equilibrium isomerization. At higher temperatures hydrogenolysis sets in. At 280°C and a contact time of about 1 second the yield was 31 mole percent methane, 8 percent ethane, 9 percent propane, 10 percent *n*-butane, 0.1 percent 1-butene, 4.6 percent *trans*-2-butene, and 9.4 percent *cis*-2-butene from a feed of approximately 2 percent *cis*-2-butene in H_2 at 1 atmosphere total pressure. Detailed data are given in Table 1. Some butadiene was formed above 200°C, and there were other products (still undetermined) above 230°C.

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References and Notes

1. D. B. Meadowcroft, *Nature* **226**, 847 (1970).
2. Our preparation of $LaCoO_3$ was made by J. Remeika of the Bell Telephone Laboratories at Murray Hill at the request of our collaborator B. Matthias of Bell Telephone Laboratories and the University of California, San Diego, to whom we had appealed when Meadowcraft's article appeared.
3. Supported in part by the Air Force Office of Scientific Research under grant AF-AFOSR-1255-67 Mod. C and by NASA (grant NASA-05-007-003).

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X-rays from Centaurus A and the Far-Infrared Background Radiation

In a recent report Byram *et al.* (*1*) reported that they have detected x-rays from Centaurus A with an observed flux in the 1- to 10-kev region of $(4.3 \pm 1.6) \times 10^{-2}$ kev cm^{-2} sec^{-1}. By comparing this measurement with the x-ray flux that would result from Compton scattering of ambient photons by the radio-producing electrons in the nebula, Byram *et al.* (*1*) concluded that their x-ray measurement is below that predicted with the use of the far-infrared observations of Shivanandan *et al.* (*2*), Houck and Harwit (*3*), and Muehlner and Weiss (*4*), all of which indicate the existence of a diffuse background radiation substantially above 3°K in the submillimeter region. This conclusion, however, is based on a crude calculation which neglects the spectral characteristics of both the synchrotron and the Compton radiations and overestimates the x-ray output by up to an order of magnitude. Furthermore, an independent measurement by Bowyer *et al.* (*5*) indicates that the x-ray flux from Centaurus A in the 1- to 10-kev region is about 1.7×10^{-1} kev cm^{-2} sec^{-1}, that is, higher by a factor of 4 than that reported by Byram *et al.* (*1*). The inconsistency between the x-ray and far-infrared measurements is therefore open to serious question and should be considered in more detail.

I studied this problem by using a more complete treatment of synchrotron and Compton radiations. By taking into account the uncertainties in the physical parameters in the radiating region, I found that both measurements in the 1- to 10-kev region, as well as the upper limits on the hard x-ray flux from Centaurus A obtained by Haymes *et al.* (*6*), are consistent with the existence of a high metagalactic submillimeter background substantially above the 3°K background observed at submillimeter wavelengths.

If the electrons in the source region have a power law spectrum,

$$N(\gamma) = k\gamma^{-\Gamma} \text{ electrons (unit } \gamma)^{-1} \quad (1)$$

where γ is the electron Lorentz factor (E/mc^2), Γ is the spectral index, and k is a normalization constant, the synchrotron flux density at the earth (in watts per square meter per hertz) is given by (*7*)

$$F_s(\nu) = 1.35 \times 10^{-25} a(\Gamma) k R^{-2} B^{(\Gamma+1)/2} \times (4 \times 10^{-2})^{(\Gamma-1)/2} (10^8/\nu)^{(\Gamma-1)/2} \quad (2)$$

where B is the magnetic field of the source in gauss, R is the distance in centimeters, ν is the frequency in hertz, and $a(\Gamma)$ is a slowly varying function of Γ, with $a(\Gamma) \cong 0.1$ for $\Gamma \cong 2.5$.

The Compton flux density (in kiloelectron volts per second per square centimeter per kiloelectron volt) from the same electron distribution is given by (*8*)

$$F_c(\epsilon) = 10^{-18} \rho k R^{-2} \times (4/3\epsilon_0)^{(\Gamma-3)/2} \epsilon^{-(\Gamma-1)/2} \quad (3)$$

where ρ is the ambient photon energy density in electron volts per cubic centimeter, and ε_0 and ε are the energies of the incident and scattered photons, respectively, in kiloelectron volts. By combining Eqs. 2 and 3, we get

$$F_c(\epsilon) = 7.5 \times 10^7 \rho F_s(10^8 \text{ hz}) \times (4 \times 10^{-2})^{-(\Gamma-1)/2} B^{-(\Gamma+1)/2} \times (4/3\epsilon_0)^{(\rho-3)/2} \epsilon^{-(\Gamma-1)/2} \quad (4)$$

Thus, the x-ray flux depends only on the measured radio flux and the magnetic field and photon energy density in the nebula, and is independent of the distance and the normalization of the radiating electron spectrum. For the parameters used by Byram *et al.* (*1*) [$\Gamma = 2.54$, $B = 4 \times 10^{-6}$ gauss, $\varepsilon_0 = 1.2 \times 10^{-3}$ ev (1 mm)] and $F_s(10^8$ hz$) = 7.6 \times 10^{-23}$ watt m^{-2} hz^{-1} (*7*), the integral of Eq. 4 from 1 to 10 kev yields

$$F_c(1 \text{ to } 10 \text{ kev}) = 0.015\, \rho \text{ kev sec}^{-1} \text{ cm}^{-2} \quad (5)$$

For $\rho = 0.25$ ev cm^{-3} and $R = 3.8$ megaparsecs, Eq. 5 yields an x-ray luminosity of 0.9×10^{40} erg sec^{-1}, which is a factor of 6 lower than that computed by Byram *et al.* for the same parameters (*1*). This discrepancy is the direct result of the neglect of the spectral distributions of the x-ray and radio emissions. The electrons used in the calculation of Byram *et al.* (*1*) correspond to the energy range ~0.25 to

Table 1. X-ray fluxes (in kiloelectron volts per square centimeter per second) from Centaurus A in the range from 1 to 10 kev.

B (gauss)	$\rho =$ 6 ev cm^{-3}	$\rho =$ 13 ev cm^{-3}
	Calculated x-ray flux	
4×10^{-6}	0.09	0.2
10^{-5}	0.02	0.04
	Observed x-ray flux	
Byram *et al.* (*1*)		0.043 ± 0.016
Bowyer *et al.* (*5*)		0.17

Table 2. Fluxes of hard x-rays from Centaurus A.

Energy interval (kev)	Calculated flux (photon cm^{-2} sec^{-1} kev^{-1})	Upper limits (*6*) (photon cm^{-2} sec^{-1} kev^{-1})
34– 60	7×10^{-5}	2.9×10^{-4}
60–100	2.8×10^{-5}	1.4×10^{-4}
100–250	7×10^{-6}	1.9×10^{-5}
250–567	1.6×10^{-6}	1.5×10^{-5}